Winter Meeting Program

January 8-12, 2011

Jacksonville
AAPT 2011
100 Years of Nuclear Physics

AAPT PHYSICS EDUCATION
American Association of Physics Teachers

AAPT 2011 Winter Meeting

100 Years of Nuclear Physics

Jacksonville, FL
January 8–12, 2011

Hyatt Regency Jacksonville Riverfront

AAPT PHYSICS EDUCATION

American Association of Physics Teachers
1 Physics Ellipse
College Park, MD 20740
301-209-3333
www.aapt.org

Jacksonville AAPT 2011 100 Years of Nuclear Physics

Welcome to Jacksonville!

You are in for a treat. Jacksonville is a delightful city situated on the secluded north Florida coast, with the St. Johns River splitting the town. Our meeting venue is right on the Riverfront in a classic urban setting with immediate access to a friendly pedestrian walking/running path that will host the return of the much anticipated 2nd AAPT Walk/Run, a fundraiser that supports our meetings and conferences.

Attendees will also have a chance to visit area attractions, including historical St. Augustine, the oldest continuously inhabited European settlement in the United States, and the University of Florida Proton Therapy Institute, one of only eight treatment centers in the country employing this revolutionary new cancer therapy. High school teachers will have the opportunity to investigate the physics behind NASCAR and the World Golf Hall of Fame in a series of special workshops and tours arranged by the Southern Atlantic Coast Section (SACS).

Like Jacksonville, the 2011 AAPT Winter Meeting has much to offer. Our celebration of 100 Years of Nuclear Physics will feature a visit from Marie Curie, the legacy of Ernest Rutherford, and the latest in nuclear energy and nuclear medicine. Our own Fred Dylla will delve into AIP's extensive historical archives to give us new insight into the discovery of the nucleus and the development of nuclear physics over the last century. Lee Peddicord, director of the Texas A&M Nuclear Power Institute, will give us an update on the state of the art in nuclear power production, focusing on breeder reactors. Nancy Mendenhall of the UF Proton Therapy Institute will talk about applications of physics in medicine.

The 2011 Winter Meeting will also give us a chance for updates from Capitol Hill as we once again host a session on policy, featuring retired Congressman Vernon Ehlers, first research physicist elected to Congress, and Michael Lach from the Department of Education. We'll also hear the latest on many initiatives including the Two-Year College Tandem Meeting, the T-TEP report from the Task Force on Physics Teacher Education, and the newly implemented PhysTEC II. We'll get the scoop on the change from the NSF CCLI program to the new TUES and its possibilities for funding.

We'll hear talks on everything from using Facebook, Wii, and iPads to teach physics to what "Item Response Theory" really means for standardized tests. We'll learn how high school students can build their own windmills, whether there is any truth in rumors that the gender gap in physics has finally been closed, and how anxiety and frustration can affect physics learning.

It will be a busy meeting and I'm excited to have you here! Please send me your feedback and stories from the 2011 Winter Meeting.

Jill Marshall, University of Texas, Austin

2011 Program Chair

Special Thanks:

AAPT thanks the following persons for their dedication and selfless contributions to the Winter Meeting:

Paper Sorters: Jill Marshall, Program Chair, David Brookes, Trina Cannon, Jan Mader, David Sturm, and Gary White

Our local organizer:

– Dr. Paul R. Simony, chair, Jacksonville University, Department of Physics

AAPT Board of Directors

Facebook/Twitter at Meeting

We will be tweeting and posting updates to our Facebook page before and during the meeting to give you all the details of the meeting. Participate in the conversation by reading the latest tweets here, or placing the hashtag **#aaptwm11** in your tweets! We will also be tweeting and posting to Facebook any changes to the schedule, cancellations, and other announcements during the meeting. Follow us to stay up to the minute on the meeting!

(facebook.com/physicsteachers and @physicsteachers on Twitter)

facebook twitter

Lost and Found: If you lose something during the meeting, please stop by the AAPT Registration desk **first** to see if it has been turned in. We will also post a note on the message board if we find something that has been lost or misplaced. If a hotel employee finds an item, it will be turned into hotel security.

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College Park, MD USA 20740-3845
301-209-3333, fax: 301-209-0845
programs@aapt.org, www.aapt.org

Workshop Bus Schedule

Saturday, January 8

Buses departing Hyatt Regency Hotel to Jacksonville University

- 7:20 a.m.
- 7:35 a.m.
- 12:20 p.m.

Buses departing Jacksonville University, returning to Hyatt Regency Hotel

- 12:15 p.m.
- 12:40 p.m.
- 5:15 p.m.
- 5:30 p.m.

Sunday, January 9

Buses departing Hyatt Regency Hotel to Jacksonville University

- 7:20 a.m.
- 7:35 a.m.
- 12:20 p.m.
- 12:35 p.m.

Buses departing Jacksonville University, returning to Hyatt Regency Hotel

- 12:40 p.m.
- 12:55 p.m.
- 4:20 p.m.
- 5:15 p.m.
- 5:30 p.m.

Pick-up Location/Meeting Hotel:
Hyatt Regency Jacksonville Riverfront
Newnan St. entrance, near Gift Shop
Jacksonville, FL 32202

Workshop Location:
Jacksonville University
2800 University Blvd. North
Jacksonville, FL 32211

PHYSICS

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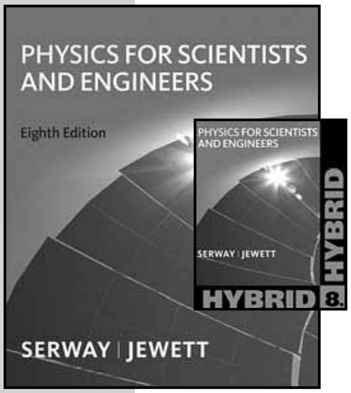

Physics for Scientists and Engineers **Eighth Edition**

Raymond A. Serway | John W. Jewett

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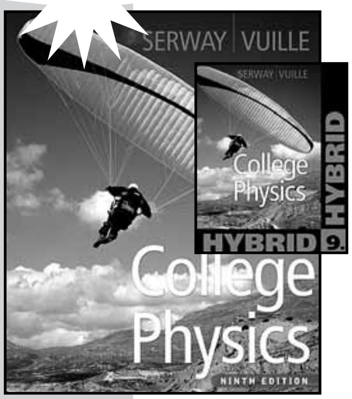

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First time at an AAPT meeting?

Welcome to the 2011 AAPT Winter Meeting in Jacksonville! Everyone at AAPT hopes you fulfill all the goals you have for attending this meeting. To help you plan your meeting activities, the following information and suggestions have been developed.

- Being at your first National Meeting can be a lonely experience if you don't know anyone. AAPT members are friendly people, so do not hesitate to introduce yourself to others in sessions and in the hallways. It is fun and rewarding to establish a network of other physics teachers with whom you can talk and share experiences. This is especially true during lunch and dinner.
- Area Committee meetings are not only for members of the committee, but also for friends of the committee. You are welcome to attend any Area Committee meeting. You should be able to find one or two committees that match your interests. Their meeting times are listed on page 19 in this guide. Area Committee meetings are often relatively small and are a great place to meet other people with interests similar to yours.
- Be sure to attend the First Timers' Gathering from 7–8 a.m. on Monday in City Terrace 10. It is a wonderful way to learn more about the meeting and about AAPT.
- Awards and other plenary sessions have distinguished speakers and are especially recommended. Invited speakers are experts in their fields and will have half an hour or more to discuss their subjects at some depth. Posters will be up all day and presenters will be available during the times indicated in the schedule. Contributed papers summarize work the presenters have been doing. You are encouraged to talk to presenters at the poster sessions or after the contributed paper sessions to gain more information about topics of interest to you. Informal discussion among those interested in the announced topic typically will follow a panel presentation, and crackerbarrels are entirely devoted to such discussions.
- Be sure to make time to visit the exhibits. This is a great place to learn what textbooks and equipment are available in physics education.

About Jacksonville!

Jacksonville is called the largest city in area in the continental United States. The region's beauty and the metropolitan skyline are tied together by water, which is everywhere! The St. Johns River divides downtown Jacksonville offering spectacular views from riverside restaurants, nightlife hotspots, theaters, and galleries. Also enjoy over 20 miles of wide beaches along the Atlantic Ocean. Spend time kayaking, spotting wildlife, and hiking in the marshes and national parks.

History

The European-American settlement called "Cowford" was founded in 1791, so named because of its location at a narrow point in the river where cattle once crossed. In 1822, a year after the United States acquired the colony of Florida from Spain, the city was renamed for Andrew Jackson, the first military governor of the Florida Territory and seventh President of the United States.

The area has been inhabited for thousands of years by Native Americans, including coastal Timucua people—archeologists found pottery on Black Hammock Island dating to 2500 BC. Years later, Florida was occupied first by the Spanish, then the British and then the Spanish again after the Revolutionary War in 1763. In 1821, Spain finally ceded the Florida territory to the U.S., and Jacksonville got its name.

A May 1901 fire that started at a fiber factory devastated downtown Jacksonville. Over eight hours, it destroyed the business district and left 10,000 residents homeless. It is said the glow from the flames could be seen in Savannah, GA, and the smoke plumes in Raleigh, NC.

In the 1910s, New York–based filmmakers were attracted to Jacksonville's warm climate, exotic locations, excellent rail access, and cheap labor. Over the course of the decade, more than 30 silent film studios were established, earning Jacksonville the title of "Winter Film Capital of the World." In later years Jacksonville suffered from urban sprawl and the creation of suburbs.

Education

Jacksonville is home to Jacksonville University, the University of North Florida, Florida State College at Jacksonville, Edward Waters College, The Art Institute of Jacksonville, Florida Coastal School of Law, Trinity Baptist College, Jones College, Fortis College, and Florida Technical College.

Things to do in Jacksonville:

➤ **World Golf Hall of Fame:** Currently the Hall of Fame is celebrating one of its members—Bob Hope—in a featured exhibit, "Bob Hope: Shanks for the Memory." Catch a movie at World Golf Hall of Fame IMAX Theater. The World Golf Village is 20 minutes south of Jacksonville, and eight miles north of St. Augustine off Interstate-95 at exit 323, International Golf Parkway. www.worldgolfhalloffame.org

➤ **Jacksonville Landing:** Located along the St. Johns River in downtown area, find shopping, restaurants, and night life. www.jacksonvillelanding.com

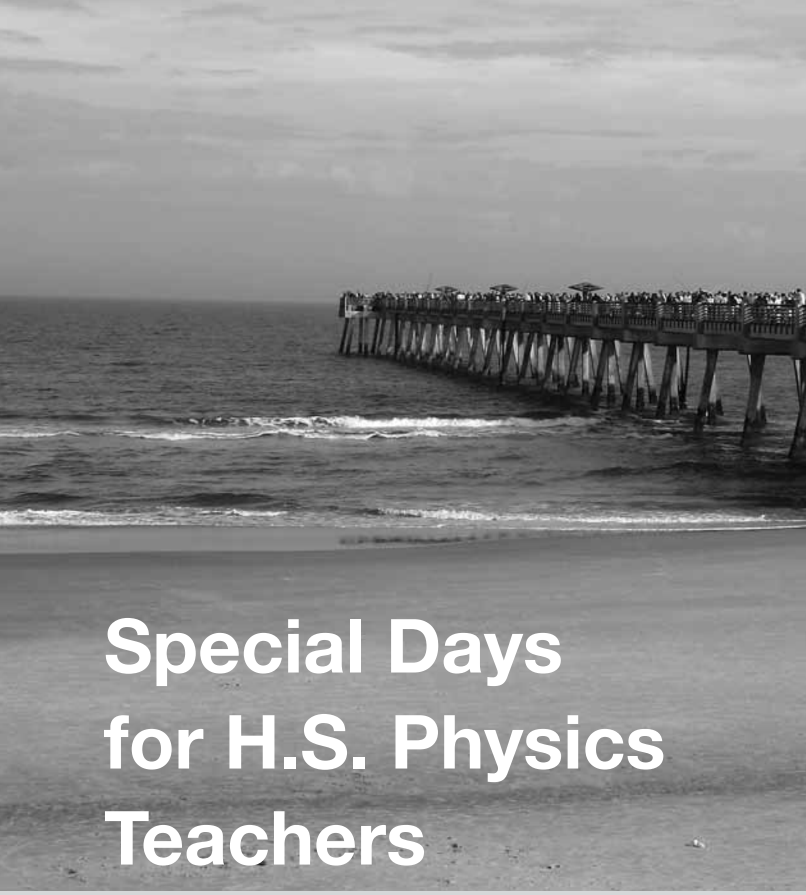
➤ **Museum of Science and History:** The Museum of Science & History strives to increase the knowledge and understanding of the natural environment and history of Jacksonville as well as Northeast Florida. Focusing on creating an awareness and appreciation of science and history through quality programs, MOSH offers exhibits and events that stimulate and inspire learning in all visitors. LOCATION: 1025 Museum Circle; www.themosh.org

➤ **Florida Theatre**: The Florida Theatre originally opened to the public on April 8, 1927, as downtown Jacksonville's 15th—and largest—movie theatre. The beautiful theatre opened following a major restoration in 1983, and more than 4,500 different events of all kinds have taken place there since then. LOCATION: 1128 E. Forsyth St., Jacksonville; www.floridatheatre.com

➤ **MOCA Jacksonville**: The Museum of Contemporary Art is open daily except Mondays. It primarily collects works from 1960 to the present. The permanent collection consists of almost 800 works of art, including painting, printmaking, sculpture, and photography. Special exhibits include: Hyberbolic Nature: Plein Air Paintings by Lilian Garcia-Roig until January 23.
LOCATION: 333 North Laura St., Jacksonville, FL; www.mocajacksonville.org/

➤ **Atlantic Beaches:** Just a short drive to the east, there are many beaches—take advantage of several state parks including Amelia Island, Big Talbot Island, Fort George Island, and Fort Clinch. Go to floridastateparks.org to find information. Also check out National Park Timucuan Ecological and Historic Preserve and Fort Caroline National Memorial, located near Jacksonville.

Photo credit: Visit Jacksonville



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Special Days for H.S. Physics Teachers

Day 1: Friday, January 7

Session I:

8–11 a.m. **Nuclear Education Program** Teachers will spend time evaluating materials and reviewing labs.

11 a.m.–2 p.m. **Trip to St. Mary's** *Choose from two options:* Cruise for two hours on Cumberland Sound, which includes lunch ***or*** visit Submarine Museum and have lunch on your own.

Session II:

2–5 p.m. **Workshops** will be presented by Energy Solutions and National Energy Education Development. Teacher kits will be available to take home for classroom use. Workshops sponsored by SACS/AAPT.

6 p.m. Dinner with Alex Dickison, Past President of AAPT, provided by College of Coastal Georgia.

Location: Coastal Georgia/Camden Campus (Transportation is not provided to/from Hyatt.)

Day 2: Saturday, January 8

7:30 a.m. Board bus first at EconoLodge in Kingsland, GA, then at Hyatt/Landing, Newnan St. entrance, then on to Daytona Beach for Embry Riddle Aeronautical University (ERAU).

10 a.m. Program at Embry Riddle on **Engineering Sciences**

12:30 p.m. **International Luncheon** sponsored by ERAU. Speaker will be Dr. Michael Hickey.

2 p.m. Travel to Daytona Speedway for **Daytona 500 experience**, part of **"Using NASCAR to Teach Physics"**

6 p.m. Return to Hyatt/Landing, then EconoLodge in Kingsland, GA.

Location: Embry Riddle Aeronautical University (Transportation is provided.)

Day 3: Sunday, January 9

Includes the Day 1 & Day 2 workshops

8 a.m. Depart first from EconoLodge in Kingsland, GA, then from Hyatt/Landing, Newnan St. entrance, for **Golf Hall of Fame**.

10 a.m. Tour facilities, attend workshop on **"Using Golf to Teach Physics"** and play an 18-hole putting green.

2 p.m. Return bus trip to Hyatt/Landing, then EconoLodge in Kingsland, GA.

6–8 p.m. High School Share-a-thon sponsored by AAPT (at Hyatt).

8–10 p.m. Opening of Exhibit Hall sponsored by AAPT (at Hyatt).

Location: World of Golf Hall of Fame. (Transportation provided for World Golf event.) *Fee:* $30

Meeting-at-a-Glance

Meeting-at-a-Glance includes sessions, workshops, committee meetings and other events, including luncheons, Exhibit Hall hours and snacks, plenary sessions, and receptions. All rooms will be in the Hyatt Regency Jacksonville Riverfront Hotel.
*All workshops will be held at **Jacksonville University.***

FRIDAY, January 7

8 a.m.–2 p.m.		High School Physics Teacher Special Day 1, Session 1	offsite
2–6 p.m.		High School Physics Teacher Special Day 1, Session 2	offsite
6–8 p.m.		Pre-registration Pickup	**Registration area**

SATURDAY, January 8

7 a.m.–4:30 p.m.		**REGISTRATION**	**Registration area**
7:30 a.m.–6 p.m.		High School Physics Teacher Special Day 2	Embry Riddle - offsite
8 a.m.–12 p.m.	W01	Critical Thinking in Introductory Astronomy	Reid 201
8 a.m.–12 p.m.	W02	Potpourri of Physics Simulations	Swisher Science 2
8 a.m.–12 p.m.	W04	NTIPERS: Research-based Reasoning Tasks for Introductory Mechanics	Merritt Penticoff 125
8 a.m.–5 p.m.	W08	Household Electricity in the Physics Classroom	Nelms 6B
9 a.m.–12 p.m.		UF Proton Therapy Institute Tour	offsite
1–4 p.m.		Awards Committee	Rm. 1804, 18th floor
1–4:30 p.m.		Area Chairs' Orientation	City Terrace 9
1–5 p.m.	W05	Ben Franklin as My Lab Partner	Reid 210
1–5 p.m.	W06	Grant Writing 101: Grant Writing Workshop for New Faculty	Merritt Penticoff 122
1–5 p.m.	W29	Modeling Applied to Problem Solving – An Adoptable Pedagogy	Reid 210
5–10 p.m.		AAPT Executive Board	City Terrace 9

SUNDAY, January 9

7 a.m.–4 p.m.		**REGISTRATION**	**Registration area**
8–10:30 a.m.		Publications Committee	Boardroom 2
8 a.m.–12 p.m.	W10	Designing and Implementing an Inquiry-based Physics Course for K-12 Teachers	Reid 210
8 a.m.–12 p.m.	W12	Learner-centered Environment for Algebra-based Physics (LEAP)	Reid 201
8 a.m.–12 p.m.	W13	LivePhoto Physics: Video-based Motion Analysis for Homework and Classroom	Swisher Science 3
8 a.m.–12 p.m.	W14	Modeling Mechanics: From Freefall to Chaos	Merritt Penticoff 122
8 a.m.–12 p.m.	W15	Observing with NASA: Expanding the Universe in the Classroom	Merritt Penticoff 130
8 a.m.–12 p.m.	W16	Using the Wii for Fun and Physics	Merritt Penticoff 114A
8 a.m.–2 p.m.		High School Physics Teacher Special Day 3	Golf Hall of Fame
8 a.m.–5 p.m.	W27	Research-based Alternatives to Traditional Problem-Solving Exercises	Merritt Penticoff 129
8:30–10 a.m.		Meetings Committee	Boardroom 1
9 a.m.–4 p.m.		Tour of St. Augustine	offsite
10:30 a.m.–2:45 p.m.		Executive Board II	City Terrace 9
11:30 a.m.–2 p.m.		Resource Letters Committee	Boardroom 1
12–2 p.m.		Nominating Committee	Boardroom 2
12–6 p.m.		Exhibitors Setup	Exhibit Hall
1–4 p.m.	T03	Preparing Teacher Candidates to Teach the New AP Physics B	Reid 105
1–5 p.m.	W17	Energy and the Environment Hands-on Activities	Swisher Science 2
1–5 p.m.	W20	Laboratories with Biomedical Applications	Merritt Penticoff 114A
1–5 p.m.	W21	Teaching About Radioactivity	Merritt Penticoff 125
1–5 p.m.	W24	Tutorials in Introductory Physics: A Research-Validated Approach	Reid 210
3–4 p.m.		Section Officers' Exchange	River Terrace 3
4–5 p.m.		Programs Committee I	River Terrace 2
4–5:30 p.m.		Section Representatives Meeting	River Terrace 3
5–6:30 p.m.		Educational Technologies Committee	Boardroom 1
5–6:30 p.m.		International Physics Education Committee	Boardroom 2
5–6:30 p.m.		Teacher Preparation Committee	Boardroom 3
5–6:30 p.m.		Science Education for the Public Committee	City Terrace 9
5–6:30 p.m.		Minorities in Physics Committee	City Terrace 4
6–8 p.m.		High School Share-a-thon	River Terrace 2
6:30–8 p.m.		Physics in Two-Year Colleges Committee	City Terrace 6

6:30–8 p.m.		Apparatus Committee	City Terrace 7
6:30–8 p.m.		History & Philosophy of Physics Committee	City Terrace 8
6:30–8 p.m.		Women in Physics Committee	City Terrace 10
6:30–8 p.m.		SI Units and Metric Education Committee	City Terrace 11
7:30–9:30 p.m.		**Registration**	**Registration area**
8–10 p.m.		**Exhibit Hall Opens**	Exhibit Hall
8–10 p.m.		SPS Undergraduate Research and Outreach Poster Reception	Exhibit Hall
8–10 p.m.		Opening Reception	Exhibit Hall

MONDAY, January 10

7 a.m.–5 p.m.		**Registration**	**Registration area**
7–8 a.m.		First Timers' Gathering	City Terrace 10
7–8 a.m.		Retirees Breakfast (ticket required)	City Terrace 11
7–8 a.m.		Review Board I	Rm 1804, 18th floor
7–8 a.m.		Bauder Endowment Committee	Boardroom 2
7–8 a.m.		Governance Review Committee	Boardroom 3
8–9:10 a.m.	AF	Meeting the Diverse Needs of Students	City Terrace 6
8–9:30 a.m.	AB	Non-Academic Partnerships: Business/Community/Education Collaborations	City Terrace 4
8–9:30 a.m.	AE	PER Around the World - I	Grand Ballroom 3
8–9:50 a.m.	AH	Preparing Pre-High School Teachers	City Terrace 9
8–10 a.m.	AA	Laboratories Rutherford Would Approve	Grand Ballroom 2
8–10 a.m.	AC	Panel: Revision of AAPT Guidelines for Two-Year Colleges	Grand Ballroom 1
8–10 a.m.	AG	Astronomy at the University of Florida	City Terrace 7
8–10 a.m.	AI	Statistical Analyses of Complicated Data	City Terrace 12
9–10 a.m.	AD	Using Robotics to Teach Physics	City Terrace 5
10–11 a.m.		Spouses' Gathering	City Terrace 10
10 a.m.–6 p.m.		**Exhibit Hall Open (Coffee break, 10–10:30 a.m.)**	**Exhibit Hall**
10:30–10:45 a.m.		Meet Beth Cunningham, AAPT Executive Officer	Grand Ballroom 4
10:45–10:50 a.m.		Welcome to Jacksonville	Grand Ballroom 4
10:50–11:45 a.m.	**Plenary**	**"Ernest Rutherford and the Accelerator," F. Dylla and S. Corneliussen**	**Grand Ballroom 4**
12–1 p.m.	CW01	EnergySolutions Foundation Commercial Workshop	Grand Ballroom 2
12–1 p.m.	CW04	Panopto/i>clicker Commercial Workshop	City Terrace 12
12–1 p.m.		Young Physicists' Meet and Greet	City Terrace 11
12–1 p.m.		PERTG Town Hall Meeting	Grand Ballroom 3
12–1 p.m.	Ckrbrl-01	Crackerbarrel on the APS Minority Bridge Program	Grand Ballroom 1
12–1 p.m.	Ckrbrl-02	Crackerbarrel on Two-Year College Issues	City Terrace 7
12–1 p.m.	Ckrbrl-04	Crackerbarrel on Difficulties International Visitors Face in Attending AAPT Meetings	City Terrace 9
12–1:15 p.m.		Membership and Benefits Committee	Boardroom 1
1:15–2:15 p.m.	BB	Service Learning as Outreach	City Terrace 7
1:15–2:35 p.m.	BF	SPS Undergraduate Research and Outreach	Grand Ballroom 3
1:15–2:45 p.m.	BH	Heliophysics, the Heliosphere and ATST	City Terrace 5
1:15–3:15 p.m.	BA	Panel: ComPADRE	Grand Ballroom 1
1:15–3:15 p.m.	BD	Objectives and Assessment of the Physics Graduate Program	City Terrace 9
1:15–3:15 p.m.	BE	Forging Successful School-College Collaborations	City Terrace 4
1:15–3:15 p.m.	BG	Investigating Student Reasoning in Physics	City Terrace 12
1:15–3:15 p.m.	BI	Sustaining the Key Elements of a High-Quality Physics Teacher Preparation Program	City Terrace 6
2:15–2:55 p.m.	BC	Science and Society	City Terrace 7
3:30–5 p.m.	**Awards**	**Oersted Medal–F. James Rutherford, DSCs, SPS Chapter Advisor**	**Grand Ballroom 4**
5–6:30 p.m.		Laboratories Committee	Boardroom 1
5–6:30 p.m.		Physics in High School Committee	Boardroom 2
5–6:30 p.m.		Professional Concerns Committee	Boardroom 4
5–6:30 p.m.		Physics in Undergraduate Education Committee	Boardroom 3
5:15–6 p.m.		Annual AAPT 5K Run/Walk (registration required) meet in hotel lobby	Outside Hotel
6:30–7:20 p.m.	CD	LaserFest: What We Did	City Terrace 9
6:30-7:20 p.m.	CI	Computational Physics from Freshman to the Senior Year - I	City Terrace 6
6:30–7:50 p.m.	CG	PER: Student Reasoning	City Terrace 7
6:30–7:50 p.m.	CH	Teaching with Technology - I	Grand Ballroom 3
6:30–8 p.m.	CA	Panel: ALPhA Session: Condensed Matter/Materials Physics Laboratories	Grand Ballroom 1

6:30–8 p.m.	CB	Outcomes of the Two-Year College Tandem Meeting	City Terrace 4
6:30–8 p.m.	CC	Extended Investigations in 5–9 Classrooms	Grand Ballroom 2
6:30–8 p.m.	CE	Cosmology Education	City Terrace 5
6:30–8 p.m.	CF	Jerrold Zacharias and the Foundations of PSSC Physics	City Terrace 12
7–8 p.m.		SPS Undergraduate Awards Reception Susan Marie Frontczak	City Terrace 10
8–9:15 p.m.		AAPT Council Meeting	River Terrace 1
9–10:30 p.m.		Poster Session 1	Outside Exhibit Hall

TUESDAY, January 11

7–8 a.m.		TYC Breakfast (ticket required)	City Terrace 10
7–8 a.m.		Physics Bowl Advisory Committee	Boardroom 1
7–8 a.m.		Yoga for Everyone (registration required)	Boardroom 4
7–8 a.m.		Review Board II	Rm 1804, 18th floor
7–4:30 a.m.		**Registration**	**Registration area**
8–8:30 a.m.	DG	High School	Grand Ballroom 3
8–9 a.m.	DF	Gender Perspectives in PER	City Terrace 9
8–9 a.m.	DA	Bridging the Gap Between Diverse Levels of Preparation of Graduate Students	City Terrace 5
8–9:10 a.m.	DB	Teaching with Technology - II	Grand Ballroom 1
8–9:10 a.m.	DH	Introductory Labs/Apparatus	City Terrace 12
8–9:30 a.m.	DC	Increasing the Number and Diversity of Physics Majors	City Terrace 4
8–9:30 a.m.	DD	Transitions from High School to Two-Year and Four-Year Colleges	City Terrace 7
8–9:30 a.m.	DE	Computational Physics from Freshman to the Senior Year - II	Grand Ballroom 2
9–10 a.m.		Exhibitors' Breakfast	City Terrace 10
9:40–10:30 a.m.	**Plenary**	**Nuclear Power: Breeder Reactors and Beyond, Kenneth L. Peddicord**	**Grand Ballroom 4**
10 a.m.–4 p.m.		**Exhibit Hall Open (Coffee Break: 10:30-11 a.m.)**	**Exhibit Hall**
11–11:50 a.m.	**Awards**	**Richtmyer Award: Kathryn Moler**	**Grand Ballroom 4**
12–1 p.m.		Audit Committee	Boardroom 1
12–1 p.m.	Ckrbrl-03	Crackerbarrel on PER Graduate Student Concerns	Grand Ballroom 1
12–1 p.m.	Crkrbrl-5	Crackerbarrel on Physics and Society Education	City Terrace 4
12–1 p.m.	Crkrbrl-6	Crackerbarrel on Supporting Emergency Professional Development	City Terrace 7
12–1 p.m.	CW02	Dearborn Resources Commercial Workshop	Grand Ballroom 2
12–1 p.m.	CW03	WebAssign Commercial Workshop	Grand Ballroom 3
1–1:30 p.m.	EE	Cosmology and Astronomy Education	City Terrace 5
1–2 p.m.	EA	Video-based Motion Analysis in the Physics Classroom	City Terrace 4
1–2:10 p.m.	EI	Best Practices for Teaching with Technology	City Terrace 12
1–2:30 p.m.	ED	The Value of Interdisciplinary Training in Graduate Education in Physics	City Terrace 7
1–3 p.m.	EG	Teaching Energy and the Environment	City Terrace 10
1–3 p.m.	EC	Panel: State of Women in Physics	Grand Ballroom 1
1–3 p.m.	EH	Recent Research in Teacher Education: A PhysTEC Project to Inform Larger Audiences	City Terrace 9
1–3 p.m.	EJ	Teaching Physics Online	City Terrace 11
1–3:10 p.m.	EK	PER: Investigating Classroom Strategies	Grand Ballroom 3
2–3 p.m.	EB	Interactive Lecture Demonstrations: Physics Suite Materials	City Terrace 4
2–2:30 p.m.	EF	Teacher Education and Training	City Terrace 6
3–3:30 p.m.		Omaha Kick-off Celebration	City Terrace 8
3:30–5 p.m.	**Plenary**	**AAPT Symposium on Education Policy: Rep. Vern Ehlers, Michael Lach**	**Grand Ballroom 4**
5–6:30 p.m.		Research in Physics Education (RIPE) Committee	City Terrace 5
5–6:30 p.m.		Physics in Pre-High School Education Committee	Boardroom 2
5–6:30 p.m.		Graduate Education in Physics Committee	Boardroom 1
5–6:30 p.m.		Space Science and Astronomy Committee	Boardroom 3
5–6:30 p.m.		Interests of Senior Physicists Committee	City Terrace 6
6:30–7:30 p.m.		PTRA Advisory Committee	Boardroom 4
6:30–8:30 p.m.		**A Living History of Madame Marie Curie** (ticket required)	**River Terrace 1**
8:30–10 p.m.		Poster Session 2	Outside Exhibit Hall

WEDNESDAY, January 12

7–8:20 a.m.		Programs Committee II	City Terrace 8
7:30–8:30 a.m.		Lotze Scholarship Committee	Boardroom 1
8 a.m.–3 p.m.		**REGISTRATION**	**Registration Area**

8–10:20 a.m.	FC	Reforming the Introductory Physics Course for Life Science Majors IV	City Terrace 5
8:30–9:40 a.m.	FB	Emerging Technology	City Terrace 7
8:30–9:40 a.m.	FF	Introductory Courses	Grand Ballroom 2
8:30–9:50 a.m.	FD	Upper-level Undergraduate Physics	City Terrace 6
8:30–10 a.m.	FH	PER: Topical Understanding and Attitudes	Grand Ballroom 3
8:30–10:30 a.m.	FA	Making Physical Meaning with Mathematics	City Terrace 4
9–9:30 a.m.	FI	Using the T-TEP Report as a Guide for Improving Physics Teacher Education	Grand Ballroom 1
9–10:10 a.m.	FE	The New AP Physics B Test and Other HS Issues	City Terrace 10
9 a.m.–12 p.m.		SEES (Students Exploring Engineering and Science)	River Terrace 1
10:30–11:30 a.m.	**Plenary**	**State-of-the-Art Nuclear Medicine: Proton Therapy, Nancy Mendenhall**	**Grand Ballroom 4**
11:30 a.m.–12:30 p.m.		ALPhA Committee	Boardroom 2
11:30 a.m.–12:30 p.m		COGS Committee	Rm 1804, 18th floor
11:30 a.m.–12:30 p.m		PERLOC Committee	City Terrace 4
11:30 a.m.–1 p.m.		Nominating Committee II	Boardroom 1
11:30 a.m.–12 p.m.	Crkrbrl-8	Crackerbarrel on Historical Perspectives on the Use of the Laser in the Classroom	Grand Ballroom 2
11:30 a.m.–12 p.m.	Crkrbrl-9	Crackerbarrel on Task Force on Teacher Education in Physics (T-TEP)	City Terrace 7
11:30 a.m.–12 p.m.	Crkrbrl-10	Crackerbarrel on Past and Present Priorities – NSF-DUE CCLI/TUES	Grand Ballroom 3
12:30–1 p.m.		AAPT Presidential Transfer Ceremony	Grand Ballroom 4
1–2:20 p.m.	GA	Rutherford: His Life and Legacy	Grand Ballroom 1
1–2:30 p.m.	GB	Is There a Need for Assessment in Undergraduate Physics?	City Terrace 4
1–2:30 p.m.	GD	Frontiers in Planetary Science	Grand Ballroom 2
1–3 p.m.	GC	Research on the Effect of Anxiety, Frustration and Annoyance on Physics Learning	City Terrace 7
1–3 p.m.	GF	Laboratory Pedagogy - I	City Terrace 9
1:15–2:15 p.m.	GE	PER Around the World - II	Grand Ballroom 3
2:30–4:30 p.m.		Walking Tour of Jacksonville	offsite
3–3:30 p.m.		Great Book Giveaway	Registration Area
3–4 p.m.		Venture Fund Committee	Boardroom 1
3:15–4:05 p.m.	HC	Post Deadline Session - II	Grand Ballroom 2
3:15-4:25 p.m.	HA	Laboratory Pedagogy - II	Grand Ballroom 1
3:15–4:25 p.m.	HB	Post-Deadline Session - I	Grand Ballroom 3
4:30–9 p.m.		Executive Board III	City Terrace 9

A Living History of Madame Marie Curie

What: Meet Madame Marie Curie

When: Tuesday, January 11 • 6:30–8:30 p.m.

Where: River Terrace 1

Meeting attendees have an unusual opportunity to meet famous scientist Madame Marie Curie, as portrayed by scholar/actress Susan Marie Frontezak.

She has given over 300 performances as Marie Curie across the United States, Canada, and Europe. In honor of the 100th anniversary of Marie Curie's second Noble Prize, AAPT will host "Marie Curie." (Ticket required, $10)

For more information, please go to: ***http://storysmith.org/manya/pd.html.***

THANK YOU: **Yours Truly Antiques for lending a piece of furniture for the show!**

(Yours Truly Antiques: 3541 Saint Johns Ave., Jacksonville, FL; 904-388-3611)

Special Events

Saturday, January 8

UF Proton Therapy Institute Tour

UF Proton Therapy Institute is the only proton therapy center in the Southeast U.S. and has successfully delivered this rarely available therapy to over 2,300 patients since 2006.

Saturday, Jan. 8: 9 a.m.–12 p.m. (Register onsite)

Sunday, January 9

St. Augustine Tour: A Colonial and Gilded Age Experience

Enjoy your day in the Nation's Oldest City! The various architectural styles, narrow brick streets, and European flavors combine for a unique escape. Your professional tour guide meets the group dressed in period costume. Lunch is on own. Meet in hotel, Newnan St. entrance next to Gift Shop.

Sunday, Jan. 9: 9 a.m.–4 p.m. (Register onsite)

Physics Exhibit Show / Opening Reception

See physics equipment and books from our Exhibitors.

Sunday, Jan. 9: 7–9 p.m. Opening Reception: 8–10 p.m.
Monday, Jan. 10: 10 a.m.–6 p.m. BREAK: 10-10:30 a.m.
Tuesday, Jan. 11: 10 a.m.–4 p.m. BREAK 10:30–11 a.m.
SPS Poster Reception, Sunday, Jan. 9: 8–10 p.m.

Monday, January 10

First Timers' Gathering

The best time to learn about AAPT and the Winter Meeting and to meet fellow attendees and AAPT leadership.

Monday, Jan. 10: 7–8 a.m. • City Terrace 10

Retirees' Breakfast

Start your day by networking and exchanging ideas with our long-serving and deserving supporters of AAPT.

Monday, Jan. 10: 7–8 a.m. • City Terrace 11 (ticket required)

Spouses' Gathering

Get to know Jacksonville and meet new people!

Monday, Jan. 10: 10–11 a.m. • City Terrace 10

Young Physicists' Meet & Greet

Monday, Jan. 10: 12–1 p.m. • City Terrace 11

2nd Annual AAPT 5K Run/Walk

The run/walk will start in front of the hotel. Bring your camera and support AAPT! Meet in the lobby of the hotel. Official start time 5:15 p.m. Course closes 6 p.m.

Monday, Jan. 10: 5;15–6 p.m. (Register onsite)

SPS Undergraduate Awards Reception

event with Susan Marie Frontczak (for undergraduate presenters, their guests and mentors)

Monday, Jan. 10: 7–8 p.m. • City Terrace 10

Tuesday, January 11

TYC Breakfast

Two-year college staff begin their day by breaking bread and sharing ideas.

Tuesday, Jan. 11: 7–8 a.m. • City Terrace 10 (ticket required)

Yoga for Everyone

Class is designed for all levels with the beginner in mind.

Tuesday, Jan. 11: 7–8 a.m. Boardroom 4 (Register onsite)

A Living History of Marie Curie

Likely the most famous woman scientist, Madame Marie Curie changed the world in which we live through her discovery of radium and radioactivity. This theatrical production highlights the Living History of Marie Curie.

Tuesday, Jan. 11: 6:30–8:30 p.m. River Terrace 1 (Register onsite)

Wednesday, January 12

Jacksonville Walking Tour

Hear the exploits of past Presidents, the great American architects and the maker of King Kong as you take a walk through time. Meet in hotel, Newnan St. entrance next to Gift Shop.

Wednesday, Jan. 12: 2:30–4:30 p.m. (Register onsite)

Great Book Giveaway

AAPT has many physics books to raffle off. Get your free raffle ticket at the AAPT booth in the Exhibit Hall before Tuesday, 3 p.m.

Wednesday, Jan. 12: 3–3:30 p.m. Registration area

Committee Meetings

Saturday, January 8

Area Chairs' Orientation	1–4:30 p.m.	City Terrace 9
Awards	1–4 p.m.	Rm. 1840, 18th floor

Sunday, January 9

Publications	8–10:30 a.m.	Boardroom 2
Meetings	8:30–10 a.m.	Boardroom 1
Resource Letters	11:30 a.m.–2 p.m.	Boardroom 1
Nominating	12–2 p.m.	Boardroom 2
Section Officers' Exchange	3–4 p.m.	River Terrace 3
Programs I	4–5 p.m.	River Terrace 2
Section Representatives	4–5:30 p.m.	River Terrace 3
Teacher Preparation	5–6:30 p.m.	Boardroom 3
Educational Technologies	5–6:30 p.m.	Boardroom 1
Minorities in Physics	5–6:30 p.m.	City Terrace 4
International Physics Education	5–6:30 p.m.	Boardroom 2
Science Education for the Public	5–6:30 p.m.	City Terrace 9
High School Share-a-thon	6–8 p.m.	River Terrace 2
History & Philosophy of Physics	6:30–8 p.m.	City Terrace 8
Physics in Two-Year Colleges	6:30–8 p.m.	City Terrace 6
Women in Physics	6:30–8 p.m.	City Terrace 10
Apparatus	6:30–8 p.m.	City Terrace 7
SI Units and Metric Education	6:30–8 p.m.	City Terrace 11

Monday, January 10

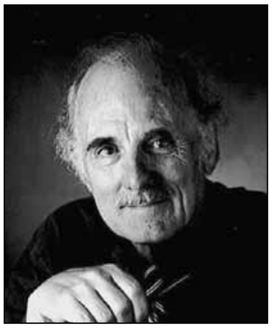
Bauder Endowment	7–8 a.m.	Boardroom 2
Governance Review	7–8 a.m.	Boardroom 3
Review Board I	7–8 a.m.	Rm. 1840, 18th floor
Membership and Benefits	12–1:15 p.m.	Boardroom 1
Laboratories	5–6:30 p.m.	Boardroom 1
Professional Concerns	5–6:30 p.m.	Boardroom 4
Physics in Undergraduate Education	5–6:30 p.m.	Boardroom 3
Physics in High Schools	5–6:30 p.m.	Boardroom 2
AAPT Council Meeting	8–9:15 p.m.	River Terrace 1

Tuesday, January 11

Physics Bowl Advisory	7–8 a.m.	Boardroom 1
Review Board II	7–8 a.m.	Rm. 1840, 18th floor
Audit	12–1 p.m.	Boardroom 1
Research in Phys. Education (RIPE)	5–6:30 p.m.	City Terrace 5
Physics in Pre-High School Educ.	5–6:30 p.m.	Boardroom 2
Graduate Education in Physics	5–6:30 p.m.	Boardroom 1
Space Science and Astronomy	5–6:30 p.m.	Boardroom 3
Interests of Senior Physicists	5–6:30 p.m.	City Terrace 6
PTRA Advisory	6:30–7:30 p.m.	Boardroom 4

Wednesday, January 12

Programs II	7–8:20 a.m.	City Terrace 8
Barbara Lotze Scholarship	7:30–8:30 a.m.	Boardroom 1
ALPhA	11:30 a.m.–12:30 p.m.	Boardroom 2
Nominating - II	11:30 a.m.–1 p.m.	Boardroom 1
PERLOC	11:30 a.m.–12:30 p.m.	City Terrace 4
COGS	11:30 a.m.–12:30 p.m.	Rm. 1840, 18th floor
Venture Fund	3–4 p.m.	Boardroom 1



F. James Rutherford

Oersted Medal

F. James Rutherford, UC Berkeley

The Particle Enigma, High School Physics, and the Search for Science Literacy

Monday, January 10, 3:30–5 p.m. • GRAND BALLROOM 4

James Rutherford served as a radar officer on an aircraft carrier in the Pacific in WWII. In 1949, he began his career in science education in California as a H.S. teacher of general science, algebra, chemistry, and physics. Rutherford became assistant professor of education at Harvard in 1964, joining Gerald Holton and Fletcher G. Watson as co-directors of Harvard Project Physics. From 1971 to 1977, Rutherford was professor of science education and head of science and mathematics education at New York University. The AAPT recognized Rutherford with a Distinguished Service Citation in 1971 for his rich record of achievement on the Panel on the Preparation of Physics Teachers of the Commission on College Physics (CCP), as a member of the joint committee of CCP and AAPT, and for his work as chairman of the NSTA Commission on Professional Standards and Practices.

Rutherford served in two federal agencies. In 1977, he was appointed assistant director of the National Science Foundation responsible for all science, mathematics, and engineering education programs, preschool through postdoctoral. When the new U.S. Department of Education was launched, he was appointed assistant secretary with responsibilities for the Office of Education for Research and Improvement, the National Institute of Education, the National Center for Educational Statistics, the Fund for the Improvement of Post-Secondary Education, and the federal programs supporting libraries and the development of educational technologies.

Rutherford's last position before retiring was as chief education officer of the American Association for the Advancement of Science in Washington, D.C. At AAAS, he started a variety of projects reasserting the role of the AAAS's nationwide science education reform. In retirement, Rutherford, currently a visiting scholar at UC Berkeley, created the website "Science Education Encore."

The Oersted Medal, established in 1936, recognizes those who have had an outstanding, widespread, and lasting impact on the teaching of physics. The recipient delivers an address at an AAPT Winter Meeting and receives a monetary award, the Oersted Medal, an Award Certificate, and travel expenses to the meeting.

Kathryn Moler

Richtmyer Memorial Award

Kathryn Moler, Stanford University

Quantum Whirlpools: Tiny Vortices of Tireless Electrons

Tuesday, January 11, 11–11:50 a.m. • GRAND BALLROOM 4

Kathryn Moler is a graduate of Stanford University where she earned both her bachelor's degree and her Ph.D. in Physics (in 1988 and 1995 respectively). She is currently Associate Professor of Applied Physics and Physics, Stanford University, a faculty member of the Geballe Laboratory for Advanced Materials, Deputy Director of the DOE-supported Stanford Institute for Materials and Energy Science, and Director of the Center for Probing the Nanoscale, an NSF NSEC. In her position, Moler fabricates microscopic sensors and uses them to study the magnetic behavior of superconductors. Like most science professors, her time is divided among preparing lectures, writing scientific papers, traveling, and working in the lab.

She has received many prestigious awards, including the Carrington Award for Excellence in Research and Teaching 1988, Stanford Centennial Teaching Assistant 1990, William L. McMillan Award for "outstanding contributions in condensed matter physics" 1999, Presidential Early Career Award for Scientists and Engineers 2000-2005, the National Science Foundation Career Award (1999-2003) and the David and Lucile Packard Foundation Fellowship for Science and Engineering from 2001-2006.

Established in 1941 and named for Floyd K. Richtmyer, distinguished physicist, teacher, and administrator and one of the founders of AAPT, the Richtmyer Memorial Lecture Award recognizes those who have made outstanding contributions to physics and their communication to physics educators. The recipient delivers the Richtmyer Lecture at an AAPT Winter Meeting on a topic of current significance and at a level suitable for a non-specialist audience and receives a monetary award, an Award Certificate, and travel expenses to the meeting.

AAPT Distinguished Service Citations 2011

Monday, January 10, 3:30–5 p.m. • GRAND BALLROOM 4

Dwain M. Desbien

Dwain Desbien
Estrella Mountain C.C.
Avondale, AZ

Dwain Desbien, physics faculty at Estrella Mountain Community College, Avondale, AZ, earned his PhD in Physics Education from Arizona State University in 2002, MS in Physics from University of Kansas in 1993 and BA in Physics from Grinnell College in 1990. His work and teaching in physics education is guided by the modeling theory of physics and he is active in running workshops on the modeling method of physics. Dwain is the Co PI on the ATE Project for Physics Faculty (an NFS-funded professional development for high school and two-year college faculty). He has presented many workshops for the PTRAs, high school, two-year college and university groups, both regionally and nationally. He has led a number of workshops at national AAPT meetings. Dwain has served on the Executive Board of the AAPT as the TYC member-at-large and President of the Arizona Section of the AAPT. In addition he has served on the TYC committee and currently is on the Undergraduate Education Committee of the AAPT. He also is currently serving on the *The Physics Teacher* five-year review committee. He has published in and reviewed for *TPT* and also reviewed for other physics journals.

Jane Bray Nelson

Jane Bray Nelson
Santa Fe College
Gainesville, FL

Jane Nelson received a BS in Chemistry from Florida State University and MS in Science Teaching from Memphis State University. She has taught Advanced Placement Chemistry, Advanced Placement Physics, Physical Science, Biology, Geometry, or Anatomy-Physiology. From 1998–2005 Nelson was Teacher-Director of University High School at Research Park, a Science and Technology magnet high school in Orange County, FL. She was inducted into the National Teachers Hall of Fame in 2002.

She has been active in AAPT since 1987, serving as a member of the Physics in High School and Minorities in Physics committees. Additionally, Nelson served as President of the Florida Section of AAPT from 2008–2010, and as Secretary-Treasurer of the Florida Section from 1992–2007. Since 1987 Jane has been a National Physics Teacher Resource Agent. She has led nearly 100 PTRA workshops impacting more than 800 teachers, and has brought $16,414 to the PTRA continuation fund.

Gordon P. Ramsey

Gordon Ramsey
Loyola University
Chicago, IL

Gordon Ramsey is a professor of physics at Loyola University Chicago. He received a BA in Physics and Mathematics from Southern Illinois University and MS & PhD degrees in Physics from Illinois Institute of Technology. He is a resident scientist at Argonne National Laboratory, doing theoretical research in high-energy physics. Gordon has been active in the Chicago and Illinois sections and has served on AAPT International and Computers area committees. Gordon has coordinated summer workshops for high school teachers, middle school teachers and high school students. Gordon and Loyola collaborators perform research in physics education and science anxiety. He has mentored many undergraduate research projects. He recently served on the AAPT Executive Board and is currently the AAPT representative to the U.S. Liaison Committee of the International Union of Pure and Applied Physicists. In this capacity he works closely with the International Commission on Physics Education and AAPT to promote communication between physics teachers internationally.

Sam Sampere

Sam Sampere
Syracuse University
Syracuse, NY

Sam Sampere earned his BS at LeMoyne College and his MS at State University of New York-Binghamton. For the last 16 years, he has been the Demonstration and Laboratory Manager at Syracuse University. He is also an Adjunct Physics Instructor at LeMoyne College and manages the Syracuse University Surface Imaging Laboratory. A member of AAPT since 1995, Sampere has been co-leader or presenter of Lecture Demonstration Workshops (1996-pres.), emcee of numerous AAPT Demonstration Shows, host of the Summer Meeting (2006), and served as an Apparatus Competition judge. He has served as Chair of the Committee on Apparatus (2008-09), as a member of the Committee on Apparatus (2007-08), Nomination Committee (2002-03), Committee on Laboratories (2001-02), and the Bauder Fund Committee (2001). He is also a member of PIRA, which includes a term as President from 2005-06, and vice president of the New York State Section AAPT. Additionally, Sampere is co-organizer of the Syracuse University Saturday Morning High School Physics Teacher Workshops. He was awarded a Physics 2005 Outreach grant.

Beth Cunningham

Meet Beth Cunningham, AAPT Executive Officer

Monday, January 10, 10:30–10:45 a.m. • GRAND BALLROOM 4

David Cook, presider

Lila Adair, introduction

Beth Cunningham's career has provided her with admirable preparation to serve as AAPT's new Executive Officer and help us all achieve our mission "to enhance the understanding and appreciation of physics through teaching." Physics and AAPT are in her blood. (Her father was a physicist who, in fact, was quite active in AAPT.) She pursued her BS, MA and PhD degrees, all in physics, at Kent State University. After a two-year post-doctoral appointment at the Hormel Institute of the University of Minnesota, she taught physics for one year at Gettysburg College before moving to Bucknell University, where she taught for 17 years, advanced through the academic ranks to full professor and, during the last six of those years, served as Associate Dean of the Faculty of the College of Arts and Sciences. In 2006, she assumed the position of Provost, Dean of the Faculty, and Professor of Physics at Illinois Wesleyan University, which she held until recently.

Cunningham is a skilled teacher and researcher. She has taught both introductory and advanced lecture and laboratory courses in physics, outreach courses for non-science majors, and one-week continuing education courses for middle school and high school teachers. She was the faculty mentor for more than 20 undergraduate research students. She has been Principal Investigator (PI) or Co-PI on several grants, including one from the NSF for the acquisition of an NMR spectrometer, and four from the NSF to support Research Experiences for Undergraduates (REU) programs during 16 consecutive summers. Much of her research has been at the interface between physics and biology, and she has investigated the structure and function of phospholipids, the major component of cell membranes. She has published over 25 papers, many with student co-authors, in refereed journals, served as reviewer for a number of journals, and participated on seven NSF review panels, chairing one.

Cunningham is also an experienced, effective, and creative administrator. In her positions at Bucknell and Illinois Wesleyan, she has supervised associate provosts and deans; overseen faculty development, hiring of new faculty members, and evaluation of faculty members for promotion and tenure; had responsibility for implementing large-scale curricular development; and managed multimillion-dollar budgets. Beyond these responsibilities, she has had a long-term association with Project Kaleidoscope (PKAL) as a member of the PKAL Faculty for the 21st Century and recently overseeing the Summer Leadership Institutes; she has since 2000 served as a councilor in the Physics and Astronomy Division of the Council on Undergraduate Research; and she served for three years on the APS Committee on Education, chairing it in the third of those years. With a variety of collaborators, she has in the last decade or so presented almost two dozen faculty development and administrative workshops.

As a teacher, scholar, and administrator, Cunningham is outstanding. Her experiences have acquainted her not only with the challenges of the classroom but also with the demands of administering large organizations and managing budgets in a variety of institutional contexts and economic climates. She is well acquainted with and well known within the professional scientific community. She has worked collaboratively on a wide variety of projects and programs. She is enthusiastic and energetic, and she communicates a passion for physics, for AAPT, and for working with AAPT to help us all advance our mission.

Lois Becker

Welcome to Jacksonville

Monday, January 10, 10:45–10:50 a.m. • GRAND BALLROOM 4

Lois Becker, *Jacksonville University, Academic Affairs*

Lois Becker, senior vice president for Academic Affairs at Jacksonville University, leads the academic programs at JU. She came to the university in 2006 after successful stints at Nevada State College and Portland State University. Becker has a BA from the University of Illinois at Urbana-Champaign, and an MA and PhD from Stanford University, all in history. Her academic specialty is Russian intellectual history.

100 Years of Nuclear Physics

▶ Ernest Rutherford and the Accelerator: "A Million Volts in a Soapbox"

Monday, January 10, 10:50–11:45 a.m. • GRAND BALLROOM 4

H. Frederick Dylla, *American Institute of Physics, College Park, MD*

Steven T. Corneliussen, *Thomas Jefferson National Accelerator Facility, Newport News, VA*

Fred Dylla

H. Frederick Dylla is the Executive Director and CEO of the American Institute of Physics (AIP), a not-for-profit umbrella organization for 10 scientific societies that publishes scientific journals and provides information-based products and services. Prior to this appointment, Dylla was the Chief Technology Officer for the U.S. Department of Energy's Thomas Jefferson National Accelerator Facility (Jefferson Lab) in Newport News, VA. Concurrently he held an Adjunct Professorship in Physics and Applied Science at the College of William and Mary. The author of over 190 publications, Dylla received his BS, MS, and PhD in physics from the Massachusetts Institute of Technology. He is a Past President of the AVS (one of AIP's 10 Member Societies) where he was elected a Fellow in 1998 and is currently a distinguished lecturer for AVS. Dylla is also a Fellow of the American Physical Society and a founding member of its largest unit—Forum of Industrial and Applied Physics. He has been an active member in numerous local and regional technology development organizations, including appointments by the Virginia governor to two scientific commissions, and has served on many national advisory committees for the U.S. Department of Energy, Department of Defense, and the National Science Foundation.

Since becoming the Executive Director of AIP in April of 2007, Dylla has been active in promoting the importance of scientific journals for the scientific enterprise, advocating improved access to scientific information through various business models. In 2008, Dylla was elected to the Board of Directors of the International Association of Scientific, Technical and Medical publishers (STM), and to the Executive Committee of the Professional and Scholarly Publication (PSP) Division of the American Association of Publishers (AAP). In 2010, he was elected a Fellow of the American Association for the Advancement of Science for his contributions to physics and national leadership of scientific professional associations in the promotion of physics.

Steven T. Corneliussen

Steven T. Corneliussen is a science writer at Jefferson Lab (Thomas Jefferson National Accelerator Facility) in Newport News, VA, and a contributing editor for the American Physical Society's Division of Physics of Beams publication *Accelerators and Beams: Tools of Discovery and Innovation.* He writes the weekly "Science and the media" column at *Physics Today* online, has published op-eds in *The Washington Post* and other newspapers, and has researched, written, and edited for NASA's academic history program. He hopes that members of the scientific community won't hold it too much against him that his BA and MA—from Duke University and Virginia Tech—are in English.

Kenneth L. Peddicord

▸ The State of the Art in Nuclear Power: Breeder Reactors and Beyond

Tuesday, January 11, 9:40–10:30 a.m. • GRAND BALLROOM 4

Kenneth L. Peddicord, *Texas A&M University*

Kenneth L. Peddicord is the Director of the Nuclear Power Institute of The Texas A&M University System and Professor of Nuclear Engineering at Texas A&M University. He received his BS degree in Mechanical Engineering from the University of Notre Dame in 1965, and MS in 1967 and PhD in 1972 in Nuclear Engineering from the University of Illinois at Urbana-Champaign. From 1972 to 1975, he was employed as a Research Nuclear Engineer at the Eidgenössisches Institut für Reaktorforschung (the Swiss Federal Institute for Reactor Research), now the Paul Scherrer Institut, in Würenlingen, Switzerland. From 1975 to 1981, Peddicord was Assistant Professor and Associate Professor of Nuclear Engineering at Oregon State University. From 1981 to 1982, he served as Visiting Scientist at the EURATOM Joint Research Centre in Ispra, Italy. In 1983, he joined the faculty of Texas A&M University as Professor of Nuclear Engineering. At Texas A&M, he has served as Head of the Department of Nuclear Engineering, Associate Dean, Senior Associate Dean for Research, and Interim Dean of the College of Engineering, Assistant Director and Director of the Texas Engineering Experiment Station, Associate Vice Chancellor of The Texas A&M University System and Vice Chancellor for Research and Federal Relations of The Texas A&M University System. Peddicord has published over 200 research articles, papers and reports. His technical interests include nuclear engineering education, nuclear workforce development, advanced nuclear fuels, nuclear materials safety, and advanced nuclear power systems.

Nancy Mendenhall

▸ State-of-the-Art Nuclear Medicine: Proton Therapy

Wednesday, January 12, 10:30–11:30 a.m. • GRAND BALLROOM 4

Nancy Mendenhall, *University of Florida Proton Therapy Institute*

Nancy Mendenhall is Medical Director, University of Florida Proton Therapy Institute, and Associate Chair, Department of Radiation Oncology in Jacksonville. She received her BA in English from the University of Florida, Gainesville, and her MD in medicine from the University of Florida School of Medicine. A University of Florida College of Medicine faculty member since 1985, Mendenhall served as the chair of the Department of Radiation Oncology from 1993-2006. She has more than 20 years of experience and specializes in the areas of breast cancer, Hodgkin's disease, lymphomas and pediatric cancers. She also treats patients who have prostate cancer and other malignancies. Mendenhall has extensive experience in cooperative group trials (specifically with the Children's Oncology Group) and has produced over 140 published works, including book chapters and journal articles. In addition, she has been named in several leading women's magazines as one of the nation's top doctors for women with cancer. Currently, she is responsible for the day-to-day clinical operations of the University of Florida Proton Therapy Institute.

Education Policy: Having an Impact, Improving the Landscape

SYMPOSIUM on Physics Education

Tuesday, January 11, 3:30–5 p.m. • GRAND BALLROOM 4

Noah Finkelstein, University of Colorado, Boulder, chair

▶ U.S. Representative Vernon J. Ehlers, *Grand Rapids, MI*

U.S. Rep. Ehlers (R-MI) was first elected to the 103rd Congress in a special election on Dec. 7, 1993. Ehlers joined Congress following a distinguished tenure of service in teaching, scientific research and public service. He has served on numerous boards and commissions and was elected to the Kent County (Mich.) Board of Commissioners, and the Michigan House and Senate. The first research physicist to serve in Congress, Ehlers has been recognized for his strong work ethic and proven leadership skills in his duties on Capitol Hill. As a former member of the 111th Congress, Ehlers served on three standing House committees. He also co-chaired the STEM Ed Caucus, which is dedicated to improving the nation's K-12 science, technology, engineering and mathematics (STEM) education. He served on the Science and Technology Committee (previously known as the House Science Committee) and the Transportation and Infrastructure Committee. Ehlers also was a member of the Education and Labor (previously the Education and the Workforce) Committee, where he blended his efforts with the Science Committee on improving math and science education.

U.S. Congressman Vernon J. Ehlers

▶ Michael Lach, *Special Assistant for Science, Technology, Engineering, and Mathematics Education, U.S. Department of Education*

Michael Lach leads science, mathematics, engineering, and technology education efforts at the U. S. Department of Education. Previously, Lach was Officer of Teaching and Learning for the Chicago Public Schools, overseeing curriculum and instruction in the 600+ schools that comprise the nation's third largest school district. Lach began his professional career teaching high school biology and general science at Alceé Fortier Senior High School in New Orleans in 1990 as a charter member of Teach For America, the national teacher corps. After three years in Louisiana, he joined the national office of Teach For America as director of Program Design, developing a portfolio based alternative-certification system that was adopted by several states. Returning to the science classroom in 1994 in New York City Public Schools, and then back to Chicago in 1995 to Lake View High School, he was named one of Radio Shack's Top 100 Technology Teachers, earned National Board Certification, and was named Illinois Physics Teacher of the Year. He has served as an Albert Einstein Distinguished Educator Fellow, advising Congressman Vernon Ehlers on science, technology, and education issues.

Michael Lach

Free Commercial Workshops

CW01: EnergySolutions: Alphas, Betas, Gamma, Oh, MY!

Location: Grand Ballroom 2
Date: Monday, January 10
Time: 12–1 p.m.
Sponsor: Energy Solutions

Leaders: Meredith Mannebach, Duane Merrell

Alphas, Betas, Gammas, Oh My! Energy Lesson Plans/Labs/Activities/Presentations for teachers to use in junior high and high school classrooms. They are intended as teaching aids for the discussion of energy with an emphasis on nuclear energy. There are PowerPoint presentations, class activities, and games that are meant to compliment state curriculum and help teachers make learning about energy fun. The EnergySolutions Foundation gives this material to anyone that is interested at no cost. They serve to increase science processing skills and thereby science literacy. They are not just aimed at educating the population that will work in this industry in the future, the intent is to for board-based education help of future community leaders, politicians and journalists thereby generating an energy literate society. The lesion plans and labs were created by a number of expert educators for use in junior high and high school classrooms to each the concepts related to energy. This material is for teachers and the creators encourage you to augment or modify them to better fit the grade and/or subject matter that you teach. The educators who developed this information realize that junior high and high schools students till have much to learn past these levels. They also know that students need to know a real world context for the information provided in an academic environment.

CW02: Dearborn Resources: What Einstein Did Not See

Location: Grand Ballroom 2
Date: Tuesday, January 11
Time: 12–1 p.m.
Sponsor: Dearborn Resources

Leader: Thomas W. Sills

The book, *What Einstein Did Not See,* presents a paradigm for understanding time and space. Its author, Thomas W. Sills, will demonstrate how three new concepts, timespace, universal time, and universal reference frames, can create a new framework for physical space. In this simple approach, Euclidean geometry describes the complex nature of higher dimensions with basic physics principles. Attendees will learn how time can be redefined as a vector of timespace and a scalar of universal time. The invisible world of four-dimensional space will be examined using four three-dimensional projections from four-dimensional space. With this paradigm the twin trip becomes visible, contraction of the fourth dimension equates to time dilation, and Einstein's quote, "no empty space exists," becomes clear in a new way. The first 20 arriving attendees receive a free copy of the book. Available at Amazon.com, or at your local bookstore. Now on YouTube.com. Since 1974 Sills is an editorial consultant for the production of college physics and astronomy textbooks.

CW03: WebAssign: Using WebAssign to Manage Your Lab Sequence

Location: Grand Ballroom 3
Date: Tuesday, January 11
Time: 12–1 p.m.
Sponsor: WebAssign

Leader: Mark Santee, Eric Boyd

Since 1997, WebAssign has been the online homework system of choice for the introductory physics lecture courses. Through our partnerships with every major publisher, WebAssign supports over 100 introductory physics textbooks with precoded, assignable questions and advanced learning tools. WebAssign For Your Labs is a simple solution to deliver WebAssign's same powerful course tools already in use at over 1700 schools, but with your own original lab experiments as the source material. We don't expect to replace the traditional lab sequence with virtual lab experiments, and you don't need computer stations in your laboratory. WebAssign For Your Labs works with your existing experiments and lab material to let you collect and instantly grade across all lab sections. Learn how WebAssign can help you increase student preparedness and decrease student cost in the introductory lab sequence.

CW04: Extend Your Teaching: Combining Panopto Lecture Capture and i>clicker to Create an Interactive, Student-driven Classroom Experience

Location: City Terrace 12
Date: Monday, January 10
Time: 12–1 p.m.
Sponsor: Panopto/i>clicker

Leader: Elizabeth Tassell

Join us to learn how Panopto, a software-based lecture capture solution, and i>clicker, an easy-to-use student response system, can transform your classroom into an interactive, student-driven learning environment. Created by educators to be simple, reliable and affordable, both Panopto and i>clicker promote active learning, student retention, and interactive lectures. In this session, we will cover product features and how to implement them successfully. Since both learning tools are easy-to-use for students and faculty, you can ensure your class content will remain the focal point of the classroom experience. Do more than record your lecture. Use Panopto to: 1. Give students access to course content outside of your lecture so that class time can be more collaborative. 2. Create opportunities for your students to further the learning process with supplemental learning objectives. 3. Cover more material without losing the ability to communicate key curriculum objectives. Make class time more productive with i>clicker: 1. Assess student participation and gauge student comprehension as you teach. 2. Get immediate feedback and enable two-way communication between you and your students no matter how large the class size. 3. Utilize peer instruction to foster discussion among your students.

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Exhibitor Information

Booths #114, 116, 118

American Association of Physics Teachers
One Physics Ellipse
College Park, MD 20740
301-209-3300
mlapps@aapt.org
www.aapt.org

Visit the AAPT booth for the latest and greatest education resources. See our line of physics toys and gifts, first-time books from our Physics Store, 2011 Calendar and favorite T-Shirts. These items will be available to order at the booth. Get raffle ticket for Great Book Giveaway by 3 p.m. on Tuesday. A Career Center representative will be available.

–Find out about fun online physics demos and lessons from **ComPADRE.**

–If you are interested in a partnership with the **AAPT/PTRA Program** to develop a pre-college physics and physical science teacher professional development grant, visit the PTRA display and leaders at the AAPT booth. The AAPT/PTRA leadership has experience, application templates and will assist with the development of grant proposals.

Booth #110

American Physical Society
One Physics Ellipse
College Park, MD 20740
301-209-3239
webb@aps.org
www.aps.org

The American Physical Society has resources for every physics educator! Faculty can learn about APS education and diversity programs. Teachers can register for our middle school science adventure, adopt physicists for your high school class, learn about minority scholarships, pick up free posters, and much more.

Booth #216

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Booth #210

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Booths #104, 106

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jason.berena@cengage.com

See the latest text and technology solutions from Brooks/Cole, a part of Cengage Learning, at Booth 106, including our featured front-list title, *College Physics*, Ninth Edition by Raymond A. Serway and Chris Vuille. Additionally, take a quick test drive of our class leading digital resources Enhanced WebAssign now available with Cengage YouBook, as well as our new, groundbreaking Virtual Physics Lab. See firsthand the unprecedented control and flexibility these products provide to deliver the course you want.

Booth #301

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Booth #108

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Jbebee@aip.org

Computing in Science & Engineering (CiSE) is the bimonthly magazine of computational tools and methods. AAPT members have been subscribing to CiSE at a faster clip than any other scientific society, at least partly because computation is being introduced earlier in physics curricula. AAPT members can subscribe to CiSE for 40% off the non-member price. Subscribers can also pick up copies of the custom-designed playing cards that uniquely chronicle computing history. CiSE is peer-reviewed and co-published by AIP and the IEEE Computer Society.

Table A

Concise Science Educational Products & Services
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Booth #102

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Booth #306

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Booth #214

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alan@design-simulation.com
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Design Simulation Technologies develops physics-based simulation software that is used by students, educators, and engineers. Interactive Physics is used by more than 13,000 schools worldwide to teach and experience the concepts of physics. Working Model 2D is used by universities for teaching about kinematics, dynamics, and machine design and also by professional engineers for simulating the performance of their designs. Dynamic Design Motion is used by CAD designers and engineers to evaluate the performance of their CAD designs before prototype parts are built.

Booth #200

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Booth #107

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A strong workforce in math, science, and engineering is the key to keeping the energy industry strong during the next century. The goal of the EnergySolutions Foundation is to be a part of fostering the next generation of mathematicians, scientists, and engineers. To help propagate this goal, the EnergySolutions Foundation offers a math, science, and engineering scholarship. The program is designed to encourage 10th grade students to pursue academic careers in math, science, and engineering. The EnergySolutions Foundation has also developed educational tools that aim to increase science processing skills and thereby science literacy, Alphas, Betas, Gammas, Oh My!

Booth #113

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It's About Time is an innovative company that specializes in developing research-based math and science programs. Many of our programs are funded by the National Science Foundation, and all follow the guidelines of the National Science Education Standards and the National Council of Teachers of Mathematics.

Booth #211

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Booth #212

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Booth #206

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Booth #112

Physics Teacher Education Coalition
One Physics Ellipse
College Park, MD 20740
301-209-3239
webb@aps.org
www.ptec.org

Your institution is invited to join the Physics Teacher Education Coalition, a network of institutions committed to improving the education of physics and physical science teachers led by APS and AAPT. Come learn about more APS education and diversity programs including a careers website and slide show, the Minority Scholars Program, Future Physicists Day, and LaserFest lessons for your physics classroom.

Booth #204

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Booths #217, 219, 316, 318

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Booth #115

Society of Physics Students
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College Park, MD 20740
301-209-3008
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www.spsnational.org

SPS is the Society of Physics Students, along with the associated honor society of physics, Sigma Pi Sigma. Through its donors, and through its parent organization, the American Institute of Physics (AIP), SPS supports scholarships, research awards, physics project awards, and outreach awards for undergraduates. SPS supports a Summer Science Research Clearinghouse, where thousands of summer research positions are listed, at www.the-nucleus.org, as part of the physics digital library, ComPADRE. In addition, a Science Outreach Clearinghouse is also supported via www.the-nucleus.org.

Booth #300

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Booths #305, 307

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Booths #203, 205

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Monday, Jan. 10, 2011 – Session Schedule

Rooms are in the Hyatt Regency Jacksonville Riverfront – Poster Session I is outside Exhibit Hall, 9 to 10:30 p.m.

	Grand Ballroom 1	City Terrace 4	Grand Ballroom 2	City Terrace 5	Grand Ballroom 3	City Terrace 6	City Terrace 7	City Terrace 9	City Terrace 12	Grand Ballroom 4
8:00 a.m.	**AC** *Panel:* Revision of AAPT Guidelines for Two-Year Colleges	**AB** Non-Academic Partnerships for Teachers	**AA** Laboratories Rutherford Would Approve		**AE** PER Around the World - I	**AF** Meeting the Diverse Needs of Students	**AG** Astronomy at the University of Florida	**AH** Preparing Pre-High School Teachers	**AI** Statistical Analyses of Complicated Data	
8:30 a.m.										
9:00 a.m.				**AD** Using Robotics to Teach Physics						
9:30 a.m.										
10:00 a.m.										
10:30 a.m.										Plenary: *100 Years of Nuclear Physics*
11:00 a.m.										
11:30 a.m.										
12:00 p.m.	**Crkrbl 1** APS Minority Bridge Program						**Crkrbl 2** Two-Year College Issues	**Crkrbl 4** International AAPT Meeting Attendees		
12:30 p.m.										
1:00 p.m.										
1:15 p.m.	**BA** *Panel:* ComPADRE	**BE** Forging Successful School-College Collaborations		**BH** Heliophysics, Heliosphere and ATST	**BF** SPS Undergraduate Research and Outreach	**BI** Sustaining a High-Quality Physics Teacher Preparation Program	**BB** Service Learning	**BD** Objectives and Assessment of the Graduate Program	**BG** Investigating Student Reasoning in Physics	
2:15 p.m.							**BC** Science and Society			
2:30 p.m.										
3:15 p.m.										
3:30 p.m.										Awards: *Oersted–J. Rutherford DSCs SPS Advisor*
4:00 p.m.										
4:30 p.m.										
5:00 p.m.										
6:30 p.m.	**CA** *Panel:* ALPhA Session: Condensed Matter/ Materials	**CB** Outcomes of the Two-Year College Tandem Meeting	**CC** Extended Investigations in 5-9 Classrooms	**CE** Cosmology Education	**CH** Teaching with Technology - I	**CI** Computational Physics - I	**CG** PER: Student Reasoning	**CD** LaserFest: What We Did	**CF** Jerrold Zacharias and the Foundations of PSSC Physics	
7:00 p.m.										
7:30 p.m.										
8:00 p.m.										

Tuesday, Jan. 11, 2011 – Session Schedule

Rooms are in the Hyatt Regency Jacksonville Riverfront – Poster Session I is outside Exhibit Hall, 8:30 to 10 p.m.

	Grand Ballroom 1	City Terrace 4	Grand Ballroom 2	City Terrace 5	Grand Ballroom 3	City Terrace 6	City Terrace 7	City Terrace 9	City Terrace 12	City Terrace 10	City Terrace 11	Grand Ballroom 4
8:00 a.m.	**DB** Teaching with Technology - II	**DC** Increasing the Number and Diversity of Physics Majors	**DE** Computational Physics from Freshman to Senior Year - II	**DA** Bridging the Gap	**DG** High School		**DD** Transitions from H.S. to Two-Year and Four-Year Colleges	**DF** Gender Perspective in PER	**DH** Introductory Labs/Apparatus			
8:30 a.m.												
9:00 a.m.												
9:30 a.m.												Plenary: *Nuclear Power*
10:00 a.m.												
10:30 a.m.												
11:00 a.m.												Awards: *Richtmyer: K. Moler*
11:30 a.m.												
12:00 p.m.	**Crkrbrl 3** PER Graduate Student Concerns	**Crkrbrl 5** Physics and Society Education					**Crkrbrl 6** Emergency Professional Development					
12:30 p.m.												
1:00 p.m.	**EC** *Panel:* State of Women in Physics	**EA** Video-based Motion Analysis		**EE** Cosmology/ Astro. Educ.	**EK** PER: Investigating Classroom Strategies		**ED** Interdisciplinary Training	**EH** Recent Research in Teacher Education	**EI** Teaching with Technology	**EG** Teaching Energy and the Environment	**EJ** Teaching Physics Online	
1:15 p.m.												
2:00 p.m.		**EB** Interactive Lecture Demonstrations				**EF** Teacher Training						
2:30 p.m.												
3:00 p.m.												
3:30 p.m.												*AAPT Symposium on Education Policy*
4:00 p.m.												
4:30 p.m.												
5:00 p.m.												
6:30 p.m.												
7:00 p.m.												
7:30 p.m.												
8:00 p.m.												

Wednesday, Jan. 12, 2011 – Session Schedule

Rooms are in the Hyatt Regency Jacksonville Riverfront

	Grand Ballroom 1	City Terrace 4	Grand Ballroom 2	City Terrace 5	Grand Ballroom 3	City Terrace 6	City Terrace 7	City Terrace 9	City Terrace 10	Grand Ballroom 4
8:00 a.m.				**FC** Reforming the Introductory Physics Course for Life Science Majors IV						
8:30 a.m.		**FA** Making Physical Meaning with Mathematics	**FF** Introductory Courses		**FH** PER: Topical Understanding and Attitudes	**FD** Upper-level Undergraduate Physics	**FB** Emerging Technology			
9:00 a.m.	**FI** T-TEP Report								**FE** The New AP Physics B Test and other HS Issues	
9:30 a.m.										
10:00 a.m.										
10:30 a.m.										Plenary: *State of the Art in Nuclear Medicine*
11:00 a.m.										
11:30 a.m.			**Crkrbrl 8** Historical Perspectives on the Laser		**Crkrbrl 10** Past and Present Priorities – NSF-DUE		**Crkrbrl 9** Task Force on Teacher Education			
12:00 p.m.										
12:30 p.m.										*AAPT Presidential Transfer*
1:00 p.m.	**GA** Rutherford: His Life and Legacy	**GB** Is There a Need for Assessment in Undergraduate Physics?	**GD** Frontiers in Planetary Science				**GC** The Effect of Anxiety, Frustration & Annoyance on Physics Learning	**GF** Laboratory Pedagogy - I		
1:15 p.m.					**GE** PER Around the World - II					
2:00 p.m.										
2:30 p.m.										
3:00 p.m.										
3:15 p.m.	**HA** Laboratory Pedagogy - II		**HC** Post-Deadline Session - II		**HB** Post-Deadline Session - I					
4:00 p.m.										
4:15 p.m.										
4:25 p.m.										
5:00 p.m.										
5:30 p.m.										
6:00 p.m.										
6:30 p.m.										

Workshops – Saturday, Jan. 8

(All workshops held at Jacksonville University. Shuttle buses will be available from the Hyatt Regency Jacksonville Riverfront Hotel—see bus schedule, page 6)

W01: Critical Thinking in Introductory Astronomy

Sponsor: Committee on Space Science and Astronomy
Time: 8 a.m.–12 p.m. Saturday
Member Price: $40 **Non-Member Price**: $65
Location: Reid 201

Joe Heafner, D3990 Herman Sipe Road NW, Conover, NC 28613-8907; heafnerj@sticksandshadows.com

In this workshop, participants will engage in inquiry activities designed to emphasize critical thinking and scientific reasoning within the context of introductory astronomy. Content may include activities applicable to all science (e.g. logical fallacies, terminology, etc.) and activities specific to astronomy (e.g. shadows, lunar illumination, etc.). These activities are part of the Learning Critical Thinking Through Astronomy Project and its associated textbook (in development). Participants should bring notebook computers with wifi capability.

W02: Potpourri of Physics Simulations

Sponsor: Committee on Physics in Two-Year Colleges
Co-sponsor: Committee on Educational Technologies
Time: 8 a.m.–12 p.m. Saturday
Member Price: $45 **Non-Member Price:** $70
Location: Swisher Science 2

Paul Williams, Austin Community College,11928 Stonehollow Dr., Austin, TX 78758; pwill@austincc.edu

A large number of simulations have become available over the last few years. This workshop will look at simulations from a consumer's point of view with a focus on effectively using simulations in the physics classroom. A number of strategies for incorporating simulations into instruction such as free inquiry activities, guided inquiry activities, lab activities (including quantitative data acquisition), and conceptual exercises based on simulations will be explored. The workshop will focus on three packages of simulations/animations that are available for free on the web including PhET simulations, Physlet simulations, and simulations and animations from the MIT TEAL site. As part of the workshop, participants will design an activity that incorporates a simulation. Participants who wish to run the simulations from their own laptop are encouraged to bring their laptop to the workshop.

W04: NTIPERS: Research-based Reasoning Tasks for Introductory Mechanics

Sponsor: Committee on Research in Physics Education
Co-sponsor: Committee on Physics in Two-Year Colleges
Time: 8 a.m.–12 p.m. Saturday
Member Price: $60 **Non-Member Price:** $65
Location: Merritt Penticoff 125

David P. Maloney, Physics Dept., IPFW, Fort Wayne, IN 46805; maloney@ipfw.edu

Curt Hieggelke, Joliet Junior College; Steve Kanim, New Mexico State University

A common question instructors wrestle with is: How do I get my students to develop a strong understanding of physics? In this workshop you will explore some new materials designed to get students to think about fundamental concepts in alternative and multiple ways to promote robust learning. Participants will work with a variety of tasks and task formats that require students to think about the basic physics in the domains of kinematics and dynamics, including rotational dynamics, in nonstandard ways. Participants will be given a CD with more than 400 tasks, and other materials.

W08: Household Electricity in the Physics Classroom

Sponsor: Committee on Physics in High Schools
Time: 8 a.m.–5 p.m. Saturday
Member Price: $140 **Non-Member Price:** $165
Location: Nelms 6B

John P. Lewis, Glenbrook South High School, 4000 W. Lake Ave, Glenview, IL 60025; jlewis@glenbrook225.org

Everything you need to start a household electricity unit in your physics classroom. Participants will build a student station that will accommodate actual electrical components used in common household electric projects. The station includes a fused power supply, conduit-connected electric boxes which will simulate an actual house with actual electrical requirements. These include 2-way and 3-way switched overhead lamps, a common outlet, a complete bedroom, doorbells, thermostats and more! You'll actually bring home a brief-case-sized self-contained student station with all of the equipment to build the circuits above and plans to build similar kits for each of your lab stations. No experience necessary. We will build and assemble the stations during the morning and use them to perform the student experiments during the afternoon. The "final exam" will be building your own working lamp "from scratch." Come enjoy this totally hands-on approach to the world of household electricity.

W05: Ben Franklin as My Lab Partner

Sponsor: Committee on History and Philosophy in Physics
Co-sponsor: Committee on Apparatus
Time: 1–5 p.m. Saturday
Member Price: $52 **Non-Member Price:** $77
Location: Reid 210

Robert A. Morse, St. Albans School, Washington, DC 20016; rmorse@cathedral.org

Benjamin Franklin's experiments and observations on electricity established his reputation as a scientist, our electrical conventions and vocabulary, and the principle of charge conservation. In his letters, Franklin builds, tests, and defends his model with skill and eloquence, arguing from experiment, sharing both his wisdom and doubts, while conveying his fascination with electricity. As Franklin lacked formal schooling in mathematics, his theory was qualitative, and is an approachable example of hands-on and minds-on construction of a conceptual model with significant explanatory power. In this workshop (developed at the Wright Center for Science Teaching at Tufts University), working with Franklin's descriptions, we will recreate many of his experiments using modern, inexpensive materials. Participants will receive a kit of materials, selections from the workshop manual and a CD-ROM containing the complete workshop manual, a collection of Franklin's letters relating to electricity, and movie clips illustrating the experiments.

W06: Grant Writing 101: Grant Writing Workshop for New Faculty

Sponsor: Committee on Research in Physics Education
Co-sponsor: Committee on Graduate Education in Physics
Time: 1–5 p.m. Saturday
Member Price: $40 **Non-Member Price:** $65
Location: Merritt Penticoff 122

Paula V. Engelhardt, Tennessee Technological University, 110 University Dr., Cookeville, TN 38506; engelhar@tntech.edu

This workshop is intended for individuals who are in their last year of graduate school, in a post-doctoral position, or are new faculty members. The workshop will focus on navigating the National Science Foundation (NSF) website, finding alterative funding sources such as Fund for the Improvement of Postsecondary Education (FIPSE) and state and local funding agencies, and preparing the grant proposal. Tips and suggestions for developing ideas and seeing them through to the development of the grant proposal will be discussed. Participants are encouraged to bring with them grant ideas to discuss with the group.

W29: Modeling Applied to Problem Solving - An Adoptable Pedagogy

Sponsor: Committee on Physics in Undergraduate Education
Co-sponsor: Committee on Physics in High Schools
Time: 1–5 p.m. Saturday
Member Price: $40 **Non-Member Price**: $65
Location: Reid 210

David E. Pritchard, Room 26-241, MIT, 77 Massachusetts Ave., Cambridge, MA 02139; dpritch@mit.edu

Analia Barrantes, Carie Cardamone, Saif Rayyan, Raluca Teodorescu

This workshop will introduce participants to a modeling-based approach to problem solving, a pedagogy that enables students to attain significant expert-like improvement of their problem solving skills that transfers to a subsequent E&M course, as well as significantly more expert-like attitudes toward science, particularly in Problem-Solving self confidence. The workshop goal is to enable participants to introduce some or all of this pedagogy into their courses with the help of our open source integrated version of LON-CAPA, ANDES, and a Wiki-Text that incorporates MAPS into a standard introductory mechanics syllabus. Workshop participants will sample the various teaching materials for in-class use and will participate in some innovative activities for class. The integrated environment will be demonstrated. We seek users/collaborators for part or all of our materials, which can be freely modified.

Workshops – Sunday, Jan. 9

(All workshops held at Jacksonville University. Shuttle buses will be available from the Hyatt Regency Jacksonville Riverfront Hotel—see bus schedule, page 6)

W10: Designing and Implementing an Inquiry-based Physics Course for K-12 Teachers*

Sponsor: Committee on Teacher Preparation
Co-sponsor: Committee on Research in Physics Education
Time: 8 a.m.–12 p.m. Sunday
Member Price: $65 **Non-Member Price:** $90
Location: Reid 210

Lillian C. McDermott, University of Washington, Dept. of Physics, Box 351560, Seattle, WA 98195; peg@phys.washington.edu

Laboratory-based courses in physics can help teachers develop the depth of understanding necessary to teach physics and physical science as a process of inquiry. For over 30 years, the UW PEG has been offering such courses using Physics by Inquiry,[1] a research-validated curriculum. This workshop focuses on the design of special physics courses for teachers and is primarily intended for college and university faculty, lead teachers, and others responsible for K-12 teacher professional development. Participants will experience and reflect on critical elements of courses that can help teachers deepen their conceptual understanding, gain familiarity with common student difficulties, and translate their own learning into effective classroom practice.

* This work has been supported in part by a series of grants from the NSF, the most recent of which is DRK-12 grant #0733276.

1. L.C. McDermott and the Physics Education Group at the University of Washington, *Physics by Inquiry* (Wiley, 1996).

W12: Learner-centered Environment for Algebra-based Physics (LEAP)*

Sponsor: Committee on Research in Physics Education
Time: 8 a.m.–12 p.m. Sunday
Member Price: $40 **Non-Member Price:** $65
Location: Reid 201

Paula V. Engelhardt, Tennessee Technological University, 110 University Dr., Cookeville, TN 38506; engelhar@tntech.edu

Steve J. Robinson

The Learner-centered Environment for Algebra-based Physics (LEAP) is a newly developed, two-semester physics curriculum for algebra-based physics. The course pedagogy and activity sequence is guided by research on student learning of physics and builds on the work of the NSF-supported project, Physics for Everyday Thinking (PET). Students work in groups to develop their understanding of various physics phenomena including forces, energy, electricity and magnetism, light and optics. Students utilize hands-on experiments and computer simulations to provide evidence to support their conceptual understanding. Traditional problem solving is scaffolded by using the S.E.N.S.E. problem solving strategy. During this workshop, participants will be introduced to the LEAP curriculum and S.E.N.S.E. problem solving strategy, will examine and work through a sample of the types of activities students do, and will view video from the college LEAP classroom.

*Supported in part by NSF CCLI grant #DUE-0737324

W13: LivePhoto Physics: Video-based Motion Analysis for Homework and Classroom

Sponsor: Committee on Educational Technologies
Co-sponsor: Committee on Physics in High Schools
Time: 8 a.m.–12 p.m. Sunday
Member Price: $45 **Non-Member Price:** $70
Location: Swisher Science 3

Robert B. Teese, Physics Dept., Rochester Institute of Technology, Rochester, NY 14623; rbtsps@rit.edu

Patrick J. Cooney, Priscilla W. Laws, Maxine Willis

This workshop is for physics teachers who wish to explore the use of video-based motion analysis in a wide range of applications including the teaching laboratory, projects, and homework. Participants will learn how to make digital video clips for analysis, as well as how to use video analysis for homework problems and in the classroom. We will discuss educationally effective uses of video analysis being developed in the LivePhoto Physics project, the Workshop Physics project, and in other settings. Evaluation copies of analysis software, selected digital video clips, and homework assignments will be provided to the participants for their use after the workshop. The software used in this workshop is available for both Mac and Windows computers. Participants in this workshop may find that some prior, hands-on experience with basic video analysis using software such as Logger Pro or Tracker will be helpful but is not required.

W14: Modeling Mechanics: From Freefall to Chaos

Sponsor: Committee on Educational Technologies
Co-sponsor: Committee on Physics in Undergraduate Education
Time: 8 a.m.–12 p.m. Sunday
Member Price: $40 **Non-Member Price:** $65
Location: Merritt Penticoff 122

Christian Wolfgang, Davidson College, Davidson NC 28035-6926; wochristian@davidson.edu

This workshop shows how to use the open-source Easy Java Simulations (EJS) authoring and modeling tool for teaching. We will describe the simplified structure and extensive scaffolding provided by the tool to create interactive, dynamical, effective simulations and we will show how teachers can connect from EJS to national digital libraries to download hundreds of ready-to-use simulations. These simulations can be used for computer demonstrations or virtual laboratories in high school and undergraduate courses, or serve as programming examples and tasks for Computational Physics and higher-level students. These EJS simulations are ready to be distributed on a CD or published on a web page as Java applets. Additional information is available at: http://www.compadre.org/osp/. Partial funding for this workshop was obtained through NSF grant DUE-0442581.

W15: Observing with NASA: Expanding the Universe in the Classroom

Sponsor: Committee on Space Science and Astronomy
Time: 8 a.m.–12 p.m. Sunday
Member Price: $55 **Non-Member Price:** $80
Location: Merritt Penticoff 130

Janelle M. Bailey, UNLV, Department of Curriculum & Instruction, 4505 S. Maryland Pkwy., Las Vegas, NV 89154-3005; janelle.bailey@unlv.edu

Erika Reinfeld, MIT Museum; Mary Dussault, Harvard-Smithsonian Center for Astrophysics

Explore the biggest questions about our place in space and time. Many new astronomy learners, students, and adults alike are unfamiliar with the universe beyond the solar system. This workshop uses online telescopes and hands-on activities to deepen content knowledge and practice strategies for teaching and learning about current scientific models and evidence for the origin and evolution of our universe of galaxies. Participants will receive a copy of the professional development NASA-funded DVD "Beyond the Solar System: Expanding the Universe in the Classroom" and gain access to the Harvard-Smithsonian Center for Astrophysics' MicroObservatory online telescopes in order to collect their own evidence for the Big Bang model of expanding, evolving galaxies. Two inquiry-based lesson plans, Cosmic Timeline and Measuring Galaxies With Telescopes, will be featured, along with video clips exploring key concepts, evidence, researchers, student ideas, classrooms and other resources from the DVD.

W16: Using the Wii for Fun and Physics

Sponsor: Committee on Physics in Two-Year Colleges
Co-sponsor: Committee on Educational Technologies
Time: 8 a.m.–12 p.m. Sunday
Member Price: $48 **Non-Member Price:** $73
Location: Merritt Penticoff 114A

Dwain M. Desbien, 3000 N Dysart Rd, Avondale, AZ 85392; rdwain.desbien@emcmail.maricopa.edu

David Weaver

Over 30 million Wii remotes have been sold and many of our students have or do use them. You will learn how to use the Wiimote as a 3-axis accelerometer in the physics lab. Then, you will assemble an IR pen and use the Wiimote to create a fairly Smart Board for use in your classroom. Participants MUST bring their own Wiimote to the workshop.

W27: Research-based Alternatives to Traditional Problem-Solving Exercises

Sponsor: Committee on Research in Physics Education
Time: 8 a.m.–5 p.m. Sunday
Member Price: $65 **Non-Member Price:** $90
Location: Merritt Penticoff 129

Kathleen A. Harper, The Ohio State University, Worthington, OH 43085; harper.217@osu.edu

David P. Maloney, Thomas M. Foster

Accumulating research on problem solving in physics clearly indicates that traditional, end-of-chapter exercises in physics texts are not useful and may actually hinder students' learning of important physics concepts. The research also raises questions about the efficacy of such tasks for helping students develop "problem solving skills." In light of these results the question is: What alternative tasks can we use to help students develop problem-solving skills and a conceptual understanding? This workshop will review the research and then provide examples of several alternative tasks and their use. Participants will also get practice writing alternative problems in a variety of formats for use in their own classrooms.

T03: Preparing Teacher Candidates to Teach the New AP Physics B: What Faculty and Mentors Need to Know

Sponsor: Committee on Teacher Preparation
Co-sponsor: Committee on Physics in Undergraduate Education
Time: 1–4 p.m. Sunday
Member Price: $40 **Non-Member Price:** $65
Location: Reid 105

Gay B. Stewart, Dept. of Physics, University of Arkansas, Fayetteville, AR 72701; gstewart@uark.edu

There will be a brief discussion on the nature and development of the new AP Physics B courses. We will move into what impact these changes may have on what faculty need to do when they prepare teachers, or what teacher mentors may need to do differently to support teachers in these greatly improved courses. The conceptual level is significantly deeper, but, because of the two years, the first year could be accessible to more students. Currently, Physics B is supposed to follow a preparatory course. Now, the material is divided up and deepened to make each year a stand-alone, rigorous, conceptual, and problem-solving course. These can be placed flexibly into a school's curriculum; examples will be discussed. We will share examples of features of our program that prepare pre-service teachers for best-practice classes. There are some resources available to help new and practicing, but perhaps not richly prepared, teachers.

W17: Energy and the Environment Hands-on Activities

Sponsor: Committee on Science Education for the Public
Co-sponsor: Committee on Minorities in Physics
Time: 1–5 p.m. Sunday
Member Price: $47 **Non-Member Price:** $72
Location: Swisher Science 2

John M. Welch, Cabrillo College, Physics Dept., 6500 Soquel Dr., Aptos, CA 95003; jowelch@cabrillo.eduu

This workshop will present some of the activities developed at the Cabrillo College Summer Energy Academy to teach basic concepts having to do with energy and the environment. Our NSF-funded program is designed to spark or strengthen an interest in science among high school seniors. Workshop participants will do the activities as the students normally would, with time afterward for discussion as teachers. Activities will include a game for teaching what "peak oil" means, building micro wind generators and measuring power output, and tracing energy conversions through various systems.

W20: Laboratories with Biomedical Applications

Sponsor: Committee on Laboratories
Co-sponsor: Committee on Apparatus
Time: 1–5 p.m. Sunday
Member Price: $95 **Non-Member Price**: $120
Location: Merritt Penticoff 114A

Nancy Beverly, Mercy College, 555 Broadway, Dobbs Ferry, NY 10522; nbeverly@mercy.edu

There is a growing need for laboratory activities that allow life science and biophysics students to explore and deepen their understanding of physics through such contexts as physiology, medical diagnostic, and therapeutic devices, biomechanics, biological processes, and biological research techniques. Several individuals and groups who have been working independently on such laboratory activities will present examples of their labs. After an initial overview by all the presenters, participants will break into rotating groups for hands-on experience with different laboratory activities and more detailed discussion with each presenter about the pertinent pedagogy and apparatus. A flash drive with materials of all the laboratory activities will be given to the participants.

W21: Teaching About Radioactivity

Sponsor: Committee on Science Education for the Public
Time: 1–5 p.m. Sunday
Member Price: $75 **Non-Member Price:** $100
Location: Merritt Penticoff 125

Alice Flarend, P209 W 15th Ave. Altoona, PA 16601; amf@blwd.k12.pa.us

Topics discussed will be: atomic models, half-life, nuclear fission, nuclear reactors. Most activities use low-cost materials and computer simulations so that they are accessible in many teaching venues. This workshop will be a sharing of methods and constructivist activities for teachers of all experience and teaching levels. Participants will receive a copy of the activities from the PTRA Teaching about Radioactivity resource. Please bring a laptop if possible.

W24: Tutorials in Introductory Physics: A Research-Validated Approach to Improving Student Learning

Sponsor: Committee on Research in Physics Education
Co-sponsor: Committee on Physics in Undergraduate Education
Time: 1–5 p.m. Sunday
Member Price: $65 **Non-Member Price:** $90
Location: Reid 210

Lillian C. McDermott, University of Washington, Dept. of Physics, Box 351560, Seattle, WA 98195; peg@phys.washington.edu

Tutorials in Introductory Physics[1] is a set of research-validated instructional materials intended to supplement the lecture, textbook, and laboratory of a standard calculus-based or algebra-based introductory course. The tutorials are designed to address specific conceptual and reasoning difficulties that have been identified through research. In addition to providing hands-on experience with the curriculum, the workshop will include discussions of instructional strategies and results from assessments of student learning. Important aspects related to implementation of the tutorials will be covered, including preparation of graduate teaching assistants, undergraduate peer instructors, and post docs. Copies of *Tutorials in Introductory Physics* will be provided to participants.

1. L.C. McDermott, P.S. Shaffer, and the Physics Education Group at the University of Washington, *Tutorials in Introductory Physics*, 1st Ed. (Prentice Hall, 2002).

* This work has been supported in part by a series of grants from the NSF, the most recent of which is CCLI grant #0618185.

Session Abstracts

Sunday, January 9

Section Officers Exchange	3–4 p.m.	River Terrace 3
High School Share-a-thon	6–8 p.m.	River Terrace 2
Exhibit Hall Opens/ Reception	8–10 p.m.	Exhibit Hall

Session SUN: SPS Undergraduate Research and Outreach (Posters)

Location: Grand Ballroom 5/8
Sponsor: Undergraduate Education Committee
Date: Sunday, January 9
Time: 8–10 p.m.

Presider: Gary White

SPS01: 8–10 p.m. Spectroscopic Ellipsometery of Gadolinium Gallium Oxide Thin Films

Poster - Kaleb Gilbert, Angelo State University, Physics, San Angelo, TX 76909; kgilbert1@angelo.edu

Toni D. Sauncy, Angelo State University
Wilhelm Geertz, Ravi Droopad, Texas State University
Kunal Bhatnagar, University of Missouri-Columbia

The dielectric parameters of Gadolinium Gallium Oxide (GGO) multilayer structures have been investigated with spectroscopic ellipsometry and modeled with a simplified modeling technique. The GGO thin films are of varying thickness and the simple four parameter model was effective in determining consistent values for the dielectric constants of this important high k dielectric material. Ellipsometric data was collected in two different acquisition configurations to insure the merit of the model. The model is further confirmed by the determination of film thickness values within an acceptable range when compared with those reported by the sample grower.

SPS02: 8–10 p.m. bLASING Across West Texas: Angelo State Road Tour 2010

Poster - Ethan D. Gully, Angelo State University, Physics, San Angelo, TX 76909; egully2@angelo.edu

Toni D. Sauncy, Angelo State University

In our continuing effort to stimulate young minds and encourage interest in physics among K12 school children, the Angelo State Society of Physics Students Peer Pressure Team science outreach group embarked on its sixth annual week-long outreach trip across west Texas. Ten undergraduate physics students ranging from freshman to veteran seniors visited eight public schools to present physics demonstrations including several new additions to celebrate LaserFest 2010. In this poster we detail our experiences and discuss the feedback we received from audience participants.

SPS03: 8–10 p.m. Characterization of Resonant Cavities in Terahertz Parallel Plate Waveguides

Poster - Blake T. McCracken, Angelo State University, San Angelo, TX 76909; bmccracken@angelo.edu

Victoria Astley, Rajind Mendis, Dan Mittleman, Rice University

Parallel-plate waveguides are among the most common low-loss broadband waveguides in the terahertz frequency regime. One application is microfluidic detection. Adding a groove into one of the waveguide plates leads to a resonant feature of relatively high quality factor (Q-factor), that shifts to different frequencies when the groove is filled with different liquids. We investigate the resonant frequencies and transmission characteristics of different-sized grooves in aluminum plates in order to determine which groove is most suitable for microfluidic sensing. This apparatus is formed by machining grooves of varying geometries into aluminum plates, which are then used to form parallel-plate waveguides.

SPS04: 8–10 p.m. Science Outreach: Simple Physics Lessons for Fifth Grade

Poster - Jordan A. Sefcik, Angelo State University Physics, San Angelo, TX 76909; jsefcik3@angelo.edu

Toni D. Sauncy, Angelo State University

In order to formalize Angelo State University Physics science outreach, we have partnered with a local elementary school to develop three hands-on labs for 5th grade students. The local elementary school was selected after a previous collaboration with the Angelo State Society of Physics Students (SPS) can roll service project. Project goals were aimed at helping with limited physical science resources available at the school and to encourage underrepresented groups to study science. Each lab was presented by Angelo State SPS undergraduate physics majors. Collaboration with the school science coordinator helped direct our efforts to those areas identified as in need of improvement, including motion, energy and optics. Labs were structured toward science criteria in the Texas Essential Knowledge and Skills (TEKS) in order to supplement student instruction in these topics. Pre- and post-lab assessments were analyzed in order to gauge the effectiveness of our efforts.

SPS05: 8–10 p.m. Investigation of the Effects of a Strong Oxidizer in Photochemical Synthesis of Porous Silicon Thin Films

Poster - Olivia D. Skeen, Angelo State University, San Angelo, TX 76909; dskeen@angelo.edu

Toni D. Sauncy, Angelo State University
Anup K. Bandyopadhyay, Texas State University

Porous silicon thin films have been produced by photochemical synthesis with a solution of hydrofluoric acid (HF) and the oxidizer cobalt nitrate. A 20mW HeNe laser was used to produce the local electric field necessary for the formation of the porous matrix on the surface of the crystalline silicon (n-type, antimony doped) substrate. Samples prepared with variations in process time from 15 minutes to five hours were examined using photoluminescence and Raman spectroscopy as well as scanning electron microscopy. Results indicate that the presence of the oxidizer during synthesis enhances the intensity of the photoluminescence produced by the porous silicon post-processing when compared with samples prepared using only HF. In addition, post process analysis reveals that the porous layer on the samples is present only on samples processed for less than two hours.

SPS06: 8–10 p.m. Temperature Dependence of Electron-Phonon Coupling and Its Correlation to Ultra Fast Demagnetization

Poster - John E. Clark, Deltona High School, Deltona, FL 32725; jeclark@volusia.k12.fl.us

Xaun Wang, Junjie Li, Jianming (Jim) Cao, Florida State University
David McPherson, University of Texas - El Paso

We report a systematic measurement of the electron-phonon thermalization timescales as a function of the sample base temperature in Ni using femtosecond electron diffraction. A strong temperature dependence has been observed in the vicinity of the Curie point. By assuming that ultrafast demagnetization completes well before the electron-phonon thermalization, this correlation between thermalization time and sample base temperature can be fit by a modified three-temperature model describing the energy transfer among charge, spin, and phonon subsystems. The results indicate that charges and spins can be characterized by a unified temperature during ultrafast lattice heating. I was invited to be part of this research project as part of my Research Experience for Teachers program sponsored by The National High Magnetic Field Lab on the campus of Florida State University.

SPS07: 8–10 p.m. Development of a Standard Fluids Assessment: Evaluating Question Alterations

Poster - Sam Cohen, Grove City College, Grove City, PA 16127; cohensj1@gcc.edu

Jason Wetstone, Adam Moyer, DJ Wagner, Grove City College

We are developing an FCI-style assessment covering hydrostatic topics commonly included in introductory physics courses. Our goal is for the assessment to provide meaningful analysis of student learning for a wide range of populations, from conceptual-based courses through honors calculus-based courses. Students from all three introductory tracks (conceptual-, trig-, and calculus-based) at Grove City College (GCC) have completed draft versions of our assessment, both pre- and post-instruction. This poster presents how the results for specific questions were affected when the wording or format of the question was changed to promote clarity. The results of chi-squared analysis suggest that most of our minor alterations did not significantly change the response distributions. We also analyzed the discrimination and difficulty of the assessment questions for each population.

SPS08: 8–10 p.m. Impact of Experimental Research and Teaching Experiences on Physics Education

Poster - Krista G. Freeman, Cleveland State University, Cleveland, OH 44102; k.g.freeman22@gmail.com

Beginning my studies in the fall of 2007 at Cleveland State University (CSU) I had a very broad list of subjects I was interested in and no real clue of what profession I wanted to pursue. After two semesters of studying the sciences, I was leaning toward physics—based in large part on my interest in how the fundamental ideas of two-hour lab experiments could be manipulated to study cross-disciplinary research topics. So I declared my major and applied for teaching assistant and research assistant positions, both of which I started in the summer of 2008. My teaching position has allowed me to take a fresh new look at basic physics—keeping me grounded in my basic knowledge and allowing me to see connections between the fundamentals and my upper-level coursework. I truly believe that the best way to really learn is to teach, so teaching lab courses is an ideal job for a physics major! Participating in research projects through summer undergraduate research at CSU and an REU at the University of Akron has also made a remarkable impact on my studies by allowing me to explore applications and applied theories of the broader subject matter of my courses.

SPS09: 8–10 p.m. Opening Up the Department: Day Camps and Workshops

Poster - Timothy T. Grove, Indiana University Purdue University Fort Wayne, Fort Wayne, IN 46805; grovet@ipfw.edu

Mark F. Masters, IPFW

We present information regarding two LaserFest events that happened at our home institution (IPFW). Over the past summer (2010) we ran a day camp for high school age students as well as a workshop for high school teachers. The day camp had several purposes: to teach kids about lasers as well as providing "fun" activities featuring lasers. The workshop was designed to have the teachers learn more about lasers and light so that they can incorporate them into their classes. We will present information regarding the activities we developed.

SPS10: 8–10 p.m. 2010 SPS Summer Intern Outreach Experience

Poster - Patrick Haddox, 512 S 3rd St. APT 104, Champaign, IL 61820; haddox1@illinois.edu*

The Science Outreach Catalyst Kits—or SOCKs—have been produced each summer by Society of Physics Students interns since 2001 at the American Center for Physics. These kits are an assembly of physics experiments and demonstrations to be sent to various SPS chapters to help jump-start an outreach program. This year was the 50th anniversary of the laser, so the theme of the SOCK was geared towards lasers and optics. It contains a laser demonstration, an optics/lens activity, and an activity to test rolling speeds of different objects. This presentation will serve to show what went into the 2010 SOCKS, as well as highlight the preparation and testing involved in their production.

*Sponsored by Gary White.

SPS11: 8–10 p.m. Experiments to Observe and Measure Thermophoresis of a Synthetic Polyelectrolyte*

Poster - Audrey S. Hammack, University of Texas at Tyler, Tyler, TX 75707; hammacas@gmail.com

Jennifer Pearce, University of Texas at Tyler,

Thermophoresis, the migration of a species as a consequence of a temperature gradient, has been a factor in the development of microfluidic laboratory instrumentation. In a system consisting of DNA in a buffered salt solution exposed to a temperature gradient in micro channels, it has previously been observed that DNA will migrate to the colder regions, yielding an irregular density profile. In previous work, we presented a computational simulation that explained the mechanism of thermophoresis, enhanced by the presence of salts. Although the simulation modeled an experiment containing DNA in a salt solution, the simulation is generic and can model thermophoresis of any polyelectrolyte. We present here an experimental design to observe and measure thermophoresis of a synthetic polymer dissolved in water, and ST values for different conformations of the polymer.

* Acknowledgment is made to the Donors of the American Chemical Society Petroleum Research Fund for support of this research.

SPS12: 8–10 p.m. Thermophoresis of a Polyelectrolyte: Experiments to Determine Temperature Dependence*

Poster - James Lee, University of Texas at Tyler, Tyler, TX 75707; khlee@austincollege.edu

Audrey Hammack, Jennifer Pearce, University of Texas at Tyler,

Thermophoresis is the phenomenon observed when particles move in response to a temperature gradient. In previous studies, research in measuring the thermophoresis of DNA has shown that DNA is repelled away from heat and will migrate toward colder regions. The profile of depletion is fitted by the thermophoretic theory to reveal the Soret coefficient. The approach opens new ways to monitor thermophoresis near boundaries and in complex mixtures. We have already examined the mechanism of DNA thermophoresis using computer simulation. We now present an experimental design to observe thermophoresis of a synthetic polymer dissolved in water which displays a solubility with inverse temperature dependence, and to measure the values of the Soret coefficient at different mean temperatures.

*Acknowledgment is made to the Donors of the American Chemical Society Petroleum Research Fund for support of this research.

SPS13: 8–10 p.m. Development of a Standard Fluids Assessment: Formulating Questions on Pressure

Poster - Adam J. Moyer, Grove City College, Grove City, PA 16127; moyer37@gmail.com

Jason Wetstone, Sam Cohen, DJ Wagner, Grove City College

We are developing an FCI-style assessment covering hydrostatic topics commonly included in introductory physics courses. Our goal is for the assessment to provide meaningful analysis of student learning for a wide range of populations, from conceptual-based courses through honors calculus-based courses. One hydrostatic topic students in these populations should understand is how the pressures at different points in a fluid compare. This poster presents our efforts to craft a series of questions that distinguishes correct physical understanding from common misconceptions expressed by students.

SPS14: 8–10 p.m. Thermophoresis of Polyelectrolytes: Lattice-Boltzmann Simulations*

Poster - Seth Norman, University of Texas at Tyler, Tyler, TX 75707; setnorm@gmail.com

Jennifer K. Pearce, University of Texas at Tyler

Thermophoresis is the movement of a species within a solution in response to a temperature gradient. Studies of this phenomenon have suggested that an enhanced understanding of thermophoresis would be particularly applicable to analytical separation methods on the microscopic scale. It has been observed that the majority of DNA molecules in a buffered salt solution will conglomerate in colder regions and this effect may be exploited to complete common reactions such as the polymerase chain reaction. In previous research, we have examined the mechanism of DNA thermophoresis using a computer simulation. Here we extend those studies by presenting the results of simulations designed to model various polyelectrolytes.

*Acknowledgment is made to the Donors of the American Chemical Society Petroleum Research Fund for support of this research.

SPS15: 8–10 p.m. Comparison of Peer-Led Team Learning (PLTL) Workshops for General Physics and General Chemistry

Poster - Grace R. Van Ness, Portland State University, Physics Dept., Portland, OR 97207-0751; vanness@pdx.edu

Ralf Widenhorn, Portland State University

Peer-led team learning (PLTL) workshops supplement lecture courses by facilitating a supportive environment for students to actively participate in the process of learning undergraduate level general chemistry and general physics at many colleges and universities. Under the PLTL model, successful students are recruited and trained as workshop leaders. These students guide a group of six to 10 students on selected problems to build conceptual understanding and problem-solving skills. In this presentation, we report on the PLTL workshop experience for both general chemistry and physics workshops at Portland State University. Student evaluation data from both workshops are compared. In addition, qualitative data from workshop leaders and students are presented. Finally, strategies for engaging students, facilitating a positive environment, and addressing special situations are discussed.

SPS16: 8–10 p.m. Physics Undergraduate Research and Extracurricular Engagement as a Modern Pedagogy

Poster - Kiril A Streletzky, Cleveland State University, Cleveland, OH 44147; k.streletzky@csuohio.edu

The role of undergraduate research (UR) in clarification of graduate school intentions and refinement of career plans for physics majors is crucial (AIP Report [R-211.32, June 2004]). However, evaluating the pedagogical benefits of learning through a research experience is somewhat challenging. We report on our efforts to integrate UR into the physics curriculum of an urban state university and evaluate its perceived pedagogical benefits. In particular, we found that UR significantly helps the personal/professional development of students, cultivates their social/networking/communicative skills, and provides clarification to their career/educational goals. The conclusions are substantiated by student and alumni interviews and compared to available literature. To deepen the interest in physics we encourage our majors to participate in teaching intro physics labs and engage them in vibrant SPS activities, which include outreach, student seminars, professional conferences, and physics competitions. The interplay between UR, teaching by undergraduates, and SPS activities provides a comprehensive physics education.

Monday, January 10

AAPT 5K Run/Walk	5:15–6 p.m.	offsite
First Timers' Gathering	7–8 a.m.	City Terrace 10
Spouses' Gathering	10–11 a.m.	City Terrace 10
Exhibit Hall	10 a.m.–6 p.m.	Exhibit Hall

Session AA: Laboratories Rutherford Would Approve

Location: Grand Ballroom 2
Sponsors: Apparatus Committee, History and Philosophy in Physics Committee
Date: Monday, January 10
Time: 8–10 a.m.

Presider: Steve Lindaas, Minnesota State University - Moorhead

In 1911 Ernest Rutherford first proposed the idea that atoms have their positive charge concentrated in a nucleus. It has been 100 years since Rutherford helped usher in modern physics with this idea about the atomic nucleus. Presentations focus on laboratory activities involving the nucleus (both introductory as well as advanced, low cost or sophisticated).

AA01: 8–8:30 a.m. Undergraduate Research and the MoNA Collaboration at the NSCL

Invited - Bryan Luther, Concordia College, Moorhead, MN; 56562 luther@cord.edu

MoNA, (the Modular Neutron Array), is a large-area high-efficiency neutron detector housed at the National Superconducting Cyclotron Laboratory, (NSCL). The detector was designed and built by the MoNA collaboration of 10 colleges and universities in conjunction with the NSCL. The bulk of the construction and testing was done by undergraduates at the collaboration institutions. Undergraduates are currently constructing a second detector system LISA. Undergraduates have not only been involved in the construction of the detectors but play a vital role in their operation and the analysis of the data taken with them using rare isotopes beams at the NSCL. The talk will describe the MoNA and LISA detectors and the role of undergraduates in their construction and use. Techniques and practices that have been successful in supporting and integrating undergraduate participation in nuclear physics research at a large user facility will be discussed.

AA02: 8:30–9 a.m. Molecular Beam Spectroscopy: A History of Precision Measurements

Invited - James Cederberg, St. Olaf College, Northfield, MN 55057; ceder@stolaf.edu

From their first investigation in 1911, contemporary with Rutherford's great discovery of the nuclear atom, thermal beams of neutral atoms and molecules have contributed to a long list of significant observations throughout the past century. Stern and Gerlach's confirmation of the spatial quantization of spin, Rabi's invention of the magnetic resonance technique and subsequent measurements of nuclear magnetic moments, and discovery of the deuterium quadrupole moment, Lamb's measurement of the anomalous electron moment, and Ramsey's development of cesium and hydrogen maser atomic clocks are examples that have led to practical applications including MRI and GPS as well as fundamental understanding. Over the last three decades undergraduate students at St. Olaf College have used a molecular beam electric resonance spectrometer to do publishable research on molecular hyperfine interactions.

AA03: 9–9:30 a.m. Nuclear Magnetism Studies on a Human Scale

Invited - Jonathan F. Reichert, TeachSpin, Inc.; jreichert@teachspin.com

Although NMR is a widely used and powerful analytical tool for all branches of science, it has become so sophisticated, automated, and expensive that it is often not accessible to the undergraduate student. This talk will describe the inverse qualities of TeachSpin's Earth's Field NMR apparatus which is affordable, user controlled, and intellectually transparent. Here is an apparatus that I believe Rutherford would have loved to play with because it examines nuclear magnetism on a human spatial and temporal scale. For example, the kHz range nuclear spin precessions can easily be heard on a speaker, the polarization times can be on the order of seconds, and a spin-echo can actually be heard as an echo. All this, and much more, can be discovered by students and faculty interested in the nucleus of the atom and its interactions with its surroundings.

AA04: 9:30–9:40 a.m. Experimental Nuclear Physics at an Undergraduate Institution

Shelly R. Lesher, University of Wisconsin - La Crosse, La Crosse, WI 54601; lesher.shel@uwlax.edu

Nuclear Physics Research Laboratories at undergraduate institutions are not unique but are still far from the norm. Nuclear scientists are usually emeritus, and equipment, if it still exists, is thought to be outdated. A new generation of students walk our halls, interested in nuclear energy, radiation therapy, and medical physics. Now is the time to build these nuclear laboratories for research. In this presentation, I will explain the UWL Nuclear Science Center, how it has been built up in the last few years, and how it has been incorporated into the classroom. I will discuss student research in our lab and opportunities available to them in the summer at The University of Notre Dame and Argonne National Laboratory.

AA05: 9:40–9:50 a.m. Rutherford Backscattering Experiment in the First-Year Seminar at Union College

Michael F. Vineyard, Union College, Schenectady, NY 12308; vineyarm@union.edu

Scott M. LaBrake

Each fall at Union College we have a first-year seminar course for incoming students interested in physics and astronomy. This is a team-taught course with five faculty each teaching a module associated with their research. The goal of the course is to introduce the first-year students to some of the exciting areas of research in physics and astronomy before they begin the introductory sequence. One of the modules that is often taught is an introduction to nuclear and particle physics in which students perform a Rutherford back-scattering experiment with the 1-MV tandem pelletron accelerator in the Union College Ion-Beam Analysis Laboratory. Alpha particles with energies around 3 MeV are scattered from unknown (to the students) targets and the students identify the elements in the target by applying the simple model of elastic scattering in the analysis of the energy spectra of the scattered ions. We will describe the experiment, present results, and discuss the success of this exercise in getting students excited about nuclear physics.

AA06: 9:50-10 a.m. The Advanced Nuclear Science Education Laboratory (ANSEL)*

Frank L. H. Wolfs, University of Rochester, Rochester, NY 14627; wolfs@

pas.rochester.edu

Wolf-Udo Schroeder, University of Rochester

A new advanced nuclear science laboratory course (ANSEL), open to undergraduate and graduate students as well as to professionals from various academic units, has been introduced at the University of Rochester. The main objectives of the semester-long ANSEL curriculum are to disseminate and illustrate knowledge about the relevance of modern nuclear science and technology for society and to provide in-depth, hands-on training in nuclear radiation applications and in the design and execution of complex nuclear procedures. ANSEL experiments demonstrate the ubiquitous nature of nuclear radiation in the environment, the characteristics of interactions of neutrons, charged particles, and gamma radiation with matter, and the utility of irradiation methods to image and transform materials in a nondestructive fashion. Establishment of ANSEL will reverse a decade-long decline of nuclear science education infrastructure, opening new nuclear science/engineering training and career options for Rochester students and professionals.

* This work was supported by grant NRC-38-07-508 from the Nuclear Regulatory Commission.

Session AB: Non-Academic Partnerships: Business/Community/Education Collaborations for Teachers

Location: City Terrace 4
Sponsor: Physics in Pre-High School Education Committee
Date: Monday, January 10
Time: 8–9:30 a.m.

Presider: Paul Dolan, Northeastern Illinois University

AB01: 8–8:30 a.m. Education and Business Partnership Development and Sustainability

Invited - Jeffrey V. Bennett, University of Arizona, Tucson, AZ 85721; jbennett@u.arizona.edu*

Scholarly and practitioner interest in education and business partnerships has increased over the past three decades amid public and private sector concerns for educating children in the U.S. to become globally competitive in the face of ever-increasing state budget reductions, trends in quality teacher recruitment, and retention in STEM fields, as well as the impact of free-market competition, accountability, and limited availability of vital educational resources. The nature of education and business partnerships will be examined as well as an original conceptual model proposed that has guided recent original studies on both local and regional collaboration between education and business leaders regarding school district improvement, regional development, and concerns for quality teacher recruitment and retention. The model also provides guidance on bridging participant perspectives, motivations, and emphasizes the influence of formal leadership roles, among other key processes, in assessing potential for partnership sustainability.
* Sponsored by Julia Olsen.

AB02: 8:30–9 a.m. Math and Science Teachers/Retention Industry Partnerships (MASTER-IP)

Invited - Julia K. Olsen, University of Arizona, Tucson, AZ 85721; jkolsen@u.arizona.edu

We are all aware of the need for highly prepared STEM Teachers, and the importance of teacher retention. MASTER-IP is an intensive internship program aimed at a select group of early career science and mathematics teachers. The internship program includes features that are essential for successful retention of new teachers: it is long-term, combines the best practices of teaching and learning with the expertise of the business and research community, creates a community of practice that supports teachers, and helps classroom teachers build their expertise in content and delivery of science, math, and technology skills within the 21st Century Skills Framework. Participating teachers investigate how people use science/math to do their work, and we seek to answer questions such as: What ideas from science/math disciplines are used and in what ways? How does business/industry science/math differ from school science/math? How might school science/math better reflect real life use of science/math? This talk will present theoretical foundations for this program as well as successes and lessons learned through our first two years.

AB03: 9–9:10 a.m. Industry Partners in the Development of an Energy Curriculum*

Michael Cherney, Creighton University, Omaha, NE 68154; mcherney@creighton.edu

Creighton University will begin to offer Bachelor of Science and Bachelor of Arts degrees in Energy Studies in the fall of 2011. A significant portion of the curriculum development process for the programs has involved input from regional businesses. The program will also rely on industry partners to supply adjunct faculty who will team teach with full-time Creighton faculty from a number of fields. The presentation will describe the efforts involving a wide variety of potential stakeholders in the creation of this multidisciplinary course of study.

*This work is supported by the U.S. Department of Energy.

AB04: 9:10–9:20 a.m. Teacher's Workshop, Lessons Learned

Tania Entwistle, Ward Melville HS, Setauket, NY 11733-3499; azart715@yahoo.com

Gillian Winters, Smithtown High School East
Thomas Tomaszewski, Shoreham Wading River HS
Helio Takai, Brookhaven National Laboratory

Merriam-Webster defines a workshop as: "a usually brief intensive educational program for a relatively small group of people that focuses especially on techniques and skills in a particular field." For the past 10 years we have been organizing one-week long physics teacher workshops with a primary focus on particle physics under the auspices of Quarknet. We have developed a unique format that balances hands-on activities, lectures, and discussions. Organized by scientists and teachers, our goal is to provide a lively collaborative environment where discussions are carried out. Hands-on activities are chosen to generate material that can be introduced in the classroom. Discussions are kept at the graduate level to achieve a good level for participants' professional development. This successful implementation of strategies has allowed a steady growth in number of participants over the past years.

AB05: 9:20–9:30 a.m. Enhanced Problem-based Freshman Physics through High School-Museum Partnerships

Sean J. Bentley, Adelphi University, Garden City, NY 11530; bentley@adelphi.edu

Elizabeth de Freitas, Lee Stemkoski, Adelphi University

A network of high school and museum partnerships has been created to explore techniques for teaching algebra-based physics to high school freshmen. The foundation of the curriculum is a problem-based, museum-based, hands-on physics course for students in their freshman year of high school. The physics and corresponding mathematics courses incorporate hands-on, "real-world" problems to give the material context and enhance the students' overall understanding of the material while exposing them to practical applications. The entire program is based on a community partnership approach, drawing on expertise from many institutions to strengthen the educational mission. We will present key results from the program, focusing on innovative ways in which the museum interaction was used to promote students' problem-solving skills.

Session AC: *Panel:* Revision of AAPT Guidelines for Two-Year Colleges

Location: Grand Ballroom 1
Sponsor: Physics in Two-Year Colleges Committee
Date: Monday, January 10
Time: 8–10 a.m.

Presider: Mary Beth Monroe, Southwest Texas Junior College

The panel will describe proposed revisions for the AAPT Guidelines for Two-Year College Physics Programs based on input from the TYC physics community.

Panelists:

Bill Hogan, Joliet Junior College, Joliet, IL 60431-8938

David Weaver, Chandler-Gilbert Community College, Mesa, AZ 85212-0908

Dennis Gilbert, Lane Comm College, Eugene, OR 97402

Dwain Desbien, Estrella Mountain Community College, Avondale, AZ 85392

Karim Diff, Santa Fe Community College, Gainesville, FL 32606

Thomas L. O'Kuma, Lee College, Baytown, TX 77520

Session AD: Using Robotics to Teach Physics

Location: City Terrace 5
Sponsors: Educational Technologies Committee, Physics in High Schools Committee
Date: Monday, January 10
Time: 9–10 a.m.

Presider: Cathy Ezrailson, University of South Dakota

The speakers in this session will examine different perspectives in the use of robotics in the teaching and learning of physics at the pre-college and college levels.

AD01: 9–9:30 a.m. Physics with Robotics – A Decade with Our Little Electro-Mechanical Friends

Invited - William Church, Littleton High School, Littleton, NH 03574; wchurch@littletonschools.org

Robotics tools for secondary classrooms have developed greatly in the past 10 years. Currently available robotics resources offer a physics student many opportunities to explore the concepts and skills of physics. Opportunities range from 15-minute prediction testing exercises to multi-week engineering projects and multi-grade outreach projects. Physics skills developed through robotics exercises range from graph interpretation to experimental design. Topics to explore with robotics include kinematics, dynamics, thermodynamics, electricity and magnetism, vibrations, and wave phenomena. This session will provide many specific examples from the authors past decade's work with robotics as a highly engaging student centered physics learning tool.

AD02: 9:30–10 a.m. Bringing Robotics into the Classroom

Invited - Jose J. D'Arruda, University of North Carolina Pembroke, Pembroke, NC 28372; Jose@uncp.edu

As a teaching tool, robotics creates an environment that encourages students to: (1) Learn by inquiry and hands-on experimentation (2) Research and solve a real-world problem based on a Challenge (3) Learn how to write a computer program that performs real-world tasks (4) Encouraging students to be designers and inventors (5) Build an autonomous robot using physics and engineering concepts and (6) Collect data and present their research and solutions. We will discuss several programs we are involved with using LEGO Mindstorm Robotic as a teaching and learning tool. One program involves more than 500 middle and high school students who are actively learning science and the other involves several summer workshops for STEM teachers we have presented over the last five years. We will demonstrate several of the robots in action. Support for these programs comes from NSF and the NASA North Carolina Space Grant Consortium.

Session AE: PER Around the World - I

Location: Grand Ballroom 3
Sponsors: International Physics Education Committee, Research in Physics Education Committee
Date: Monday, January 10
Time: 8–9:30 a.m.

Presider: Genero Zavala, Tecnologico De Monterrey

AE01: 8–8:30 a.m. Lexicon, Terminology and Physics Teaching

Invited - Jesús Madrigal-Melchor, Unidad Académica de Física, Universidad Autónoma de Zacatecas; jmadrigal.melchor@fisica.uaz.edu.mx

Juan López-Chávez, Juan Manuel Rivera-Juárez, David Armando Contreras-Solorio, Agustín Enciso-Muñoz

In this paper we propose a new model for the physics teaching based on the ordering and grouping of the mechanics and electricity and magnetism's terminology. The term's distribution ordering has its foundation in a distributive model based on the Availability Lexical Index. The groupings produce word's constellations that show the needed direction for getting better and more efficent learning from the students. Our research show two word's constellations: one of them with the term "linear momentum" as its core, and the other one with the term "electrical field" in this nuclear position.

AE02: 8:30–9 a.m. Assessment of Advanced Ability in Chinese College Admission Test*

Invited - Lei Bao, The Ohio State University, Columbus, OH 43210; bao.15@osu.edu

Jing Han, The Ohio State University
Tao Ren, Beijing Education Testing Center

Every year, more than 10 million Chinese high school graduates take the national college admission test, on which the top performers would gain privileges to continue higher education in selective universities. The test is highly competitive, which also directs teaching and learning in schools. Traditionally, the test has been putting emphasis on complex highly specialized problem-solving skills that would discriminate the advanced students. The drawbacks of such tests are that teachers are forced to train students with a huge amount of practice problems so that students can perform well on the admission test with precision and speed. In recent years, widespread research has been invested into reforming the curriculum and admission test in all STEM areas. In this talk, I will introduce the background of the education system in China and discuss the current trends in the reform of the admission test that target the assessment of advance general abilities.

*Supported in part by NIH Award RC1RR028402 and NSF Awards DUE-0633473 and DUE-1044724.

AE03: 9–9:10 a.m. Exhibition-based Education

Maryam Etminan, Negaresh Private School, Shiraz, Fars, Iran; maryametminan@gmail.com

Nowadays, despite all transformation in physics education, traditional methods are still being used at schools in Iran--in which the teacher's role is the base. In such courses; students' main goal is their mark and their only perception in physics is to solve typical physics problems. Now, after years of ongoing effort, we have constructed for the first time a new method that we named NEGARESH MEHVAR (exhibition based education). We hope that it will be a way for revision of educational methods in our country. In this process we have converted all high school physics books to 3D by mixing movies, animations, formulas, and meanings step by step in PPT files. Now we have archived a fantastic complete educational kit that includes more than 1500 slides. This method is currently being used in our private school (NEGARESH SCHOOL) and has had excellent results.

AE04: 9:10–9:20 a.m. Students' Understanding Related to Introductory Mechanics Courses through in-lab Videos Research

Sergio Flores, University of Juarez, Ciudad Juarez, 32310 Mexico; sergiflo1@hotmail.com

Jose V. Barron, Luis L. Alfaro, Sergio M. Terrazas, University of Juarez
Maria E. Alanis, Centro Universitario de la Cienega UG

Many introductory physics students have understanding problems when they try to learn physics concepts through the knowledge mathematical representations during lab sessions. The research group named Physics and Mathematics in Context from the University of Ciudad, Juarez, Mexico, has developed a research approach based on videos to detect, analyze and categorize students' understanding problems to recognize and learn the properties of concepts such as forces as vectors. These videos are projected during the lab sessions to allow a direct interaction between the object knowledge (physical concepts) and the knowledge subject (the students). These videos show the materials, instruments, procedures, and the corresponding description of the cognitive and physical abilities students demand to develop the labs successfully. This didactic design is based on the theories of mathematical representations and visualization. We will show and describe samples of these videos and the corresponding learning difficulties.

AE05: 9:20–9:30 a.m. An Evaluation of the Effectiveness of Short Physics Workshops for In-service Teachers

Jung Sook Lee, Harvard University, Cambridge, MA 02138; jslee@seas.harvard.edu

Jung Bog Kim, Myoung Soo Hwang, Korea National University of Education
Eric Mazur, Harvard University

There is compelling evidence that Peer Instruction improves students' ability to complete both conceptual and traditional computational physics problems. We used Peer Instruction during a four-week long (120 hours) retraining course for in-service teachers of grades 7-12 in Korea. The goal of this study is to investigate if Peer Instruction can be used to improve the participating teachers' conceptual understanding of introductory physics concepts. To this end we pre- and post-tested the teachers using the Force Concept Inventory and The Conceptual Survey of Electricity and Magnetism. Because the average FCI pre-test score was 92%, we did not administer an FCI post-test. The CSEM pre-test score was 66% and revealed that teachers had difficulties with the concepts of electric shielding, induced electromagnetic force, and Faraday's law. We addressed their specific misconceptions using ConcepTests on these subjects and then administered a CSEM post-test at the end of the course. The post-test score was 88%, yielding a gain of 22%. The results suggest that Peer Instruction improved the teachers' conceptual understanding even in a course of only four weeks. We will discuss the instructional implications of this study and propose Peer Instruction as a useful approach in improving students' conceptual understanding in the middle and high school classroom.

Session AF: Meeting the Diverse Needs of Students

Location: City Terrace 6
Sponsors: Minorities in Physics Committee, Physics in Two-Year Colleges Committee
Date: Monday, January 10
Time: 8–9:10 a.m.

Presider: Katya Denisova, Baltimore City Public Schools

AF01: 8–8:30 a.m. Maximizing Rigor and Engagement in Teaching Physics to Diverse Learners

Invited - Criselda Belarmino, Baltimore City Public Schools/Maritime Industries Academy High, Baltimore, MD 21206; cgbelarmino@bcps.k12.md.us

This presentation focuses around initial results of a small study, conducted in several public high schools of the city of Baltimore, MD. The study includes 15 physics teachers handling Physics First and regular physics classes from different inner-city schools. They teach inclusion classes with diverse learners in a regular classroom environment. The survey reveals strategies and best practices shared by teachers, maximizing students' engagement and academic rigor in teaching physics in an inclusion setting.

AF02: 8:30–9 a.m. The Challenge of Matching Physics Curricula to Specific Student Populations

Invited - Stephen Kanim, New Mexico State University, Las Cruces, NM 88003; skanim@nmsu.edu

Research into student understanding is conducted with specific student populations, and often curricular materials are developed and tested on those same populations. However, college-age students taking introductory physics may have markedly different levels of preparation from one course to another, and from one institution to another. Will the difficulties noted by researchers also be present with a different student population? Are curricular interventions that have been successful with a research population also appropriate for a specific target population? I will discuss attempts we have made to characterize the level of preparation of different student populations for introductory physics, and some differences we have noticed between students in different courses and at different institutions. I will also describe some gender differences in the response statistics to some of our diagnostic questions. Finally, I will give examples of curricular modifications that we are trying in order to give our students additional help.

AF03: 9–9:10 a.m. Conference Learning: A Literacy Strategy to Teach the History of the Atom*

John E. Clark, Deltona High School, Deltona, FL 32725; jeclark@volusia.k12.fl.us

Conference Learning is a literacy-based strategy to raise student understanding of scientific vocabulary and textbook comprehension. It is a student-driven, inquiry-learning based approach to teaching textbook content. It has proved very effective in teaching the history of the atom to students. It also contributes to the academic comprehension of literacy-challenged students. A standard lecture has been replaced with an interactive activity where students teach each other the history of the atom's evolution. The focus is on the contributions of Democritus, Dalton, Thomson, Rutherford, Bohr, Chadwick, Schrodinger, and Heisenberg. Student groups review articles on each scientist, select the important information, display their findings on a poster and then share it with the other students. The teacher's role is to serve as facilitator, keeping the students on task and guiding the groups toward "boarding" and sharing the critical information that the class needs to learn.

* There is a poster I created for a program at Jefferson Labs, "The Evolution of the Standard Model", that accompanies this presentation.

Session AG: Astronomy at the University of Florida

Location: City Terrace 7
Sponsor: Space Science and Astronomy Committee
Date: Monday, January 10
Time: 8–10 a.m.

Presider: Joe Heafner, Catawba Valley Comm. College, Hickory, NC

This session will survey several of the exciting research programs under way at the University of Florida.

AG01: 8–8:30 a.m. Exploring the Distant Universe at the University of Florida

Invited - Anthony H. Gonzalez, Dept. of Astronomy, University of Florida, Gainesville, FL 32611-2055; anthony@astro.ufl.edu*

How do galaxies form and change with time? What are the main forms of matter and energy in the universe? How will the future history of the universe unfold? These are among the central questions that astronomers aim to address through observations of the distant universe. In my talk I will explore how some of these questions are being addressed through research at the University of Florida using facilities such as the Hubble Space Telescope and the world's largest ground-based telescopes. I will also describe the opportunities available at UF for undergraduates to become involved in cutting edge research, astronomical instrumentation, and public outreach.

* Sponsored by Kevin Lee.

AG02: 8:30–9 a.m. Using the World's Largest Telescopes to Explore the Birth of Planets

Invited - Charles M. Telesco, Dept. of Astronomy, University of Florida, Gainesville, FL 32611-2055; telesco@astro.ufl.edu

More than 400 planets have been discovered orbiting other stars, and the exciting field of "exoplanet" research is developing rapidly. However, the earliest phases of planetary evolution—the first million to tens of millions of years of a planet's life—-remain elusive. Planets coalesce from dust and gas orbiting a newly formed star, and the complexity of this chaotic, crowded environment poses significant observational challenges to viewing this fascinating phase. Astronomers at the University of Florida (UF) have developed special cameras that they have used at the world's largest telescopes to explore this phase. Of particular interest is the newly completed Gran Telescopio Canarias (GTC) on the island of La Palma, Canary Islands, Spain, just off the coast of northwest Africa. UF is a partner with Spain and Mexico in this project, and we will describe how we are using this and other telescopes to explore how planets are born.

AG03: 9–9:30 a.m. The Formation of Massive Cluster Galaxies

Invited - Conor Mancone, Dept. of Astronomy, University of Florida, Gainesville, FL 32611-2055; cmancone@ufl.edu

It is believed that all the structures we see in the universe were seeded by inflation early in the history of the universe. The largest of these structures, clusters of galaxies, grew in the highest density regions left behind by inflation, and the most massive galaxies in the universe are commonly found in these clusters. These massive cluster galaxies were the first galaxies to form because their dense environments accelerated their evolution. This makes the formation of massive cluster galaxies both an interesting and challenging topic of study—interesting because they formed early in the history of the universe, and challenging because they formed so long ago that detecting them in large numbers pushes the limits of telescope technology. We study massive galaxies in 335 clusters in order to answer some basic questions about their formation: when did they form their stars, and when did they finish assembling into the galaxies we see today?

AG04: 9:30–10 a.m. Searching Exoplanets in Habitable Zone Around Low Mass Stars

Invited - Ji Wang, Dept. of Astronomy, University of Florida, Gainesville, FL 32611-2055; jwang@astro.ufl.edu*

There are more than 400 exoplanets discovered as of 2010 and the family is still expanding. We are approaching a stage on which the technology is marginally matured for us to search exoplanets in a habitable zone around low mass stars using radial velocity technique. Low mass stars, especially M type stars, make up more than 70% of the stellar population of local universe and yet they are rarely observed using radial velocity technique. The habitable zone around low mass stars shrinks due to low luminosity of host star which enhances radial velocity signal for given planet mass. The discovery of exoplanet in a habitable zone will be a milestone in human history, from which we will start a new quest for extraterrestrial life and understand the fundamental question: are we alone in the universe?

*Sponsored by Kevin M. Lee.

Session AH: Preparing Pre-High School Teachers

Location: City Terrace 9
Sponsors: Physics in Pre-High School Education Committee, Teacher Preparation Committee
Date: Monday, January 10
Time: 8–9:50 a.m.

Presider: Kathleen Falconer, Buffalo State College

The physics and physical science preparation of pre-high school teachers is a sometimes forgotten part of AAPT. However, AAPT has been involved with pre-high school teacher preparation for many years and the community has many ideas to share. This session looks at several exemplary programs, curriculum, and models for preparing elementary and middle school teachers to teach physical science and physics to their students.

AH01: 8–8:30 a.m. Preparing Future Generations: A Bit With Some Promise

Invited - Dewey I. Dykstra Jr., Boise State University, Boise, ID 83725-1570; ddykstra@boisestate.edu

Unless we change their relationship with knowledge, how can we expect them to change how they will teach? Most elementary education teacher candidates, as well as most non-science majors, are used to being presented with established canon (truth in their understanding) by various methods and then being asked to repeat it back. After all, these are not science majors, how could we expect them to really understand? They have been drilled at this process for more than 12 years of schooling. How might we engage the students in the knowledge such that their relationship to the knowledge could change? What if we engaged them in constructing their own understanding of the phenomena, with their present conceptions as the starting point? Could they do this? If so, how well? Lessons learned and challenges still standing will be noted.

AH02: 8:30–9 a.m. Physics and Everyday Thinking and Physical Science and Everyday Thinking

Invited - Steve Robinson, Tennessee Technological University, Cookeville, TN 38505; sjrobinson@tntech.edu

Physics and Everyday Thinking (PET) and Physical Science and Everyday Thinking (PSET) are coherent, guided-inquiry, curricula for one-semester college courses designed[1] for prospective and practicing elementary teachers and non-science majors.[2] PET focuses on the themes of interactions, conservation of energy and Newton's laws. PSET adds focuses on conservation of mass and atomic molecular theory. Both curricula include a substantive Learning about Learning component, focusing on the learning of scientists (NOS), young children and the college students themselves. Both curricula were designed around principles based on research on learning: learning builds on prior knowledge; knowledge construction is a gradual process; interaction with tools facilitates learning; social interactions aid in learning; and classroom norms can structure student interactions, discourse, and learning. Pre-/post- conceptual tests and the Colorado Learning Attitudes about Science Survey[3] show growth in students' understanding of content and the nature of science and learning.

1. Supported by NSF Grant #0096856

2. Physics and Everyday Thinking and Physical Science and Everyday Thinking are both published by It's About Time, Herff Jones Education Division.

3. W. Adams, K. Perkins, N. Podolefsky, M. Dubson, N. Finkelstein and C. Wieman, *Phys. Rev ST: Phys. Educ. Res.* 2(1) 010101, 2006.

AH03: 9–9:10 a.m. Hate Is a Strong Word, But I Really Don't Like Physics

Nina Abramzon, California State Polytechnic University, Pomona, CA 91786; nabramzon@csupomona.edu

Barbara M. Hoeling, Homeyra Sadaghiani, Stefanie A. Saccoman, California State Polytechnic University, Pomona
Art Hammon, Paula S. Partida, Jet Propulsion Laboratory

The dislike that many elementary school teachers have for teaching physics is a well-known problem. Our study aims at investigating a potential cause for this dislike, and at evaluating an approach for changing it. Our hypothesis is that by restructuring SCI210, our physics course for future elementary school teachers at Cal Poly Pomona, its relevance to the students' careers will be clearer, and their attitude toward science will improve. We introduced the relevance through collaboration with faculty from the college of education and support of the NASA/JPL Office of Education, and by providing the students with physics teaching experience with children. To gage the effectiveness of this approach, we implemented an attitudinal survey, which we gave to the students both at the beginning of the course and again at a later date. Data from this study will be presented.

AH04: 9:10–9:20 a.m. Ramps & Pathways: An inquiry-based Approach to Physical Science

Lawrence T. Escalada, University of Northern Iowa, Cedar Falls, IA 50614-0150; Lawrence.Escalada@uni.edu

Betty L. Zan, University of Northern Iowa

Ramps and Pathways is an NSF-funded curriculum for young children (PreK-2nd Grade) with the focus on children investigating the movement of objects on inclines. The curriculum utilizes principles of teaching that enable teachers to set up the learning environment, intervene in ways that promote the construction of mental relationships, and support children's active experimentation. These physical science activities promote children's development of their practical understanding of force and motion as well support their ability to engage in science inquiry. Examples of what young children can do and evidence of their learning will be provided. How teachers can support young children experimentation and learning will also be discussed.

AH05: 9:20–9:30 a.m. Identifying Instructional Goals in a Physics Course for Education Majors

Jon D. H. Gaffney, University of Kentucky, Lexington, KY 40506-0055; jon.gaffney@uky.edu

At the University of Kentucky, pre-service elementary and middle school teachers are required to take only a few science courses, most of which follow the typical lecture-lab format. The exception to this traditional format is Physics 160, which is an inquiry-based course loosely based on the popular "Physics by Inquiry" text by McDermott and the University of Washington PEG. While the course instructors, education faculty, and students themselves have reported general satisfaction with Physics 160, each group maintains particular goals for what this course should accomplish, and these goals are not necessarily the same. In this project, I present some results from surveys, interviews, and a semester-long observation of two sections of Physics 160 to identify these goals. I will discuss specific overlap between goals, as well as differences in priority between the groups, with the intent of opening dialogue about the challenging task of balancing these goals.

AH06: 9:30–9:40 a.m. Integrating Physics and Mathematics for Middle School Grades

Zenobia Lojewska, Springfield College, Springfield, MA 01109; lojewskz@spfldcol.edu

Fides Ushe, Springfield College

The presentation will focus on the course Integrating Physics and Mathematics for Middle School Grades that we conducted at Springfield College during summer and fall semester of 2009 for in-service teachers from the Pioneer Valley Region in Massachusetts. The course was offered as a result of a grant from the Massachusetts Mathematics and Science Partnership Program (MMSP) through the Pioneer Valley STEM Network (PVSTEM-NET). Concepts of force, motion, work, and power, and forms of energy and energy transformation were explored in a physics laboratory setting, and the data were modeled using mathematical functions that included linear, quadratic, and exponential. The experimental component of the course utilized CPO equipment and the modeling was facilitated with the use of graphing calculators and software such as EXCEL, and Data Studio (PASCO). We will share some projects that the teachers carried out in their classrooms after participating in the course.

AH07: 9:40–9:50 a.m. Do Elementary School Teachers Need Physics? Lessons from the Field

Marina Milner-Bolotin, University of British Columbia, Vancouver, BC, V6T 2K9 Canada; marina.milner-bolotin@ubc.ca

British Columbia Ministry of Education mandates physical science to be taught from K-7. For example, Grade 1 prescribed learning outcomes require students to understand the relationships between forces and motion and seasonal changes. In Grade 3, students are introduced to the process of science via learning to ask meaningful "If-then" questions. These learning outcomes imply that elementary school teachers have basic physics knowledge. However, most elementary teachers have only taken Physics 11 and have never completed an introductory university physics course. Moreover, being fully aware of the limitations of their physics background, elementary teachers are often reluctant to teach physical science beyond the factual memorization. To address this issue, the University of BC Teacher Education Program created a Problem-Based-Learning Elementary Teacher Education cohort and asked the author (a Physics Education Researcher) to teach a science methods component in the program. The results of this "experiment" will be described in this presentation.

Session AI: Statistical Analyses of Complicated Data

Location: City Terrace 12
Sponsor: Research in Physics Education Committee
Date: Monday, January 10
Time: 8–10 a.m.

Presider: Scott Franklin, RIT, Rochester, NY

This session will include invited speakers on unusual (to the PER community) methods of analyzing qualitative, large-N quantitative data, or other necessarily complicated data sets. These include Bayesian inference, factor analysis/response curves, and chi-squared analyses techniques.

AI01: 8–8:30 a.m. Using Extant Data to Predict Future Data

Invited - Eleanor C. Sayre, Crawfordsville, IN 47933; le@zaposa.com

Bayesian statistics have profound implications for studies of student learning, retention, and placement. Using a between-students design to probe the knowledge of a large class of students weekly, we can observe rapid learning and forgetting, as well as destructive interference between related topics. By gathering students' demographics information, we can measure which students learn more (and when), have more success in classes, and persist better through the introductory physics sequence. We follow students in three introductory calculus-based sequences: traditional, research-based, and research-inspired honors. In this talk, I discuss how Bayesian statistics in conjunction with the response curve methodology can be used for research questions beyond the construction of learning and forgetting curves.

AI02: 8:30–9 a.m. The Confusions of Orthodox Statistics: A Bayesian Answer

Invited - Sanjoy Mahajan, Olin College of Engineering, Needham, MA 02492 sanjoy@olin.edu

Most users of p values—namely, readers of our papers—read "$p<0.05$" to mean that the null hypothesis is 95% certain to be false. This significant misinterpretation, which is shared by many producers of p values, is natural: Users want to know the probability of a hypothesis. But orthodox statistics, based on the frequentist interpretation of probability, insists that probabilities are objective, that a hypothesis is merely true or false, and therefore that one cannot assign it a probability. Orthodox statistics thereby forces one to ignore actual information while considering nonexistent information, sowing conceptual confusion throughout. To illustrate these confusions, I will employ simply chosen examples, contrasting the orthodox approach with the coherent framework pioneered by physicists such as Jaynes, Jeffreys, and Laplace: subjective probability and Bayesian inference.

AI03: 9–9:30 a.m. Sequential Logistic Regression: Predicting Success Through Self-Efficacy and Gender

Invited - Vashti Sawtelle, Florida International University, Miami, FL 33199; vashti.sawtelle@gmail.com

Eric Brewe, Laird H. Kramer, Florida International University

Sequential logistic regression is a powerful method for predicting membership in a group. It incorporates previous knowledge (theory or prior work) into the prediction model through the ordered addition of both categorical (gender or course type) and continuous (self-efficacy or FCI score) variables. We will provide an overview of each step of the sequential logistic regression process, as well as discuss types of questions this method is especially adept at answering. We have successfully used sequential logistic regression in a study of how well self-efficacy predicts success in the introductory physics classroom for both men and women. We will present the findings of this study as an example of the implementation and interpretation of sequential logistic regression for discussion.

AI04: 9:30–10 a.m. Factor Analysis 1-2-3 and the Benefits of the Reduced-Basis Factor Analysis

Invited - Wendy K. Adams, University of Northern Colorado, Greeley, CO 80639; wendy.adams@colorado.edu

Have large quantities of student data? Then factor analysis may be the statistical tool for you! Factor analysis is useful for learning about how different groups of questions/statements fit together according to students' responses. It is a statistical data reduction technique that uses large sets of students' responses and group statements according to the correlations between statement responses. Research has shown that categories of statements chosen by educators and researchers do not always reflect how students think. This technique allows the data to determine the categories. We will discuss basic factor analysis as well as reduced-basis factor analysis which is a method for investigating one category at a time as well as confirmation of individual categories if desired.

Opening Remarks

Location: Grand Ballroom 4
Date: Monday, January 10
Time: 10:30–11:45 a.m.

Presider: David Cook

Beth Cunningham
AAPT, College Park

Lois Becker
Jacksonville University

10:30–10:45 a.m. *Meet Beth Cunningham, New AAPT Executive Director*

10:45–10:50 a.m. *Welcome to Jacksonville, Lois Becker*

Fred Dylla

Steven T. Corneliussen

Plenary: 100 Years of Nuclear Physics

➤ Ernest Rutherford and the Accelerator: "A Million Volts in a Soapbox"

Fred Dylla, American Institute of Physics, College Park, MD

Steven T. Corneliussen, Thomas Jefferson National Accelerator Facility, Newport News, VA

A century ago, Ernest Rutherford's discovery of the atom's nucleus revolutionized study of the submicroscopic realm. That research continues today as a fundamental effort to understand matter itself. It is still conducted by making inferences from the scattering of particles in collision with each other. But because Rutherford could only draw on naturally occurring radioactive sources, he described in his 1927 "Anniversary Address as President of the Royal Society" a long-standing "ambition to have available for study a copious supply of atoms and electrons which have an individual energy far transcending that of the alpha and beta particles" available from those natural sources. He wanted to "open up an extraordinarily interesting field of investigation." This wish spurred invention of the particle accelerator. A century later, nuclear and particle physics research has led not only to new fundamental understanding of matter, and not only to new understanding of astrophysical phenomena, but to an extraordinary range of particle-accelerator technologies and applications. Rutherford's wish during the 1920s for a "million volts in a soapbox" has been fulfilled, and so have many other accelerator desiderata. Against the backdrop of a century's progress in nuclear and particle physics, this talk will present the extraordinary – and exponentially expanding – range of applications for the planet's more than 30,000 accelerators, not only in discovery science, but in medicine, industry, energy, the environment, and national security.

Crackerbarrel 1: APS Minority Bridge Program

Location: Grand Ballroom 1
Sponsor: Minorities in Physics Committee
Date: Monday, January 10
Time: 12–1 p.m.

Presider: Theodore Hodapp, American Physical Society

Physics ranks at the bottom in helping minorities attain PhDs; only 5-6% of all doctorates given to US citizens go to Hispanic-, African-, or Native-Americans. The good news is that to bring this number up to 10% (the rate at which we educate minorities at the bachelor level) will require only 30 more individuals each year. The American Physical Society is launching a national program to replicate effective bridge programs with minority serving institutions and leading research universities. Come here a brief description of the project and ask questions about how to get involved.

Crackerbarrel 2: Two-Year College Issues

Location: City Terrace 7
Sponsor: Physics in Two-Year Colleges Committee
Date: Monday, January 10
Time: 12–1 p.m.

Presider: Robert Hobbs, Seattle, WA

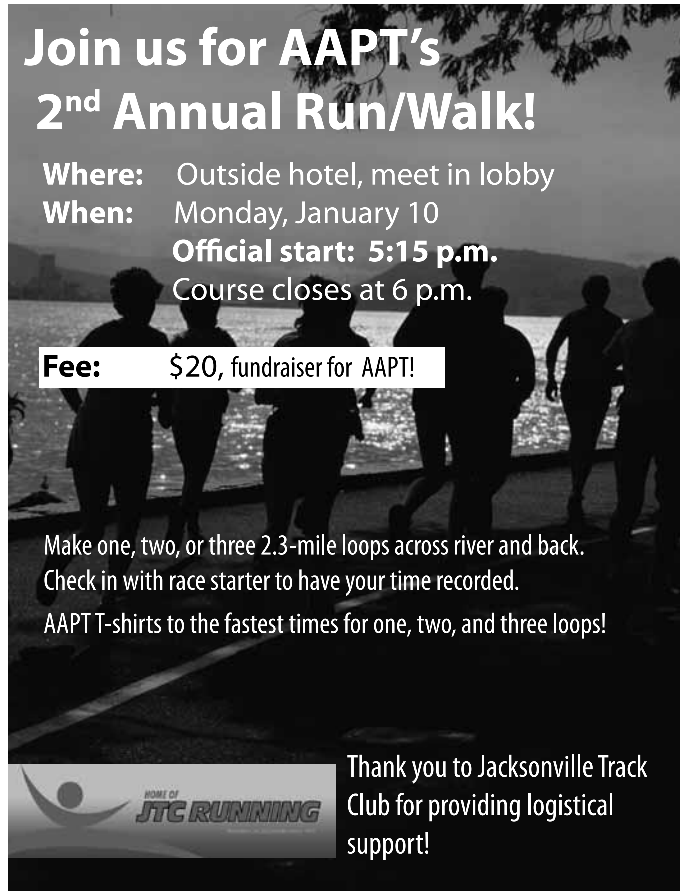
This crackerbarrel will give physics teachers at two-year colleges the chance to discuss issues important to them and share ideas.

Crackerbarrel 4: Difficulties International Visitors face in Attending AAPT Meetings

Location: City Terrace 9
Sponsors: Professional Concerns Committee, International Physics Education Committee
Date: Monday, January 10
Time: 12–1 p.m.

Presider: Dan MacIsaac, Buffalo State College

Discussion of difficulties, resources and some solutions for international visitors attending AAPT Meetings. In particular, support opportunities and mechanisms made possible by the Committee on International Physics Education will be described.



Come to the Spouses' Gathering

Meet new people, see old friends, and learn about Jacksonville!

Monday, January 10
10–11 a.m.
City Terrace 10

Session BA: *Panel:* ComPADRE

Location: Grand Ballroom 1
Sponsor: Educational Technologies Committee
Date: Monday, January 10
Time: 1:15–3:15 p.m.

Presider: Bruce Mason, University of Oklahoma

The speakers in this session will present the latest developments of the ComPADRE resource collections. ComPADRE editors and contributors will describe recent work in content development and new tools for ComPADRE users.

BA01: Overview of The Nucleus – The Student Collection of ComPADRE

Panel - David Donnelly, Texas State University-San Marcos, San Marcos, TX 78666; donnelly@txstate.edu

The Nucleus, the student collection on ComPADRE, has been in existence since the inception of the ComPADRE project. We will discuss the history and evolution of the collection, including the emphasis on community building, pointing out some successful projects. In particular we will discuss the research opportunity database. We will then present the current state of the collection, and discuss plans for future programs and features, including new databases that will be implemented in the near future, and efforts to integrate the collection with social media such as Twitter and Facebook.

BA02: The Evolution of the Open Source Physics ComPADRE Collection*

Panel - Mario Belloni, Davidson College, Davidson, NC 28036; mabelloni@davidson.edu

Wolfgang Christian, Davidson College
Anne J. Cox, Eckerd College
Todd Timberlake, Berry College

Over the past six years, the Open Source Physics (OSP) project has produced a collection of more than 400 interactive computer-based curricular materials for the teaching of advanced physics topics. These materials are based on Java-based OSP programs and authoring tools and available for free on the OSP Collection on ComPADRE. This talk outlines the current efforts to extend the reach of the OSP Collection with the inclusion of course-related filing cabinets and the creation of simulations for the teaching of introductory topics in physics and astronomy. The Open Source Physics collection is available on the ComPADRE website at http://www.compadre.org/osp/.

* Partial funding for this work was obtained through NSF grant DUE-0442581.

BA03: The Physic Source, the Digital Library for Teachers of Introductory Physics

Panel - Taha Mzoughi, Kennesaw State University, Kennesaw, GA 30144-5591;tmzoughi@kennesaw.edu

Teaching introductory physics can be enhanced and made easier if faculty can easily find and share teaching resources. The Physics Source (http://www.physicssource.org/), a component of ComPADRE, is designed for that specific purpose. It is a web resource that faculty can use to find, share, and collaborate on building high-quality, effective teaching and learning materials. Content is not included in the library until verified by editors. Since the library is focused on just introductory physics content, Source searches result in faster matches and added opportunity to discover relevant related content. Additionally, the Source enables the users to organize the content they like, and to submit their own resources.

BA04: Mining The Physics Front for Teaching Resources

Panel - Cathy Ezrailson, University of South Dakota, Vermillion, SD 57069; Cathy.Ezrailson@usd.edu

As part of our comPADRE Panel, this paper will highlight what The Physics Front has to offer you and your students. TPF is a collection of web-based and archived resources to support teachers of physics and physical science. This collection houses editor-reviewed best teaching practices, labs, lesson plans, assessments, activities, and much much more. There are many examples of physics and physical science units with elements such as student tutorials, teacher content support, simulations, and reference information. These materials span the breadth of uses from late elementary to high school AP. There is the ability for teachers to organize the resources, share them with colleagues and students, as well as add resources of their own via links. If you haven't seen The Physics Front, lately, consider exploring all of its possibilities for you and your students.

*Resources: http://compadre.org http://thephysicsfront.org

Session BB: Service Learning as Outreach

Location: City Terrace 7
Sponsor: Science Education for the Public Committee
Date: Monday, January 10
Time: 1:15–2:15 p.m.

Presider: Paul Williams, Austin Community College

Service Learning offers a challenging avenue for student learning through service-based projects. One possible use of service learning, applicable to the physics classroom, is to focus the service projects on outreach. In this session, presenters will share their experiences and ideas of incorporating service learning outreach projects into their instruction.

BB01: 1:15–1:45 p.m. Fifteen Years of Service Learning

Invited - Matt Evans, U of WI - Eau Claire, Eau Claire, WI 54701; evansmm@uwec.edu

The University of Wisconsin Eau Claire has had a service learning requirement for all graduates for the past 15 years. These individual projects span 30 hours and generate over 100,000 community service hours each year. This high-impact practice can provide both educational experiences and community spirit. An introduction as to what service learning can entail, how it may be defined, examples from our university and the overlying idea of service learning will be presented.

BB02: 1:45–2:15 p.m. Simple Service Learning Outreach Programs In Physics and Astronomy Classes

Invited - Alice M. Hawthorne Allen, Concord University, Princeton, WV 24740; amhallen@concord.edu

Simple outreach opportunities enhance the quality of undergraduate learning by providing a chance for students to gain confidence communicating their content knowledge of and enthusiasm about science with others in our local communities. Part of Concord University's mission is to serve the regional community and short, single-day, outreach programs have been incorporated into our Introductory Astronomy class in a variety of forms for several years as a living experience of this mission. This informal program was expanded into our second semester physics class during the fall of 2010. The short-term impact of this expansion and the cumulative success of these outreach opportunities will be presented.

Session BC: Science and Society

Location: City Terrace 7
Sponsor: Science Education for the Public Committee
Date: Monday, January 10
Time: 2:15–2:55 p.m.

Presider: John Griffith, Mesa Community College

BC01: 2:15–2:25 p.m. Identifying Non-science to Raise Scientific Awareness

Sadri Hassani, Illinois State University, Normal, IL 61790; hassani@phy.ilstu.edu

I'll discuss the content of a couple of courses that I have developed for general students. While presenting physical ideas with an emphasis on modern physics, I use these ideas to show the baselessness of the arguments of such diverse groups as New Agers, mind/body healers, certain philosophers of science, and academicians who hold science responsible for the evil in the world.

BC02: 2:25–2:35 p.m. Citizen Science: Using Physics to Model Traffic Intersections

Matthew P. Perkins, Oak Ridge High School, Oak Ridge, TN 37830; mperkins@ortn.edu

Red light and speed cameras were installed at four major traffic intersections in our city, generating significant debate around their purpose and effectiveness. This paper reports the efforts of high school physics students to collect data and construct mathematical models of each of these intersections. From a citizen science approach, the students reviewed local and national news articles, contacted local and state transportation authorities, and searched for scholarly research on other traffic cameras in order to become informed citizens capable of contributing to the public debate. Pre- and post-tests of students' understanding of traffic safety provide a basis for understanding what students learned through participation in the project.

BC03: 2:35–2:45 p.m. Physics Aspects of Correct Posture

Saami J. Shaibani, Instruction Methods, Academics & Advanced Scholarship (IMAAS), Lynchburg, VA 24506; shaibani@imaas.org

The advent of increasing numbers of airbags in passenger vehicles has engendered debate regarding the most appropriate positioning for various parts of the body, especially hands on the steering wheel. Among the arguments for placement of the latter is the contention that one with a lower of the center of mass produces an extra contribution to safety. Although such a claimed benefit is not supported elsewhere, this study shows how advanced techniques in anthropometry can be built with physics to quantify any change in c.m. so that the assertion can be examined scientifically. Results are calculated for multiple vehicle occupants to cover a full range of height, weight and sex. The values obtained allow proper consideration of driver posture and they provide an impartial perspective from which to combat any error or fallacy. Opportunities for student learning are enhanced by their familiarity with such a common everyday activity.

BC04: 2:45–2:55 p.m. Designing Physics Courses for Non-traditional College Students: Theology*

Thomas Nordlund, University of Alabama at Birmingham, AL 35294-1170; nordlund@uab.edu

Philip Markham, Beeson Divinity School, Samford University

Physics and theology have structural similarity, in spite of frequent scornful encounters between the two fields. Physics is organized by overarching principles, such as conservation of energy, while theology invokes the nature of God to describe the observed (and unobserved) world. Up until the middle of the 19th century, scientists who studied matter and light also frequently taught moral behavior and faith in churches and mosques. In contrast, a survey we have undertaken of over 200 M. Div.-granting institutions accredited by the Association of Theological Schools shows almost no prerequisites or opportunities in the physical sciences for students training to become pastors--the primary religious instructors in North America. In addition, further education in the sciences is low on the priority list of deans of those institutions. We present a proposal for design of an expandable course in physics that partially addresses these issues of opportunity and priority.

*Supported in part by a grant from the Teagle Foundation.

Session BD: Objectives and Assessment of the Physics Graduate Program

Location: City Terrace 9
Sponsors: Graduate Education in Physics Committee, Research in Physics Education Committee
Date: Monday, January 10
Time: 1:15–3:15 p.m.

Presider: Juan Burciaga, Denison University, Granville, OH

Physics graduate programs represent a host of complex, varied experiences and expectations that go far beyond the classroom. But what are the objectives of a graduate education in physics? What experiences (both curricular and non-curricular) best meet these objectives? How can we assess whether or not our program is preparing our students to meet the challenges expected of a physicist? How do we determine if we can do a better job?

BD01: 1:15–1:45 p.m. A New Curriculum for Physics Graduate Students

Invited - Harald W. Griesshammer, George Washington University, Washington, DC 20052; hgrie@gwu.edu

Effective fall 2008, GW Physics implemented a new graduate curriculum, addressing nationwide problems: (1) wide gap between 50-year-old curricula and the proficiencies expected to start research; (2) high attrition rates and long times to degree; (3) limited resources in small departments to cover all topics deemed essential. The new curriculum: (1) extends each course to four hours weekly for better in-depth coverage and cautious additions; (2) decreases the number of core-courses per semester to two, with less "parallel-processing" of only loosely correlated lectures; (3) increases synergies by stricter logical ordering and synchronisation of courses; (4) frees faculty to regularly offer advanced courses; (5) integrates examples tied to ongoing research in our department; (6) integrates computational methods into core-lectures; (7) encourages focusing on concepts and "meta-cognitive skills" in studio-like settings. The new curriculum and qualifying exam, its rationale and assessment criteria will be discussed. This concept is tailored to the needs of small departments with only a few research fields and a close student-teacher relationship.

BD02: 1:45–2:15 p.m. How Does the Physics Graduate Program Meet Its Goals?

Invited - Kenneth Heller, University of Minnesota, Minneapolis, MN 55455; heller@physics.umn.edu

With a few notable exceptions, there is a standard structure of graduate programs in physics designed to produce students with a PhD in this country. This talk will compare the structure of that program with potential career paths of the students in them. It will raise the question of whether this standard program matches the needs of the students in their likely careers.

BD03: 2:15–2:45 p.m. Graduate Physics Programs in an Interdisciplinary Environment

Invited - Richard Haglund, Vanderbilt University, Nashville, TN 37235-1807; richard.haglund@vanderbilt.edu*

Graduate programs in physics in many universities increasingly are connected thematically to interdisciplinary research programs in nanoscience, materials science, and even chemistry and engineering disciplines. In this environment, the concept of the "physics graduate program" may well extend beyond departmental boundaries, posing particular challenges for graduate-level instruction in the fundamentals of our own discipline. The intrinsic challenges are exacerbated in an era of constricted faculty hiring, increasing undergraduate teaching and undergraduate research loads and the pressure to do more with less. In this presentation, I will highlight some possible ways to meet this challenge that are in varying stages of implementation at Vanderbilt. These include modular and cross-cutting courses, shared courses between departments, and creative uses of the academic calendar to provide instruction beyond the core graduate physics courses to a more diverse audience of students who need to know physics, but who do not plan a traditional physics career.

*Sponsored (invited) by Juan Burciaga.

BD04: 2:45–3:15 p.m. Physics Graduate Students, On the Way to Becoming Physicists

Invited - Yuhfen Lin, Florida International University, Miami, FL 33186; fireflylin@gmail.com

Physics graduate programs prepare graduate students to be future physicists. That means by the time they finish their degree, they should be able to communicate physics ideas, be effective in adopting new tools, and be ready to conduct independent research. In graduate school, they are provided with opportunities to learn in a classroom setting, to teach as teaching assistants, and to do research in the research laboratory. The three roles graduate students play seem to be independent from each other, and only minimal scaffolding is provided to help them become proficient in each of those roles. In this talk, I am going to examine the physics graduate program as a whole, in terms of how physics graduate students develop epistemologically in being students, teachers, and researchers. I will also argue for students to develop into independent researchers, it is vital for all elements of the physics graduate program to be coherent.

Session BE: Forging Successful School-College Collaborations

Location: City Terrace 4
Sponsors: Physics in Pre-High School Education Committee, Professional Concerns Committee
Date: Monday, January 10
Time: 1:15–3:15 p.m.

Presider: Jim Dunn, Mississippi State University

Why would educators enter into a collaboration between school and college? Who benefits? What are the longer term results. There are an increasing number of collaborative efforts to enhance science learning in all parts of the country. The key to successful collaboration is local efforts and this session will present a number of programs that are assisting in bridging the gap between K-12 science and college physics.

BE01: 1:15–1:45 p.m. Bridging the Gap: Keys to Successful K-12–College Collaborations*

Invited - Sandra H. Harpole, Mississippi State University, West Point, MS 39773; sharpole@research.msstate.edu

Mississippi State University, through the Department of Physics and Astronomy and the Center for Science, Mathematics and Technology, has a long history of successful collaborations with the K-12 community. Outreach components have included workshops for teachers and students, physics courses for high school teachers, physics demonstration shows for K-12 students, and physics experiments with departmental equipment conducted by K-12 students. The success of these programs has been the result of forging collaborations based on developing positive relationships with teachers and administrators, soliciting input from the K-12 community, developing meaningful programs, utilizing teacher leaders, and delivering results. Examples of programs will be discussed with an emphasis on keys to developing collaborations to bridge the gap between the K-12 and college communities.

*This work is supported in part by NSF-ESI-9555646, 9911885 and 0353441.

BE02: 1:45–2:15 p.m. The Evolution of a Few Successful School/College Collaborations*

Invited - Patricia A. Sievert, Northern Illinois University, STEM Outreach, DeKalb, IL 61010; psievert@niu.edu

What constitutes successful school/college collaborations? Can they be crafted or do they need to evolve? Having been involved in school/college partnerships and collaborations over the past eight years, I have observed a number of variations on developing these collaborations. I will share my experiences forming working relationships with teachers and school administrators, both in small scale, self-initiated collaborations and in large scale, legally defined partnerships. The smaller collaborations allow me to bring to local classrooms activities that they would not otherwise experience. My role in one of the larger partnerships included supporting an initiation of Physics First in Rockford: running content workshops, visiting classrooms to coach biology teachers starting to teach physics, and working with teachers and an administrator to determine power standards and write core assessments. Collaborations foster two-way communication, providing a valuable source of feedback for the college involved.

* www.niu.edu/stem

BE03: 2:15–2:45 p.m. Developing and Maintaining Collaborations' Suggestions on What You Can Do

Invited - Paul J. Dolan, Jr., Northeastern Illinois University, Chicago, IL 60625; p-dolan@neiu.edu

STEM collaborations between colleges and local schools (high school, pre-high school, school districts) can be both long-term and successful, in terms of STEM interest and learning passed on to the school students, in terms of opportunities for college students and faculty, and also can be personally satisfying for all the participants. This talk will discuss two successful collaborations between Northeastern Illinois University (NEIU) and the Chicago Public Schools (CPS): 'Science Fair Central', and the collaborative effort between NEIU's middle school (STEM) teacher preparation program (MSTQE) and the local CPS middle school area. While there is no single formula, the lessons learned from these collaborations will be used to offer suggestions as to how other collaborations that address the specific needs of other schools and colleges can be fostered and maintained.

BE04: 2:45–3:15 p.m. H.S. Teachers Sharing University Research to Transform Elementary Classrooms

Invited - John P. Lewis, Glenbrook South High School, Glenview, IL 60025; jlewis@glenbrook225.org

For over 20 years, award-winning high school science teachers have been providing "Inquiry Science Workshops" to the elementary and middle school teachers in the Chicago area. These workshops have forged strong relationships between teachers from the neediest schools and the Universities and world-class museums in the metropolitan area. The inquiry approach modeled in this program has become the foundational principle for numerous graduate programs that have evolved in the area. Universities have benefited from this program using the facilitators as adjunct faculty, receiving funds by offering graduate credit to participants, accepting students into pre-existing graduate programs for educators and, in one case, the development of a whole new Master's degree program in Science Content and Process. John will model the process, and share the evolution of the program.

Session BF: SPS Undergraduate Research and Outreach

Location: Grand Ballroom 3
Sponsor: Physics in Undergraduate Education Committee
Date: Monday, January 10
Time: 1:15–2:35 p.m.

Presider: Gary White, SPS/AIP

BF01: 1:15–1:25 p.m. Fabrication and Characterization of ZnO-based Ultraviolet Photodetectors

Laura Covington, Coastal Carolina University, Conway, SC 29526; lrcoving@coastal.edu*

We are fabricating ZnO-based ultraviolet (UV) photodetectors via thermal oxidation of Zn-metal films and patterning of electrical contacts. Zinc films are deposited on sapphire substrates via magnetron sputtering, and are then thermally oxidized at various annealing temperatures. Electrical contacts are then made via sputtering of aluminum on the ZnO surface via a shadow mask technique. Current passing through the film is measured as a function of voltage to determine conductivity both in dark and under UV illumination. In dark conditions, oxygen is absorbed by capturing an electron from the surface, which should reduce film conductivity. While under UV illumination, the oxygen is photodesorbed, and conductivity should increase. The relationship between the annealing temperature at which Zn is oxidized and the conductivity of the ZnO film will also be determined. Higher annealing temperatures result in larger number of defects, which should increase film conductivity.

* Sponsored by James Christopher Moore.

BF02: 1:25–1:35 p.m. Recombination and Free-Carrier Diffusion Near an Isolated Defect in GaAs

Mark Crowley, Davidson College, Davidson, NC 28036; macrowley@davidson.edu*

Tim Gfroerer, Davidson College
Mark Wanlass, National Renewable Energy Lab

When electron-hole pairs are generated in GaAs-based solar cells, they can recombine by emitting light before being extracted for electricity. Defects in the lattice can provide intermediate energy levels that also allow for heat-generating recombination. In images of optical emission from GaAs, we observe isolated dark regions where the darkened area decreases substantially with increasing laser excitation. At lower excitation, fewer carriers are present and it takes longer to find a partner, which allows more time to reach defects. When we model the behavior with a simulation that allows for Laplacian diffusion and defect-related recombination only through mid-bandgap energy levels, we cannot obtain good agreement between experimental and simulated images. But if we allow for an arbitrary distribution of defect levels between the valence and conduction bands, we have more flexibility for fitting the excitation-dependent recombination rates. We have employed this model successfully to obtain better simulated images.

*Sponsored by Tim Gfroerer.

BF03: 1:35–1:45 p.m. Exploring Free Carrier Diffusion with Light- and Heat-Generating Recombination

Ryan Crum, Davidson College, Davidson, NC 28036; rycrum@davidson.edu*

Tim Gfroerer, Davidson College
Mark Wanlass, National Renewable Energy Lab

Light- and heat-generating recombination decrease the efficiency of GaAs-based solar cells, while free carrier diffusion is an important mechanism for modeling solar cell performance. Using optical and thermal imaging, we seek an accurate measurement of the diffusion-driven free carrier distribution in GaAs near a tightly focused laser excitation spot. We obtain temperature distributions that are broader than the optical emission profiles. This observation is consistent with how these mechanisms depend on carrier density: heat-generating recombination should be approximately proportional to the density of carriers while radiative-recombination is proportional to the density of carriers squared. Since the carrier density decreases with distance from the excitation position, radiative recombination dominates at short distances while heat-generating recombination becomes more important with increasing distance. We show that the square root of the light signal follows the heat profile, giving consistent, independent measurements of the local carrier density.

*Sponsored by Tim Gfroerer.

BF04: 1:45–1:55 p.m. Alternative Numerical Technique for Determining Acceleration from Video Analysis Data

Martin DeWitt, High Point University, High Point, NC 27262; mdewitt@highpoint.edu

Aaron Titus, Catherine Hendricks, High Point University

Video analysis of a moving object provides position data that can be analyzed to obtain acceleration and thus net force. Typically, video analysis software numerically calculates the second derivative of position to find acceleration. We present an alternative method for finding the component of the acceleration that is perpendicular to an object's path. This involves thinking of an arbitrary curved path as being composed of a succession of small intervals during each of which the object is in uniform circular motion. At each point along the path, a best-fit circle is generated and the corresponding centripetal acceleration is calculated. We compare the results of this technique with the typical numerical method.

BF05: 1:55–2:05 p.m. Cosmic Ray Research in Undergraduate Curriculum

Abaz Kryemadhi, Messiah College, Grantham, PA 17027; akryemadhi@messiah.edu

Jennifer Esbenshade, Messiah College

We have built Messiah College Air Shower (MCAS) array of cosmic ray detectors. The array has been calibrated and the arrival direction of the cosmic ray showers is determined. Our results will be discussed and compared to other arrays. We will also discuss how the exciting field of high- energy cosmic rays can be implemented in the undergraduate curriculum.

BF06: 2:05–2:15 p.m. Using the Context of Modern Experimental Physics in Undergraduate Curriculum

Sharif Onihale, Chicago State University, Chicago, IL 60628; onihaleshar-if1@yahoo.com*

Thomas Kuhn, Chaan Thomas, Mel Sabella, Edmundo Garcia, Chicago State University

The goal of this project is to improve student understanding of modern physics in the undergraduate curriculum by building stronger content knowledge, reasoning and laboratory skills. This project is centered on the development of lab modules that help students move beyond theory and develop an appreciation of modern experimental physics. These modules will allow students to experimentally determine the existence of subatomic particles using detectors made of scintillator plastic, phototubes and read-out electronics. These instructional modules will permeate throughout the undergraduate curriculum forming a coherent conceptual thread. As students progress through the materials the content will become more challenging as the level of scaffolding decreases. As students complete the conceptual thread they will become versed in nuclear physics experimental techniques. In this talk we introduce the project, describe the detectors, and explain how education research will be used to guide the development of instructional materials.

*Supported by NSF-CCLI grant DUE-0941034. Sponsored by Mel Sabella.

BF07: 2:15–2:25 p.m. How Learning About Learning in Physics Changed My Future Career*

Heidi K. Rowles, Seattle Pacific University, Seattle, WA 98119; rowleh@spu.edu

Hunter G. Close, Rachel E. Scherr, Seattle Pacific University

As a student working toward a degree in the sciences, the Learning Assistant (LA) program swayed me from pursuing a medical career to a teaching career. The program organically exposes LAs to the ways that students process fundamental ideas in physics. Through daily classroom interaction with students, an LA preparation session, and a pedagogy course for LAs (including quarterly clinical interviews with non-physics students), the program teaches LAs to creatively assess what students approach their physics education already knowing. LAs learn to observe, marvel at, and facilitate real-time productive cognitive processes in which students engage during interactive instruction. Viewing instruction through this lens helped me learn more deeply about both learning and physics itself. The intrigue I experienced diverted me from a career in medical diagnosis to one discerning the dynamic relationship between students and concepts, and the tactics teachers use to influence that relationship.

* Supported in part by NSF DRL 0822342 and the Seattle Pacific University Science Initiative.

BF08: 2:25–2:35 p.m. Discovering Cognitive Resources in Students Teaches LAs About Genuine Dialogue*

Michael A. Willcockson, Seattle Pacific University, Seattle, WA 98119; willcm@spu.edu

Hunter G. Close, Rachel E. Scherr, Seattle Pacific University

At SPU, undergraduate physics students practice teaching through the Learning Assistant (LA) program, which includes interviewing non-physics students about some basic physical phenomena. The results were startling to me, an LA; without being taught, the interviewees were pre-loaded with some pieces of physics understanding. As an LA, I learned that understanding physics is achievable not because the concepts are simple but because students are clever, i.e., willing and able to think innovatively about a life of physics experience. My new-found appreciation for student thinking changed the way I teach and the way I communicate generally. As I encouraged students to engage tasks, I found that they knew more than I thought and needed what I knew less than they thought. As a future medical student, this lesson has changed how I view interactions with patients. Valuing others' ability to think is essential to productive communication, regardless of the profession.

* Supported in part by NSF DRL 0822342 and the Seattle Pacific University Science Initiative.

Session BG: Investigating Student Reasoning in Physics

Location: City Terrace 12
Sponsor: Research in Physics Education Committee
Date: Monday, January 10
Time: 1:15–3:15 p.m.

Presider: Mackenzie Stetzer, University of Washington

Systematic investigations of student understanding of specific physics concepts have long been a focus of physics education research. Considerably less emphasis, however, has been placed on probing and documenting student reasoning abilities. This invited session will focus on ongoing investigations of reasoning skills and critical thinking abilities that instructors hope to cultivate, explicitly or implicitly, in undergraduate physics courses.

BG01: 1:15–1:45 p.m. Student Difficulties with Multi-variable Reasoning

Invited - Andrew Boudreaux, Western Washington University, Bellingham, WA 98225-9164; andrew.boudreaux@wwu.edu

In many topics in introductory physics, students must reason about situations that involve multiple variables. For example, when analyzing an ideal gas system, students are taught that the pressure is inversely proportional to its volume, given a constant temperature and number of moles. When considering the flow of an ideal fluid, students must recognize that changes in elevation and pipe diameter contribute independently to the pressure difference between two points. At WWU, we are examining students' multivariable reasoning in a variety of contexts. In some cases, students have difficulty recognizing situations in which the competing effects of two different variables render a qualitative analysis incapable of predicting the behavior of the system. In this talk, student responses on written tasks will be used to illustrate specific difficulties.

BG02: 1:45–2:15 p.m. Disciplinary Reasoning in the Classroom: Dilemmas in Fostering Engagement*

Invited - Brian W. Frank, University of Maine, Orono, ME 04469; brian.frank@maine.edu

Michael C. Wittmann, University of Maine

We use case studies drawn from an inquiry physics course to explore the complex relationship between students' engagement with disciplinary reasoning and classroom structures that aim to foster it. For example, classroom questions might aim to support student argumentation by requiring consensus or promote evidence-based reasoning by asking students to carefully discuss observations. While often engaging students with elements of disciplinary practice, such questions can also present dilemmas. For example, a student who values their own opinion and also believes in following instructions is faced with the dilemma of either ignoring instructions or abandoning her idea. Another student who knows the "right" answer but has evidence to the contrary is faced with the dilemma of supporting a wrong idea with evidence or accepting the right one. We discuss these dilemmas and students' resolutions of them in order to illuminate the curricular experiences of students as they engage in disciplinary work.

* The research has been funded in part by the National Science Foundation under Grant Nos. DRL-0633951, DUE-0962805, and DUE-0410895.

BG03: 2:15–2:45 p.m. Exploring Student Reasoning in the Context of Periodic Waves

Invited - Mila Kryjevskaia, North Dakota State University, Fargo, ND 58108-6050; mila.kryjevskaia@ndsu.edu

As a part of an ongoing investigation of student understanding of wave behavior in introductory calculus-based physics courses,[1] we have been examining the approaches that students use while reasoning about propagation of periodic waves. In particular, we have been probing the extent to which students recognize and are able to apply the cause and effect relationships between propagation speed, frequency, and wavelength. Questions focusing on wave behavior at boundaries between different medial have been particularly valuable in helping us identify specific incorrect lines of reasoning. Several of the erroneous reasoning strategies do not appear to be limited to the boundary context, and data will be presented to illustrate how such strategies may hinder student understanding of more advanced physics phenomena such as interference and diffraction. Broader insights into student reasoning extending beyond the specific physics contexts of waves and physical optics will also be discussed.

1. L.C. McDermott, P.S. Shaffer and the Physics Education Group at the University of Washington, *Tutorials in Introductory Physics,* Prentice Hall (2002).

BG04: 2:45–3:15 p.m. Sense-Making in Physics: What Assumptions Are We Making about the Students?

Invited - Suzanne White Brahmia, Rutgers, the State University of New Jersey, Piscataway NJ 08854; brahmia@physics.rutgers.edu

Mathematical reasoning in introductory physics, namely the use of integers and the operations of multiplication, division, addition and subtraction, is the platform for our understanding of profound and fundamental concepts such as conservation laws, net force and charge, and ratio and product quantities. Although students learn to perform these mathematical operations in their middle school math class, they struggle with our specialized use as we reason about abstract physical quantities. The mismatch between what they learn in math and its application in physics affects students' ability to reason like we do in physics contexts. In order to better match with the students we teach, we need to examine our expectations about their reasoning, and make our reasoning more transparent to them. In this talk I will review research from math and science education literature about student difficulties using mathematical reasoning about physical quantities. I will also present data from an ongoing collaboration between Rutgers, NMSU and WWU in which some of the implied mathematical reasoning has been made an explicit part of the curriculum.

Session BH: Heliophysics, the Heliosphere and ATST

Location: City Terrace 5
Sponsor: Space Science and Astronomy Committee
Date: Monday, January 10
Time: 1:15–2:45 p.m.

Presider: Mary Ann Kadooka, University of Hawaii At Manoa - Institute of Astronomy

We take our Sun for granted but we need to solve its mysteries in order to survive. What can heliophysics teach us about space weather, how our Sun impacts the Earth? Why do we study the heliosphere? Does it help to protect our solar system from radiation? How will the Advanced Technology Solar Telescope (ATST) promote our solar research efforts? Our solar astrophysicists and astronomers will share cutting-edge research.

BH01: 1:15–1:45 p.m. Putting a Microscope on the Sun

Invited - Dave Dooling, National Solar Observatory, Sunspot, NM 88349; dooling@nso.edu*

After more than four centuries of study, our Sun remains Stella Incognita, an "unknown star." We need a "solar microscope" that can unravel the solar magnetic carpet that covers the face of the Sun and gain new insights into the solar dynamo that drives space weather and affects climate on Earth. This will be the 4-meter Advanced Technology Solar Telescope (ATST), which the National Solar Observatory and its partners are preparing to build atop Haleakala, Maui, Hawaii. Its large aperture and adaptive optics will let it see 30 to 40 times sharper than uncorrected ground-based telescopes, and thus peer deep into new realms of solar activity. This session will discuss the design and goals of the ATST, and the range of careers it will enable.

* Sponsored by Mary Ann Kadooka

BH02: 1:45–2:15 p.m. Interstellar Neutral Atoms and Their Journey Through the Heliosphere

Invited - Elena Moise, Institute for Astronomy, University of Hawaii, Honolulu, HI 96822; emoise@ifa.hawaii.edu*

The heliosphere, the volume inflated by the solar wind, is impenetrable to interstellar plasma, except for high-energy galactic cosmic rays. Neutral components of the local interstellar medium (LISM), however, do enter at the speed of Sun's relative motion to LISM. On their journey through the heliosphere, interstellar neutrals are subject to ionization by solar wind protons and electrons, solar photons, and also the gravitational pull of the Sun. Once ionized, the newly created ions, called "pickup ions" (PUIs), are swept out by the solar wind toward the termination shock. Helium atoms, having a higher ionization potential, penetrate deeper into the solar system, with their trajectories gravitational focused to form a cone of high concentration of LISM He in the wake of the Sun's motion through LISM. This He cone provides a rich source of He+ PUIs. Recent theories suggest that PUIs are the seed particles for the detected anomalous cosmic rays—singly charged ions highly enriched in He, N, O, and Ne.

* Sponsored by Mary Ann Kadooka

BH03: 2:15–2:45 p.m. Heliophysics: Anatomy of Solar Anger

Invited - Ilia I. Roussev, Institute for Astronomy, University of Hawaii, Honolulu, HI 96822; iroussev@ifa.hawaii.edu

Mary Kadooka, Elena Moise, Kathryn Whitman, Institute for Astronomy

For a few centuries now the Sun has been diagnosed with cyclophrenia (or manic-depressive psychosis). This behavior is characterized by the occurrence of mania (or euphoria) during the so-called solar maximum, alternated with bouts of depression during the so-called solar minimum. The cycle of this behavior is 11 years, which is also known as solar cycle. In addition to this predicable part of Sun's behavior, there is also an unpredictable component characterized as solar anger. The solar anger first starts with the misplaced stage (accumulative, or implosive, stage for later explosive behavior), followed by a second, excessive stage that yields solar flares and coronal mass ejections. It has been only three decades since heliophysicists have begun to understand—through sophisticated observations and state-of-the-art numerical simulations—the true nature of solar anger. Heliophysics also attempts to predict and manage Sun's wrath. The talk focuses on solar anger management and what can be learned from it for the sake of better education.

Session BI: Sustaining the Key Elements of a High-Quality Physics Teacher Preparation Program

Location: City Terrace 6
Sponsors: Teacher Preparation Committee, Physics in High Schools Committee
Date: Monday, January 10
Time: 1:15–3:15 p.m.

Presider: Paul Hickman, Boston, MA

Research has identified certain key elements that are essential to vibrant teacher preparation programs. Active recruitment, engaging early field experiences, active learning in content coursework, effective student teaching, and continued support during their first year all contribute to the development of an effective novice teacher. Our invited speakers will address how their institution was able to sustain reform efforts in a climate of down-sizing and budget cuts.

BI01: 1:15–1:45 p.m. Sustaining the Teacher-in-Residence

Invited - Chance Hoellwarth, California Polytechnic State University, San Luis Obispo, CA 93407; choellwa@calpoly.edu

The Physics Teacher Education Coalition (PhysTEC) has been advocating that physics departments take a larger role in teacher preparation, and they have highlighted many ways to do this successfully. One of the components is to hire a teacher-in-residence (TIR)—a local K-12 teacher who becomes a visiting lecturer in the department. At Cal Poly, we have found that the TIR can be a valuable change agent for improving teacher education. The TIRs have helped improve the recruitment of future teachers, the supervision of student teachers, and the communication with local school districts. In addition they have taught methods courses and are currently helping put in place an early field experience program. The TIR position was largely funded by an external source (PhysTEC) from 2003-2006; however, since that time the dean of the College of Science and Mathematics has supported the position, and he is supporting two TIRs this year. In this talk I will discuss the role and benefits of the TIR, how the TIR was sustained at Cal Poly, and how these lessons can be helpful to other institutions wishing to hire a TIR.

BI02: 1:45–2:15 p.m. Post-PhysTEC Teacher Preparation at Arkansas, Numbers Stable, Student Enthusiasm High*

Invited - Gay B. Stewart, University of Arkansas, Fayetteville, AR 72701; gstewart@uark.edu

At the University of Arkansas, active learning in content coursework has been the key to recruitment of majors and teachers. We have supported the improvement of the courses through the use of apprentice teachers, one learning assistant model. Master Teachers have also aided in recruitment, and true partnerships with local schools have allowed us to provide improved support to our graduates through the induction years. We will address how we created these programs with a focus on institutionalization.

* This work supported in part by NSF Grants PHY-0108787, DUE-0733841 and DUE-0832091

BI03: 2:15–2:45 p.m. Undergraduate STEM Reform Drives Transformation of Physics Teacher Program

Invited - Leanne M. Wells, Florida International University, Miami, FL 33199; Leanne.Wells@fiu.edu

Laird Kramer, George O'Brien, Eric Brewe, Florida International University

Florida International University awards more degrees to Hispanic students than any other university in the country as well as serving as the main source of high school teachers for the country's fourth and sixth largest school districts. The imperative to produce high-quality physics teachers prepared to serve majority minority student populations drives ongoing efforts in undergraduate STEM education reform and has led to the transformation of teacher preparation programs. In an intricate web of Physics Modeling Instruction, introductory physics lab reform, a Learning Assistant program, and education outreach, a physics teacher preparation program was designed around pedagogical content knowledge, relevant field experiences, and multiple entry points and now serves as a model for new teacher preparation programs in mathematics, chemistry, earth science, and biology. We outline program design, including explicit elements for sustainability, as well as the importance of the new programs as a leverage for further funding and reform.

BI04: 2:45–3:15 p.m. On Sustaining Positive PhysTEC Outcomes at a Research Oriented University

Invited - Martin D. Alderman, Cornell University, Ithaca, NY 14853; mda35@cornell.edu

Teacher preparation programs at heavily research-oriented institutions like Cornell University tend to be "well kept secrets" in spite of efforts to publicize them. Staff and programs funded by our university-matched PhysTEC grant have resulted in projected growth from one newly certified physics teacher every other year to at least two per year. They have also resulted in improvements in physics instruction, awareness of effective instructional methods, and interest in adding a PER faculty position. Now that the grant support is ending and the economic situation for universities is grave, our laudable outcomes could easily become a brief footnote. This presentation will look at sustainability efforts made, and hopeful signs of ongoing influences.

AAPT Awards Ceremony

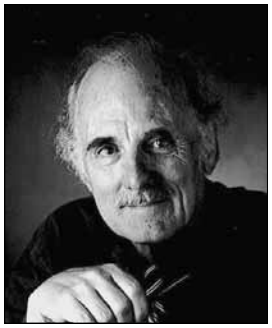
Location: Grand Ballroom 4
Date: Monday, January 10
Time: 3:30–5 p.m.

Presider: Alex Dickison

Oersted Medal to F. James Rutherford

The Particle Enigma, High School Physics, and the Search for Scientific Literacy

There is a compelling reason why students should study physics in high school. It is not, however, for the reasons so often given. It is not, for example, to enable students to understand contemporary physics or to learn to think scientifically, nor is it because our Nation's future depends on our capability in science and engineering or because U.S. students as a whole perform poorly on international comparisons of scientific proficiency. Rather it is, I will argue, because physics is essential for achieving scientific literacy, a requisite of the general education of all students. In this I will be joined by Galileo's interlocutors from the *Dialogue Concerning the Two Chief World Systems*: Salviati, Simplicio, and Sagreda.



F. James Rutherford
UC Berkeley

AAPT Distinguished Service Citations

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Distinguished Service Citations are presented to AAPT members in recognition of their exceptional contributions to AAPT at the national, sectional or local level.

Outstanding SPS Chapter Advisor Award

Presented by SPS President Toni Sauncy

DJ Wagner, Grove City College of Pennsylvania

While there are many truly excellent SPS Advisors, this past year's top award, the 2010 SPS Outstanding Chapter Advisor winner, is DJ Wagner of Grove City College of Pennsylvania. Her students wrote extensively about her nine years of exceptional leadership there, including this glimpse: "Having 25 students travel to FermiLab for the SPS Congress at minimal cost, and pulling off a multi-zone meeting with over 100 attendees, were both huge learning experiences for us, and definitely would not have happened without her guidance and encouragement. She is always excited about physics and her enthusiasm is contagious."
Wagner is a familiar face at AAPT meetings, conducts physics education research with the help of several undergraduate research assistants, and is an enthusiastic handbell ringer. The award consists of a cash prize split among the awardee, the department and the SPS chapter, as well as a plaque.

DJ Wagner
Grove City College

Session CA: *Panel:* ALPhA Session: Condensed Matter/Materials Physics Laboratories

Location: Grand Ballroom 1
Sponsors: Laboratories Committee, Apparatus Committee
Date: Monday, January 10
Time: 6:30–8 p.m.

Presider: Gabe Spalding, Illinois Wesleyan University

A panel discussion of instructional laboratories: Why is there so little of Condensed Matter / Materials Physics in the typical instructional laboratory curriculum? Is it not true that many-body physics contains paradigms that are really of fundamental importance in modern physics?

CA01: Quartz Tuning Fork in Liquid Helium: Frequency and Temporal Response

Panel - Robert DeSerio, University of Florida, Gainesville, FL 32611; deserio@phys.ufl.edu

Our newest advanced lab experiment explores the behavior of small quartz crystal tuning forks immersed in liquid helium. Originally designed for use in wristwatches, the tuning fork is factory sealed inside a vacuum can, which is cut away to expose the tines. Its resonant frequency and damping constant vary as the helium is brought from its nominal temperature of 4.2 K through the superfluid transition at 2.2 K down to our lowest achievable temperature around 1.6 K. A "suck stick" cryostat, developed here at the University of Florida by low-temperature researchers, holds the liquid helium and facilitates vacuum pumping to vary the helium temperature. It fits inside a standard 100-liter helium Dewar where all measurements are made and it uses only a few liters per day. The experiment was initially performed in our advanced lab as an undergraduate project associated with faculty research. It was further refined into an experiment for our advanced lab course and includes measurements of both the resonant frequency response and the temporal ringdown response. Details of the apparatus and data acquisition will be presented along with representative data.

CA02: Lab Faculty/Staff Development Opportunities & CMMP Physics

Panel - Gabriel C. Spalding, Illinois Wesleyan University, Bloomington, IL 61701; gspaldin@iwu.edu

In the new "ALPhA Immersion Program," laboratory instructors spend three days, with expert colleagues on hand, learning the details of a single, key instructional physics experiment well enough to incorporate it into their teaching with confidence. We seek your input regarding future Immersion Program offerings. ALPhA has also begun planning the Conference on Laboratory Instruction Beyond the First Year (BFY), for July 25-27, 2012. I will describe some faculty-staff development initiatives for this particular panel focusing on those relevant to the area of laboratory instruction in Condensed Matter / Materials Physics, including upcoming opportunities as well as a quick review of some recent activities.

CA03: Surface Plasmons, Waves on Gels, and Hydrodynamic Instabilities

Panel - Randall Tagg, University of Colorado Denver, CO 80217-3364; randall.tagg@ucdenver.edu

A key lesson in the understanding of condensed systems is the idea of collective modes, which are viewed as properties that emerge from the aggregation of large numbers of atoms. A key attribute of such modes is the dispersion relation that relates frequency to wavenumber. Our undergraduates, as well as some high school students, have used such ideas to explore the behavior of systems that literally lie at the boundaries of condensed matter physics. Surface plasmon dispersion relations can be digitally imaged by the elegant method of Swalen, et al. (*AJP* v.48 pp 669-72 (1980)). Waves on the surfaces of hydrogels can be excited at different frequencies using pulsed air from fuel injector valves. Finally, pattern formation in flow between rotating cylinders extends the idea of dispersion relations to nonequilibrium systems, introducing students to hydrodynamic instabilities and amplitude equations.

Session CB: Outcomes of the Two-Year College Tandem Meeting

Location: City Terrace 4
Sponsor: Physics in Two-Year Colleges Committee
Date: Monday, January 10
Time: 6:30–8 p.m.

Presider: Tom O'Kuma, Bay College

During this session, presenters will discuss some of the outcomes of the TYC Tandem Meeting held in Portland, OR, during the AAPT 2010 Summer Meeting.

CB01: 6:30–7 p.m. Addressing Isolation in Two-Year Colleges with New Technologies

Invited - Karim Diff, Santa Fe College, Gainesville, FL 32606; karim.diff@sfcollege.edu

The National Two-Year College Tandem Meeting was organized in conjunction with the summer 2010 AAPT Meeting in Portland, OR. This one-day conference focused on issues of interest to physics faculty in two-year colleges. This talk will report on the session devoted to the issue of isolation in TYCs and ways to address it with new technologies. According to a 2002 AIP survey, 86% of two-year colleges have two or fewer full-time physics faculty. To alleviate the problem of isolation caused by this situation, projects such as the TYC21 Project, developed 20 years ago, a network of TYC faculty through regional and national meetings. The Portland session revisited the lessons learned by TYC21 and explored opportunities available today with new technologies. In addition to the cptyc-l discussion list, the TYC social network (http://tycphysics.ning.com/) and the new TYC Physics blog (http://www.tycphysicsblog.org/) are examples of such opportunities.

CB02: 7–7:30 p.m. The Who, What and Why of the 2010 Tandem Meeting

Invited - Marie F. Plumb, Jamestown Community College, Jamestown, NY 14701; MariePlumb@mail.sunyjcc.edu

On the Saturday of the 2010 Summer AAPT meeting, the Two-Year College community held a Tandem Meeting to address issues that are particular to the Two-Year College Community. This talk will discuss the reasons for the meeting, the highlights of the meeting and some impressions of the meeting as expressed by those in attendance.

CB03: 7:30–8 p.m. Adopting & Adapting PER-based Curriculum: A Session Review

Invited - Todd R. Leif, Cloud County Community College, Concordia, KS 66901; tleif@cloud.edu

Are Two Year Colleges (TYCs) the perfect testing ground for curricular innovation? This talk discusses the outcomes of the session Adopting and Adapting PER-based Curriculum at the TYC Tandem Meeting held at Portland during the summer 2010 AAPT meeting. A series of experienced adapters guided participants through the process of molding PER-based curriculums to fit into their own classrooms. Reactions of the participants and the greater Two-Year College community will be discussed.

Session CC: Extended Investigations in 5-9 Classrooms

Location: Grand Ballroom 2
Sponsors: Physics in Pre-High School Education Committee
Date: Monday, January 10
Time: 6:30–8 p.m.

Presider: DIane Riendeau, Deerfield High School

This session will introduce labs and activities that are appropriate in the middle school classroom. These activities will extend beyond the normal curriculum and serve as extensions for the students.

CC01: 6:30–7 p.m. Plasmas and Fusion Energy

Invited - John W. DeLooper, Princeton Plasma Physics Laboratory, NJ 08543 jdeloope@pppl.gov

The study of plasmas, the fourth state of matter is fundamental to fusion energy research. Fusion has the potential to revolutionize the way the world generates clean, green, electricity. This presentation will cover the basics of plasma and review the current state of fusion research.

CC02: 7–7:30 p.m. Middle School Spectroscopy

Invited - Pamella W. Ferris, Riverside Middle School, Evans, GA 30809; PamellaFerris@comcast.net

Never before has such state-of-the-art equipment been available for use in middle schools. With new low-cost spectrometers, now even middle school teachers can use cutting-edge technology in their classrooms. Pique student interest in physical science by utilizing technology that allows students to conduct real scientific research with equipment that is comparable to that used by actual scientists in the field. Inquiry-based lesson plans developed by classroom teachers facilitate student observations of emission spectra of various light sources. First by using only the naked eye and diffraction gratings participants make qualitative observations, then using inexpensive spectroscopes, students gather data and compare it to measurements of the same gas samples made with a low-cost, but fully functional spectrometer. Never before have middle schools been able to afford such leading-edge technology. Students can now become “real” scientists and collect “real” data. This will undoubtedly spark many middle school students’ interest in science and may even encourage them to become the scientists that we so greatly need in the future.

CC03: 7:30–7:40 p.m. Hands-On Activities Exploring Nanoscale Science Investigations in Pre-High School Classrooms

Kandiah Manivannan, Missouri State University, Springfield, MO 65897; ManiManivannan@MissouriState.Edu

Anjali Manivannan, Bryan E. Breyfogle, Kartik C. Ghosh, Missouri State University

The fast-growing interdisciplinary field of nanoscience and nanotechnology is still in its infancy, and science education research findings and curricular developments are still emerging. One nanometer is about one hundred thousand times smaller than the diameter of human hair, and at the nano-level we begin to see the intimate connections among the STEM disciplines. Appropriately integrating hands-on nanoscience activities into school classrooms is expected to have outcomes such as supporting inquiry-based teaching and learning, increased interest and engagement in learning science, and enhanced understanding of core science and nanoscale STEM concepts and applications. We present some inquiry-based hands-on activities using paper models and plastic building blocks, and discuss other activities suitable for pre-high school students. We will assemble models to simulate some of the unique properties of nanoparticles. Finally, we will present preliminary results of pre- and post-Nano Concept Inventory assessments given to pre-service teachers.

CC04: 7:40–7:50 p.m. POWER-ful Hands-on Activities: Renewable Energy from The Science House*

Lisa L. Grable, NC State University, Raleigh, NC 27606; grable@ncsu.edu

The smart grid, green power, renewable energy--these topics are intriguing and exciting for middle and high school students. Through our partnership with a Gen-III Engineering Research Center, The Science House at NC State has developed activities to build understanding of research being done in the FREEDM Systems Center, including wind, solar, plug-in electric vehicles, and more. Basic building blocks of batteries, capacitors, and transformers lead to engaging units that can be used for project-based learning or science fair projects.

* See http://www.science-house.org/freedm/ for information and resources. Sponsored in part by NSF Award #0812121, Division of Engineering Education and Centers.

CC05: 7:50–8 p.m. Exploring Wind Energy in the Classroom

Mary Spruill, National Energy Education Development Project, Manassas, VA 20110; rlamb@need.org

DaNel Huggins, Kuna High School

Wind energy is the fastest growing energy source in the United States. Installations have become commonplace in many states, and jobs in the wind industry are growing at high rates as training programs become more prevalent at community colleges and engineering programs adopt a wind focus at universities. The National Energy Education Development Project, in conjunction with the Department of Energy’s National Renewable Energy Lab and the America Wind Energy Association, provide curriculum to K-14 educators on wind energy. Working with desktop models, students understand how turbines produce electricity and investigate blade design. Students measure wind speed and discuss siting issues. Classrooms access realtime energy production data from the Wind for Schools network of turbines to understand weather patterns in relation to energy production and learn to manipulate the data to create power curves. Materials are available at www.need.org free for download. Materials are correlated to state standards.

CD: LaserFest: What We Did

Location: City Terrace 9
Sponsors: Science Education for the Public Committee, Apparatus Committee
Date: Monday, January 10
Time: 6:30–7:10 p.m.

Presider: Jane Flood, Deerfield High School

Several AAPT members were recipients of grants to bring LaserFest on the Road in 2010 to celebrate the 50th anniversary of the first LASER. Laser light shows, hands-on explorations, demonstration shows, historical presentations, and museum exhibits are some of the ways AAPT members shared enthusiasm for laser applications and apparatus this past year.

CD01: 6:30–6:40 p.m. Angelo State Society of Physics Students LaserFest 2010 Activities

Travis S. Barnett, Angelo State University Physics, San Angelo, TX 76909; tbarnett3@angelo.edu

Toni D. Sauncy, Angelo State University Physics

Angelo State University Society of Physics Students Peer Pressure Team (SPS-PPT) was the recipient of a LaserFest 2010 Physics on the Road grant. Since receiving this grant, we have incorporated LaserFest 2010 demonstrations into our already highly active SPS-PPT programs. These laser-oriented demos include a laser sound transmission apparatus, a home built CO_2 laser, several reflection/refraction demos with a hand-held 140mW green laser and a programmable laser light show. These demos were added to the SPS-PPT annual road tour to generate excitement and educate K-12 school children about the laser and the 2010 anniversary. We will discuss these and other events aimed at involving the local community in LaserFest 2010 activities, including a community laser light show in the newly outfitted Angelo State digital planetarium.

* Sponsored by Toni Sauncy

CD02: 6:40–6:50 p.m. Opening the Department through Workshops and Day Camps

Timothy T. Grove, Indiana University Purdue University Fort Wayne, IN 46805;, grovet@ipfw.edu

Mark F. Masters, IPFW

We present information regarding two LaserFest events that happened at our home institution (IPFW). Over the past summer (2010) we ran a day camp for high school-age students as well as a workshop for high school teachers. The day camp had several purposes: to teach kids about lasers as well as providing "fun" activities featuring lasers. The workshop was designed to have the teachers learn more about lasers and light so that they can incorporate them into their classes. We will present information regarding the activities we developed.

CD03: 6:50–7 p.m. LaserFest in the Rockies*

Steve L. Shropshire, Idaho State University, Pocatello, ID 83209; shropshi@physics.isu.edu

The Idaho State University Physics Demo Road Show is one of 38 programs across six continents funded by the APS LaserFest grant program. Of the APS-supported programs, the ISU program has one of the largest service areas, including Idaho and portions of Oregon, Nevada, Utah, Wyoming, and Montana. Presentations on Light, Lasers, and Illusions were made at public and private schools, to community groups, and the general public. Teacher workshops were provided prior to presentations at schools. The program will be briefly described. What went well, and what did not go so well will be discussed.

* Supported by the APS, the Idaho Community Foundation, The J.A. and Katheryn Albertsons Education Foundation, and Idaho State University.

CD04: 7–7:10 p.m. Beam Me Up Scottie! LaserFest in Atlanta, GA

Amy Sullivan, Agnes Scott College, Decatur, GA 30030; asullivan@agnesscott.edu

Mary Hinkle, Ethan Sudan, Hannah Marlowe, Sophia Newton

"Beam Me Up, Scottie!" is an interactive outreach event to engage the local Atlanta, GA, community in learning about light, lasers and optics. The LaserFest outreach event consists of a set of interactive stations where the participants have the opportunity to explore lasers and their many applications in an engaging, hands-on environment. The program consists of five stations for participants to visit, each with a poster of background information on the concept being explored as well as an expert--either an Agnes Scott College professor or student--to assist the participants in their exploration. The stations include laser communications, lasers in astronomy, hands-on-optics alignment, lasers in the movies, and laser radar. Support provided by a LaserFest On the Road grant.

CD05: 7:10–7:20 p.m. Laserfest at Penn State Altoona and Quaint Corner Children's Museum

Richard Flarend, Penn State Altoona, Altoona, PA 16601; ref7@pasu.edu

We added laser and optics exhibits to our standard lineup of hands-on activities that we bring to schools and showcase in our annual Spooktacular Science show around Halloween. We also used matching funding from our outreach program to have a laser show at our fall program. In addition, the exhibits were duplicated and placed in the local children's museum where they are now on display. These exhibits will be shown in a slide show along with some of the difficulties we encountered should someone else want to duplicate them.

CE: Cosmology Education

Location: City Terrace 5
Sponsor: Space Science and Astronomy Committee
Date: Monday, January 10
Time: 6:30–8 p.m.

Presider: Doug Lombardi, North Las Vegas, NV

This session will feature the burgeoning area of educational research and best practices in instruction of cosmology.

CE01: 6:30–7 p.m. Overcoming Common Conceptual and Reasoning Difficulties in Cosmology: A Lecture-Tutorial Approach

Invited - Colin S. Wallace, Dept. Astrophysical & Planetary Sciences, University of Colorado at Boulder, CO 80309; colin.wallace@colorado.edu

Edward E. Prather, Doug Duncan, CATS University of Arizona

For the past two years, we have conducted fundamental research into Astro 101 students' conceptual and reasoning difficulties in cosmology. To date, we have analyzed the responses of more than 2000 students from institutions across the United States to questions on the Big Bang, the expansion and evolution of the universe, and the evidence for dark matter. Our findings have informed the development of a new suite of cosmology Lecture-Tutorials designed to increase students' understanding of these common cosmology topics. In this talk, we present our key findings with reguard to Astro 101 students' common learning difficulties with studying cosmology and provide evidence showing that the new Lecture-Tutorials help students achieve larger learning gains than lecture alone. This material is based upon work supported by the National Science Foundation under Grant No. 0833364 and Grant No. 0715517, a CCLI Phase III Grant for the Collaboration of Astronomy Teaching Scholars (CATS). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

CE02: 7–7:30 p.m. The Big Ideas in Cosmology: A Curriculum for College Students

Invited - Kim Coble, Chicago State University, Chicago, IL 60628 kcoble@csu.edu

Kevin M. McLin, Anne J. Metevier, Lynn R. Cominsky, Sonoma State University
Janelle M. Bailey, University of Nevada, Las Vegas

Powerful new observations and advances in computation and visualization have led to a revolution in our understanding of the origin, evolution and structure of the universe. These gains have been vast, but their impact on education has been limited. We are bringing these tools and advances to cosmology education through a series of web-based learning modules informed by our research on undergraduate learning. The major themes include: the vastness and nature of space and time, gravity and dark matter, and the big bang. Students will master scientific concepts as well as the reasoning processes that led to our current understanding of the universe, through interactive tasks, prediction and reflection, experimentation, and model building. This curriculum will fill the acute need for research-based educational resources in the rapidly changing field of cosmology while serving as a model for transforming introductory courses from primarily lecture- and book-based to a more engaging format.

CE03: 7:30–8 p.m. Dark Energy is "Dying," and Other Student Ideas About Cosmology

Invited - Janelle M. Bailey, University of Nevada, Las Vegas, NE 89154-3005; janelle.bailey@unlv.edu

Kim Coble, Chicago State University
Geraldine L. Cochran, Florida International University
Roxanne Sanchez, University of Nevada, Las Vegas
Donna Larrieu, Virginia L. Hayes, Melissa Nickerson, Chicago State University
Kevin L.. McLin, Lynn R. Cominsky, Somoma State University

Determining the range and frequency of "alternative conceptions" is an important first step to improving instructional effectiveness. Modern topics in astronomy, such as cosmology, are of primary interest to many educators and students, but we are only beginning to understand students' alternative conceptions in this area. Through analysis of pre-instructional open-ended surveys (N > 500), our research group is attempting to classify students' ideas about concepts important to modern cosmology, including the structure, age, and evolution of the universe; dark matter and dark energy; and the Big Bang. Survey responses, analyzed through an iterative process of thematic coding, reveal a number of alternative conceptions. For example, students frequently conflate structure terms such as solar system, galaxy, and universe or do not understand the relationship between the terms; believe the universe to be infinitely old; and may not be aware of dark matter or dark energy.

CF: Jerrold Zacharias and the Foundations of PSSC Physics

Location: City Terrace 12
Sponsors: Interests of Senior Physicists Committee, History and Philosophy in Physics Committee
Date: Monday, January 10
Time: 6:30–8 p.m.

Presider: Charles Holbrow, MIT, Cambridge, MA

Jacksonville is the birthplace of Jerrold Zacharias, principal instigator of PSSC physics. The session will review Zacharias's origins and how he came to originate PSSC. Also there will be comparisons of Zacharias's high school physics in the 1920s with high school physics today.

CF01: 6:30–7 p.m. Jerrold Zacharias and the Origins of PSSC Physics

Invited - Charles H. Holbrow, Colgate University/MIT, Cambridge, MA 02139; cholbrow@mit.edu

Jerrold Zacharias (1905-1986) was born and grew up in Jacksonville, FL. He had a long, close association with Nobelist and science statesman Isidor I. Rabi of Columbia University. During World War II Zacharias established close relations with many eminent physicists as he worked on radar at the Radiation Laboratory and on the atomic bomb at Los Alamos. After the war Zacharias became a physics professor at MIT. He led intense, focused efforts by groups of physicists to help the U.S. develop its Cold War military defenses. My talk will review how in the late 1950s he became the principal initiator of PSSC (Physical Sciences Study Committee) Physics, an effort by some of America's best physicists to develop a new high school physics syllabus around the ideas that had revolutionized 20th-century physics. He wanted content and teaching style to help students learn to see the world as physicists do.

CF02: 7–7:30 p.m. High School Physics Before PSSC: Content, Pedagogy, Texts and Tests.

Invited - Keith Sheppard, Stony Brook University, Stony Brook NY 11794-5233; keith.sheppard@stonybrook.edu

In the late 1950s Jerrold Zacharias helped to initiate a revolution in high school physics education with the development of PSSC (Physical Science Study Committee) Physics. This talk details what high school physics was like before PSSC. The talk will outline the evolution of high school physics from the late 1800s until the 1950s in terms of its physics content, the methods advocated for its teaching, the texts used, the laboratory work required and the standardized tests that were given. Particular attention will be given to the type of physics course that Zacharias was exposed to when he attended Duval High School in Jacksonville, FL, from 1918 to 1922.

CF03: 7:30–7:40 p.m. What Prompted a Group of Physicists to Design a New High School Physics Course?

John L. Hubisz, North Carolina State University, Apex, NC 27523-6753 hubisz@mindspring.com

This is not to say that physics teachers were not involved, but the stimulus came from Jerrold Zacharias who was concerned about stories that he heard about the superiority of Soviet education and what it could mean for national defense. In 1956 (before Sputnik!) he conceived a project to create a series of instructional films to promote the teaching and learning of physics in pre-college education. That project grew into what we know as PSSC Physics.

CF04: 7:40–7:50 p.m. Zacharias and PSSC Physics Breaking the Mold

Jim Nelson, Santa Fe College, Gainesville, FL 32205; nelsonjh@ix.netcom.com

Jerrold Zacharias was a prime mover of the PSSC high school physics curriculum which started in 1958. This was a radical departure from the physics curriculum that Zacharias experienced when he was a high school student in Jacksonville. This paper will discuss some of the unique characteristics of the PSSC curriculum and highlight some of the changes that can still be seen today in high school physics classrooms.

CF05: 7:50–8 p.m. Physics as Taught in the Duval County Schools Today

Kenneth B. Shacter, Duval County Public Schools, Jacksonville, FL 32205; shacterk@gmail.com

Duval County's approach to teaching high school physics in the 21st century is student-centered and inquiry-based. Today's students won't sit still for the "sage on the stage" approach to instruction, and enjoy hands-on interactions. Research has also shown the inquiry-based form of instruction yields a better and longer-lasting comprehension of the concepts we wish to instill. Today's physics students come from all walks of life and all interest levels, not just those students who think they want to pursue a career in the sciences. This talk will focus on how high school physics classes in the Duval County Public School system are structured and our successes and continuing challenges.

CG: PER: Student Reasoning

Location: City Terrace 7
Sponsor: Research in Physics Education Committee
Date: Monday, January 10
Time: 6:30–7:50 p.m.

Presider: Karen Cummings, SCSU, New Haven, CT

CG01: 6:30–6:40 p.m. Assessment of Scientific Reasoning: A Case in Probabilistic Reasoning*

Lei Bao, The Ohio State University, OH 43016; lbao@mps.ohio-state.edu

Jing Han, The Ohio State University
Kathy Koenig, Wright State University
Tianfang Cai, Beijing Jiaotong University

Probabilistic reasoning is one of six dimensions assessed by the Lawson's classroom test of scientific reasoning. An adequate level of probabilistic thinking is crucial for understanding data and statistical features of experimental outcomes, which are important processes of scientific inquiry. To help fostering students' ability in probabilistic thinking, we need valid assessment instrument to assist researchers and teachers to develop and implement effective instructions. There are four questions in the Lawson's test on probabilistic reasoning, which are too simple for college students. In this presentation, we will report our research on the development of new questions aimed to provide valid assessment of senior college students.

*Supported in part by NIH Award RC1RR028402 and NSF Awards DUE-0633473 and DUE-1044724.

CG02: 6:40–6:50 p.m. Comparison of Item Response Theory Methods

Li Chen, School of Electronic Science and Engineering, Southeast University, Nanjing, Jiangsu 210096, China: chenli.seu@163.com

Jing Han, Lei Bao, Ohio State University
Jing Wang, Eastern Kentucky University
Yan Tu, Southeast University

Item Response Theory (IRT) is a good tool to investigate the item features. There are several software packages commonly used to do IRT analysis. It is then interesting to see how the different software packages perform on physics concept tests. In this study, we choose to use R and MULTILOG to compare their performance on the three-parameter IRT model with college students' FCI data collected at The Ohio State University. The results showed that both methods generated very consistent outcomes on the estimation of item difficulties, however, the estimations on item discrimination and guessing vary significantly. Implications of the relations among various estimations and conditions will be discussed, which can provide useful insight on how researchers and instructors can implement IRT tools in research and education practices.

* Sponsored by Lei Bao.

CG03: 6:50–7 p.m. Student Methods for Solving Cross Product Direction Questions

Mary Bridget Kustusch, North Carolina State University, Raleigh, NC 27695-8202; mbkustus@ncsu.edu

Robert J. Beichner, NCSU

Identifying the strategies used by students is an important piece of understanding how they find the direction of a cross product. The current qualitative analysis identifies the methods that students use to solve cross product direction questions: both formal methods (e.g. right-hand rules and the use of matrices) and informal methods (e.g. picking up the paper or using orthogonality). In addition, this analysis will explore how these methods relate to previous research [1] on the relationship between quantitative measures of student performance (correctness and response time) and factors such as participant spatial ability and differing problem features.

1. Kustusch, M.B. & Beichner, R. Student difficulties with right hand rules. Contributed Poster: AAPT & PERC, Portland, OR, 17-22 July 2010.

CG04: 7–7:10 p.m. A Protocol for Classifying Sophistication of Students' Reasoning*

Mojgan Matloob Haghanikar, Kansas State University, Manhattan, KS 66506; mojgan@phys.ksu.edu

Sytil Murphy, Dean Zollman, Kansas State University

As part of a study of science preparation of elementary school teachers, students' reasoning skills in courses with inquiry-oriented teaching strategies are compared with those in traditional courses. We devised content questions that are open-ended and focus on application of recently learned concepts in a context that is new to the students. These questions require that students recognize relevant facts or concepts and their interrelationships to provide an applicable or plausible explanation of a scenario presented in the question. We devised a rubric based on the hierarchies of knowledge and cognitive processes developed for two dimensional expansion of Bloom's taxonomy. [1] We coded students' answers in terms of knowledge types, cognitive process components, and for each component, we defined three levels of accomplishment. In this paper we compare students' reasoning for two sets of data we collected from traditional and inquiry-oriented classes in which classes are teaching two different disciplines.

* Supported by National Science Foundation grant ESI-055 4594 1-A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives, L.W. Anderson & D.R. Krathwohl, D.R. New York: Longman (2001).

CG05: 7:10–7:20 p.m. Students' Reasoning About Entropy in Chemical and Physical Contexts*

David E. Meltzer, Arizona State University, Mesa, AZ 85212; david.meltzer@asu.edu

In recent years a number of studies have been published that address students' reasoning about entropy in the context of chemical thermodynamics. These studies have revealed common student difficulties such as confusion regarding distinctions between "system" and "surroundings," misunderstandings regarding microstates and macrostates, and a tendency to confuse entropy with kinetic energy. I will review these studies from the standpoint of related research that has been done in the context of physics education.

*Supported in part by NSF Grant DUE-0817282

CG06: 7:20–7:30 p.m. When Students Do and Do Not Invoke "Force-Of-Motion"

Rebecca J. Rosenblatt, The Ohio State University, Columbus, OH 43214; rosenblatt.rebecca@gmail.com

Andrew F. Heckler, The Ohio State University

Researchers have found that many students believe an object that is moving in a given direction will have an additional force that is responsible for the motion, a "force-of-motion." We report on a study comparing the prevalence of force-of-motion responses for four types of one-dimensional problems. These types are: one force, which opposes the motion; two forces, one with the motion and a larger force against; a qualitative question, which asks students to list the forces; a quantitative question, which asks the students to use numerical information to find the final velocity after one second. Our data suggests that for both the qualitative and quantitative questions fewer students refer to a force-of-motion in the two force questions than in the one force questions. Additionally, the data suggests that the force-of-motion concept is not invoked as often in the quantitative questions as in the qualitative questions.

CG07: 7:30–7:40 p.m. Helping Students Reflect on their Intuitive and Formal Physics Knowledge*

Mel S. Sabella, Chicago State University, Chicago, IL 60628; msabella@csu.edu

*Sean Gallardo,** Chicago State University*

The topic of intuitive physics knowledge in the context of physics instruction has long been a subject of discussion by the physics education community. In this talk we discuss the role students' intuitive knowledge plays when they are confronted with different types of physics tasks in our introductory physics class at Chicago State University. In addition, we describe how our instructional approach attempts to activate and connect this intuitive knowledge to the formal knowledge that makes up the bulk of the coursework. The approach relies heavily on a series of opportunities in which students explicitly reflect on their initial ideas and the physics content they are exploring.

*Supported by NSF-CCLI grant DUE-0632563. *Sponsored by Mel Sabella.

CG08: 7:40–7;50 p.m. Visual Cognition and Spatial Ability in Physics and Other STEM Fields

Ximena C. Cid, University of Texas, Arlington, TX 76013; xcid@uta.edu

Ramon Lopez, University of Texas, Arlington

It has been argued that visual cognition and spatial ability are essential to physics and other Science Technology Engineering and Mathematics (STEM) fields because of the spatial nature of their spatial topics. The mental manipulation of a visualized system, while trying to solve a problem, has the ability to produce a sufficient cognitive load where the student is unable to solve the problem. Such difficulties may be separate from other conceptual difficulties related to the content, or they may interact with conceptual difficulties and block student learning. Previous research suggests that this cognitive load creates an incorrect mental image of the problem, and it is this misconception resulting from the incorrect mental image (or an incorrect mental manipulation), not the lack of content knowledge that can generates student error. It has also been shown that there is a correlation between achievement in STEM fields and spatial ability. I will be presenting on student assessments of spatial ability in physics and a brief comparison to other STEM students.

CH: Teaching with Technology - I

Location: Grand Ballroom 3
Sponsor: Educational Technologies Committee
Date: Monday, January 10
Time: 6:30–7:50 p.m.

Presider: Brian Holton, Passaic County College

Contributed session focused on innovations and best practices in the use of technology for physics education.

CH01: 6:30–6:40 p.m. Innovative Use of a Classroom Response System during Physics Lab

Jay Walgren, Vernon Hills High School, Vernon Hills, IL 60061; jay.walgren@D128.org

Newer generation classroom response systems (clickers) have evolved to accept numeric answers instead of just single multiple choice entries. This evolution makes it possible for clickers to be used to electronically capture student's lab data as they are performing a physics lab. This presentation discusses the use of a classroom response system (clickers) during physics laboratory and three benefits that result. 1) Students are encouraged to "take ownership of" and "have integrity with" their physics lab data. 2) Students' measuring and unit conversion deficiencies are identified immediately during the lab. 3) The process of grading students' labs is simplified because the results of each student's lab calculations can be pre-calculated for the instructor using a spreadsheet.

CH02: 6:40–6:50 p.m. Camtasia Mini-Lessons for Undergraduate Physics Courses

Tetyana Antimirova, Ryerson University, Toronto, ON M5B 2K3; antimiro@ryerson.ca

Marina Milner-Bolotin, University of British Columbia

The electronic inking and screen capture technologies utilized in tablet personal computers open up new exciting opportunities in undergraduate physics teaching since they allow capturing the writing and drawing process. The audio part can be recorded simultaneously, or can be added later. Therefore the entire problem-solving process can be recorded in the form of a short video. This video can be posted on the courses management system website, where the students can access and replay it as many times as needed. We used Camtasia Studio to create a number of mini lessons targeting particularly difficult concepts in an undergraduate physics course. Our mini lessons (shorter than 10 minutes) typically include a problem statement, animated diagrams, questions to probe student initial knowledge, and detailed explanations and solutions, including derivations. Our present content includes mini-lessons for an introductory mechanics and third-year electricity and magnetism courses. The examples of mini-lessons will be demonstrated.

CH03: 6:50–7 p.m. Interactive NMR Exploration: Fundamentals to Application

Joshua Bridger, Dover Sherborn High School, Dover, MA 02030; bridgerj@doversherborn.org

Keith Brown, Harvard University
Sarah Griesse-Nascimento, Boston University

Computer models and simulations can be effective tools in bringing contemporary physics research topics to the introductory physics classroom. A series of Graphical User Interfaces (GUIs) and accompanying curriculum were developed to guide students toward conceptual understanding of Quantum Spin, Nuclear Magnetic Resonance (NMR) and Protein Biosensors. This series of exploratory GUIs steps users through T1 and T2 relaxation time measurement, the mathematics of phase reversals, protein detection using magnetic nanoparticle biosensors and disease diagnosis using protein fingerprinting. The aim is to introduce students, through self-paced discovery, to the fundamental physics underlying NMR operation and to new developments in portable NMR devices that utilize magnetic nanoparticles as a diagnostic tool for disease detection. These explorations will both reinforce topics in the standard curriculum and provide students with an authentic glimpse at contemporary research.

CH04: 7–7:10 p.m. Einstein on Facebook?

Anne J. Cox, Eckerd College, St. Petersburg, FL 33712; coxaj@eckerd.edu

Nikki Bell, Alex Roberts, Amber Simon, Eckerd College

The class "Einstein for Everyone" required a project on Einstein and popular culture. One group of students decided to put Einstein on Facebook. The students involved in the project and the faculty member who taught the course (which was essentially relativity for nonscientists) will give their perspectives on the project and the use of social networking for this project.

CH05: 7:10–7:20 p.m. Magnetism Made Easy: A Quantum Spin Simulation Anyone Can Use

Larry Engelhardt, Francis Marion University, Florence, SC 29505; lengelhardt@fmarion.edu

Although the magnetism produced by a current-carrying wire is relatively easy to understand, and easy to calculate, understanding the magnetism of materials is much more difficult. This magnetism arises from interactions between neighboring atoms, and calculations require concepts from quantum mechanics, modern physics, and statistical physics. Since most students haven't completed these courses until the end of an undergraduate education, only a relatively smaller number of students get to experience the joy of studying this phenomenon. In this presentation, we will introduce new Open Source Physics software for simulating magnetic materials that is sufficiently user friendly that it can be used by students at any level. It allows the user to "experiment" with geometries, spin quantum numbers, temperatures, and fields, and to observe the resulting energy spectra, magnetization, and susceptibility. This software can be downloaded from the Open Source Physics website at www.compadre.org/osp/items/detail.cfm?ID=10038 as an executable Java (JAR) file.

CH06: 7:20–7:30 p.m. Evaluation of Physics Pathway, Web-based Assistance for Teachers of Physics*

Dean A. Zollman, Kansas State University, Manhattan, KS 66506-2601; dzollman@phys.ksu.edu

Sytil K. Murphy, Kansas State University
Scott Stevens, Michael Christel, Carnegie Mellon University

The Physics Teaching Web Advisory (Pathway) is continuing to demonstrate the ability to address pedagogical issues of many physics teachers via the web and to evolve as a tool for teachers. Pathway's "Synthetic Interviews" which engage teachers in a natural language dialog about effective teaching of physics includes about 6000 different recorded answers and over 10,000 question/answer pairs. During the past year a group of high school teachers have been using Pathway to enhance their physics teaching. Preliminary analysis of the evaluation data is now under way. Pathway is available at http://www.physicspathway.org.

*Supported by the US National Science Foundation under Grants 0455772 & 0455813.

CH07: 7:30–7:40 p.m. Blessing and Blight of Wireless Computers in Lecture-Oriented Physics

Zdeslav Hrepic, Columbus State University, Columbus, GA 31907; hrepic_zdeslav@colstate.edu

Kimberly Shaw, Columbus State University

A recent article in *The Washington Post* titled "More colleges, professors shutting down laptops and other digital distractions"[1] cites a number of references that question the educational benefits of allowing students to use wireless-ready computers in classrooms. While potentially valuable, wireless computers can be also misused during the class time, thus distracting the user, students in vicinity, and the instructor. In an attempt to capitalize on interactive learning options associated with wireless computers and DyKnow software, we encouraged students to voluntarily bring their personal wireless computers to two introductory physics courses (one algebra-based and one calculus-based). We compare the performance of students who consistently used computers in classroom with those who did so less frequently or not at all. We also gauge student attitudes and recommendations related to DyKnow software.

1. Laura Mortkowitz, in The Washington Post (The Washington Post, 2010).

CH08: 7:40–7:50 p.m. Combining Electronic Voice and Ink Capture in Physics Classes

William (Bill) F. Junkin, Eckerd College, Saint Petersburg, FL 33711; junkinwf@eckerd.edu

When students access notes posted electronically by their teachers, the order of the drawing of diagrams and writing of equations is important, but the accompanying spoken words of explanation may be even more important. This presentation will explore some of the ways that sound can be captured inexpensively along with the dynamic writing on paper and this "movie (with audio)" can be posted electronically using the LiveScribe pen and other programs.

CI: Computational Physics From the Freshman to the Senior Year - I

Location: City Terrace 6
Sponsors: Physics in Undergraduate Education Committee, Educational Technologies Committee
Date: Monday, January 10
Time: 6:30–7:20 p.m.

Presider: Trina Cannon, Highland Park High School, Dallas, TX

Computational physics is becoming an essential component of the standard curriculum for physics majors. Sometimes computational physics is integrated into courses, sometimes it is a stand-alone course, and sometimes there is a track or a major in computational physics that includes many courses. This session will include invited and contributed papers describing various ways to teach computational physics in the undergraduate curriculum for physics majors.

CI01: 6:30–6:40 p.m. Intro. Students Using Physics to Evaluate Functional, but Incomplete Programs

Shawn A. Weatherford, Elon University, Elon, NC 27244; sweatherford@elon.edu

Ruth Chabay, North Carolina State University

Computational activities in the Matter & Interactions[1] curriculum for calculus-based introductory physics promote the tenets of the curriculum: mainly, the deterministic view of classical mechanics. For systems that are too complex to calculate analytically, computers perform an iterative calculation of the fundamental principles of physics to predict the system's dynamics. An ongoing research project[2] analyzes video data of groups of students who completed restructured computational activities with VPython[3] in a lab setting. These activities were designed to guide student attention on using fundamental principles to repair functional, but incomplete programs. The programs are provided to students to first interpret and predict what the visual scene will display before being executed for the first time. I'll present data on how students justify their own predictions and compare these predictions to both the visual output and the existing program code.

1. http://www.matterandinteractions.org
2. Supported by NSF Grant DUE-0618504
3. http://www.vpython.org

CI02: 6:40–6:50 p.m. Mathematica: Changing the Way Our Majors Do Physics

Nathan L. Harshman, American University, Washington, DC 20016; harshman@american.edu

This talk presents a case study of injecting computational physics into multiple courses as a small but integral component. Over the last five years, the Department of Physics has engaged in an on-going process to employ the mathematical software Mathematica across our physics major curriculum, especially in upper-level core classes. The Mathematica component of each course focuses on a particular theme, such as function visualization in Waves and Optics, automation of calculation in Experimental Physics, and analytical computation in Classical Mechanics. Formal and informal assessment shows that, for some of our majors, these new tools have transformed the way they approach physics problems in their classes and in their undergraduate research.

CI03: 6:50–7 p.m. Comprehension Before Computation

Paul G. Hewitt, City College of San Francisco, San Francisco, CA 94112; Pghewitt@aol.com

Computation is important in all the sciences, especially physics. Computations are more meaningful when they follow comprehension of the concepts they involve. Examples will be given to demonstrate how concept development first leads to understanding at the problem-solving stage of learning physics.

CI04: 7–7:10 p.m. Computational Neuroscience Course in a Liberal Arts College Setting

Minjoon Kouh, Drew University, Madison, NJ 07940; mkouh@drew.edu

I would like to present an interdisciplinary course in computational neuroscience, developed within a liberal arts college setting in 2009. This course covered various topics in biophysics of a neuron and neural network theory. The course was geared toward juniors and seniors in physics, neuroscience, and computer science programs. The students learned to program in Matlab/Octave, and worked on short-term research projects. The review of the course was very positive. Offering a highly interdisciplinary course like this one, attracting students from various fields, is one way of pooling the limited resources from smaller departments and providing the students with excellent learning opportunities.

CI05: 7:10–7:20 p.m. Threading Matlab Through a Four-Year Curriculum

Donald A. Smith, Guilford College, Greensboro, NC 27410; dsmith4@guilford.edu

Steven Shapiro, Thomas Espinola, Rexford Adelberger, Guilford College

We report on a department-wide approach to thread the use of Matlab through all levels of a coherent undergraduate curriculum. Matlab is a flexible tool made easily accessible by the decreasing cost of powerful computers. With Matlab skills, even a small liberal arts college can empower students to tackle complex and innovative problems. First-semester students learn to use the symbolic toolbox, while increasingly challenging programming tasks are assigned in later courses. Intermediate lab courses use Matlab for curve fitting and data analysis. A second-year mathematical physics class focuses on computational physics techniques such as Fourier analysis and numerical solutions to partial and ordinary differential equations, which are subsequently applied in upper-level physics courses. Students also use Matlab in their senior theses and internships. Students report that experience with computational techniques and fluency in Matlab have helped them during internships and in graduate school.

PST1: Poster Session 1

Location: Outside Exhibit Hall
Date: Monday, January 10
Time: 9–10:30 p.m.

Odd number poster authors will be present 9–9:45 p.m.
Even number posters will be present 9:45–10:30 p.m.
(Posters should be set up by 9 a.m. Monday and taken down by 10:30 p.m. Monday)

Astronomy, Physics Education Research, Labs/Apparatus, Pre-college/Informal and Outreach, Teacher Training/Enhancement, Upper Division and Graduate

PST1A-01: 9–9:45 p.m. Energy-Momentum in Galilean and Special Relativity Using Spacetime Trigonometry*

Poster - Roberto B. Salgado, Bowdoin College, Brunswick, ME 04011; rsalgado@bowdoin.edu

Spacetime Trigonometry is a unified treatment of the geometry of Euclidean space, Galilean spacetime, and Minkowskian spacetime that provides a new framework for teaching relativity. Within this framework, we present a new unified formulation of energy-momentum in both Galilean and Special Relativity. We provide some examples of standard introductory-textbook collision problems solved with this approach.

* An overview of Spacetime Trigonometry is available at http://www.aapt.org/doorway/Posters/SalgadoPoster/SalgadoPoster.htm (from http://www.aapt.org/doorway/TGRU/).

PST1A-02: 9:45–10:30 p.m. What Can I Do With a Major in Computational Physics?

Poster - Robert S. Smith, Francis Marion University, Florence, SC 29506; rsmith@fmarion.edu

Francis Marion University (FMU) has a physics major with two separate concentrations. One concentration is called Health Physics and is concerned with radiation safety and protection. The other concentration is called Computational Physics. In addition to the courses that are normally required in a "traditional" physics major, Computational Physics also includes four additional courses that are entitled Computational Methods for Physics and Engineering, Computational Physics, Advanced Computational Physics, and Senior Research in Physics. Computational projects, simulations, and exercises are also incorporated into other physics courses. The founder of physics at FMU, Dr. Skip Hendrick, was fond of saying that "physics seems to attract some of the best students." Of course, he was right. Learning about the fundamental nature of the universe is a fascinating journey for our students and it stimulates the intellects and imaginations of many of our best students. However, these same students often approach me with a very practical question — "What can I do with a major in Computational Physics?" The purpose of this presentation is to provide an answer to this question.

PST1A-03: 9–9:45 p.m. Graduate Quantum Mechanics Reform*

Poster - Lincoln D. Carr, Colorado School of Mines, Golden, CO 80401; lcarr@mines.edu

Sarah B. McKagan

We address four main areas in which graduate quantum mechanics education can be improved: course content, textbook, teaching methods, and assessment tools. We report on a three-year longitudinal study at the Colorado School of Mines using innovations in all these areas. We find that graduate students respond well to research-based techniques that have been tested mainly in introductory courses, and that they learn much of the new content introduced in each version of the course. Their ability to answer conceptual questions about graduate quantum mechanics is highly correlated with their ability to solve calculational problems on the same topics. In contrast, their understanding of basic undergraduate quantum mechanics concepts at the modern physics level is not improved by instruction at the graduate level.

* Funded by the NSF.

PST1A-04: 9:45–10:30 p.m. Women in Physics: a SUNY Oswego Approach to an Old Problem

Poster - Carolina C. Ilie, State University of New York at Oswego, Oswego, NY 13126; carolina.ilie@oswego.edu

Lillie Ghobrial, Michael Evans, Gregory Maslak, Mark Stewart, SUNY Oswego

It is not a surprise that the number of women in physics is not impressive, and the reasons are diverse and well-known.[1] Herein we discuss how to the increase the number of women students in physics, what we do and what else can be done to improve the atmosphere in physics departments for all the students, female and male and to make sure they are successful. A few undergraduate students contribute to this study and their insight will hopefully benefit our department and other science departments in which women are underrepresented. The faculty is a member of the Committee of Women in Materials Science and Engineering—Materials Research Society, gave invited talks on women in physics and would like to see more successful women in physics at SUNY Oswego.

1. Rachel Ivie and Katie Stowe. June 2000. "Women in Physics," 2000, AIP Publication Number R-430.

PST1A-05: 9–9:45 p.m. Dr. Seuss Used Acronyms to Simplify the Study of Physics

Poster - Shannon Schunicht, Texas A&M University, College Station, TX 77845; mnemonicmind@alpha1.net

A plane crash damaged this author's Right brain, Spatial/musical, to accentuate his left Language/Logic hemisphere. Coupled with 2ea BA degrees, pysics were simple because EVERYTHING HAD LEARNED MYSELF The residual deficit continues to plague this author, Out of Sight is truly Out of mind. The nuts & bolts of this presentation are essentially having each Vowel represent a Mathematical operation. a for multiplication implying @, o for division implying over, i for subtraction implying minus, u for addition implying plus, and e implying equals. Constants and variables are indeed consonants, e.g. F for Faraday's and v for velocity. Additional consonants insertion are used to enhance intelligibility, but NEED BE CONSONANTS ONLY. Catchy phrases remain with students throughout their lifetime, despite non-use/need. Building rabbits 4 cats on 2 hats is an acronym for a complicated formula, attendance will reveal. Everyone remembers Dr. Seuss. The possibilities of this Mnemonic technique [Vowels: Mathematical operations] are limitless as Delta x approaches 0.

PST1A-06: 9:45–10:30 p.m. Graphical Representation of the Process of Solving Problems in Statics*

Poster - Carlos Lopez, Universidad Del Valle De Mexico, Queretaro, Queretaro; academ58@hotmail.com

We present a method of construction to a graphical representation technique of knowledge called Conceptual Chains. Especially, this tool has been focused to the representation of processes and applied to solving problems in physics, mathematics and engineering. The method is described in 10 steps and is illustrated with its development in a particular topic of statics. Various possible didactic applications of this technique are showed.

*Thanks to Laureate International Universities, Baltimore MD, for the financing granted for the accomplishment of this work

PST1A-07: 9–9:45 p.m. Theoretical Model to Explain the Problem-Solving Process in Physics

Poster - Carlos Lopez, Instituto Tecnologico De Queretaro, Mexico; geneaux2001@yahoo.com.mx

This work reports a theoretical model developed with the aim to explain the mental mechanisms of knowledge building during the problem-solving process in physics using a hybrid approach of assimilation-formation of concepts. The model has been termed conceptual chains and represents graphic diagrams of conceptual dependency, which have yielded information about the background knowledge required during the learning process, as well as about the formation of diverse structures that correspond to distinct forms of networking concepts Additionally, the conceptual constructs of the model have been classified according to five types of knowledge. Evidence was found about the influence of these structures, as well as of the distinct types of knowledge about the degree of difficulty of the problems.

Teacher Training/Enhancement

PST1B-01: 9–9:45 p.m. Description of a Physics by Inquiry Program for K-12 Teachers*

Poster - Robert J. Endorf, University of Cincinnati, Cincinnati OH 45221-0011; robert.endorf@uc.edu

Don Axe, Amy Girkin, Jeffrey Radloff, University of Cincinnati
Kathleen M. Koenig, Wright State University

We report on our experience in conducting *Physics by Inquiry*[1] professional development programs since 1996 for K-12 teachers at the University of Cincinnati. During the summer two professional development programs are given, a four-week 120-hour graduate course in Physics by Inquiry for middle school and high school teachers and a separate two-week 60-hour course for teachers in grades K-5. A total of 512 teachers have completed one of the programs. We will describe responses from the participants and results from pre-tests, post-tests, journals and surveys completed by the participants. The programs have produced large gains in the teachers' science content knowledge, science process skills, and confidence in teaching inquiry-based science lessons.

* Supported by The Improving Teacher Quality Program administered by the Ohio Board of Regents.

1. L.C. McDermott and the Physics Education Group at the University of Washington, *Physics by Inquiry*, John Wiley & Sons (1996).

PST1B-02: 9:45–10:30 p.m. Comparing Masters Degree Physics Teacher Preparation in Buffalo NY and Helsinki

Poster - Daniel L. MacIsaac, SUNY Buffalo State College Physics, Buffalo, NY 14222; macisadl@buffalostate.edu

Luanna S. Gomez, SUNY Buffalo State
Ismo Kaponen, Ari Hamaleinen, University of Helsinki Physics

We juxtapose Masters degree programs for physics teacher preparation offered at University of Helsinki and SUNY Buffalo State College. We describe program coursework, candidates, and program outcomes.

PST1B-03: 9–9:45 p.m. Promoting Physics Student Reflection via Reading Logs and Learning Commentaries

Poster - Daniel L. MacIsaac, SUNY Buffalo State College Physics, Buffalo, NY 14222; macisadl@buffalostate.edu

David Abbott, Kathleen A. Falconer, Dave R. Henry, SUNY Buffalo State

We describe our use of Reading Logs and Learning Commentaries to promote physics student reflection on their own physics learning in lower-division college and university physics courses, and in courses at multiple levels for pre-service physics teachers. Reading Logs are intended to free lecture and classroom time from reading the text, and provide a mechanism to guide, support, recognize, and credit students for reading their physics text outside class time. Reading Logs (RLs) are intended to be fast, frequently collected, and readily evaluated rewards for appropriate student effort. Learning Commentaries (LCs) are short, three-paragraph essays intended to promote reconciliation of student experiences learning physics with their own lived experience through writing. LCs are typically collected only a few times during the semester (typically before exams) and are graded via a sophisticated rubric. We present the forms for RLs and LCs, the LC rubric and some exemplars of student work.

PST1B-04: 9:45–10:30 p.m. Enhancing PCK on Electrostatics in Primary School Teachers

Poster - Marisa Michelini, Physics Department of the University of Udine, 33100, Italy; marisa.michelini@uniud.it

Alessandra Mossenta, University of Udine

Discovering the need for microscopic entities into matter to interpret electrostatic charging phenomena constitutes an opportunity in building childrens' scientific ideas. The PCK approach interpreted as a way to form perspective primary teachers (PPT) by means of discussion of teaching/learning paths is the background of a questionnaire on pupils' difficulties on the charge transfer submitted to 64 PPT after an exploration of simple charging phenomena. Experimental exploration were focused on recognizing a change in the state of systems after the charging actions (preparation), features of the new state of the system, types of interaction (attraction and repulsion), dual nature of the (state) property and interpreting phenomena assuming that something always into the material, is conserved and able to move. From data analysis of the questionnaire, it emerges that there are some fertile critical situations for conceptual discussion and for clarification of crucial concept as those of potential.

PST1B-05: 9–9:45 p.m. Physics Teacher Education in Brazil: Examining Federal Institutes Certification Programs

Poster - Luzia Mota, Instituto Federal de Educação, Ciência e Tecnologia da Bahia, Campus Salvador, Brazil 40301-015; luziammota@gmail.com

Robéria Lopes, Universidade do Ceará
Luísa Senna, Instituto Federal de Educação
Katemari Rosa, Columbia University

This study describes the experience of implementing Science and Mathematics Teacher Education programs in general, and physics in particular, in a traditionally technological institute in Brazil that recently started to offer teacher certification programs. Initially, we present an analysis of the pedagogical frameworks that guide these new programs, and were grounded in the institute's vision and mission: professional education integrating science, technology, labor, and culture. In addition, the new projects had be integrated with the professional and pre-college, college, and graduate degrees the institution already offered. Finally, we analyzed the process of implementing these programs, considering issues of infrastructure, students' background, and administration. Our goal with this study is to present a recent and innovative experience in physics teacher certification programs in Brazil.

PST1B-06: 9:45–10:30 p.m. ATE Program for Physics Faculty

Poster - Thomas L. O'Kuma, Lee College, Baytown, TX 77522-0818; tokuma@lee.edu

Dwain M. Desbien, Estrella Mountain Community College

The ATE Program for Physics Faculty is into its fifth year and has finished its 17th workshop/conference. In this poster, we will display some of the materials from these various workshops/conference and illustrate some of the activities, sessions, and individuals involved - particularly from the PTIP Workshop at Southeast Community College and the STIP Workshop at Lee College. We will also display what's next.

PST1B-07: 9–9:45 p.m. Teacher Professional Development through Science Notebooking and Content Institutes

Poster - Patricia E. Palko, Dept. of Biological Sciences, University of Denver, Denver, CO 80208; ppalko@du.edu

Steven Iona, University of Denver

The Denver Public Schools/University of Denver Urban Partnership for Improving Elementary Science is a Mathematics and Science Partnerships (MSP) Grant geared toward providing an enriching professional development experience to 51 in-service grades 4-7 teachers of this large, urban district. Teacher-participants attended a two-week summer institute, in which they were instructed in Earth, life, or physical science content and the science note booking pedagogy of Michael Klentschy. To assess the degree that professional development of teachers affects student understanding of/mastery in these subjects, we looked at the following measures: the teachers pre-/post-content-based concept inventory test scores, the quality of the teachers' science notebooks, the quality of the teachers' collaborative discussions, the students' science notebooks, and the quality of the students' collaborative discussions.

PST1B-08: 9:45–10:30 p.m. A Study on the Perception of Korean Secondary School Science Teachers' Toward Scientific Writing

Poster - Kilsoon Park, Pusan National University, Republic of Korea 609735; pkilsoon@hanmail.net

Jina Kim, Pusan National University

The purpose of this study was to find out a way to activate scientific writing in educational fields. To accomplish this, three investigations were involved: 1) Korean secondary school science teachers' perception toward scientific writing to realize the degree of using it, 2) the necessity and effect of scientific writing that teachers realize, 3) teachers' intention to use scientific writing. The object of this study was 429 Korean science teachers. The questionnaire was completed and modified by a professional science educational group after four seminars. The survey was conducted in March to April 2010. The results of this study were that the degree of using scientific writing was low with 31.2% of teachers having experience to use it, that teachers realized the necessity and effect of scientific writing and that teachers were positive about using scientific writing in class if given proper programs or teaching materials.

PST1B-09: 9–9:45 p.m. Emphasizing the Professional Nature of Teaching: The CSU Noyce and PhysTEC Projects*

Poster - Mel S. Sabella, Chicago State University, Chicago, IL 60628; msabella@csu.edu

*Andrea Gay Van Duzor,** Chicago State University*

Central to the recruitment of students into science teaching at a school like CSU is to focus on the professional nature of teaching. The purpose of this focus is twofold: it serves to change student perceptions about teaching and it prepares students to become teachers who value continued professional development and value the science education research literature. The Noyce and PhysTEC programs at CSU place the professional nature of teaching front and center by involving students in education research projects, paid internships, attendance at conferences, and participation in a weekly science education journal reading class. Through PhysTEC funding, we are implementing two new components to the teacher education program at CSU that also build and reinforce this idea of professionalism in science teaching. In this poster we describe these two programs and how they complement each other.

* Supported by the NSF (Grant 0833251) and the American Physical Society (PhysTEC)

**Sponsored by Mel Sabella.

PST1B-10: 9:45–10:30 p.m. Elementary Pre-service Teachers' Preparation: Self Assessment Rubric for Scientific Reasoning Ability

Poster - Homeyra R. Sadaghiani, California Polytechnic University, Pomona, CA 91768; hrsadaghiani@csupomona.edu

The objectives of K-12 teacher education often focus on conceptual learning and improving students' overall attitude toward physics. In addition, it is often assumed that with the use of research-based curriculum material and more hands-on inquiry approaches, student scientific and critical thinking skills would also be enhanced. I have been investigating student scientific and evidence-based reasoning abilities in a K-8 pre-service science courses at Cal Poly Pomona in the last three years. I have provided explicit feedback using rubrics to assist students in becoming more rigorous and reflective thinkers; using appropriate and accurate vocabulary, exercising evidence-base reasoning, and developing skepticism with respect to their own views. I will share the preliminary rubrics and report the preliminary results.

PST1B-11: 9–9:45 p.m. New Faculty Experience for Two-Year College Physics Instructors

Poster - Scott F. Schultz, Delta College, University Center, MI 48710;sfschult@delta.edu

Todd Leif, Cloud County Community College

We are pleased to announce a very special program as part of the American Association of Physics Teacher's commitment to improving physics education—The New Faculty Experience for Two-Year College Physics Faculty. The New Faculty Experience will provide new faculty members in their first five years of teaching at a two-year college with knowledge of active learning techniques that are both Physics Education Research-based, and that have been successfully implemented at two-year colleges across the country.

PST1B-12: 9:45–10:30 p.m. PCK Study on Prospective Primary Teachers Facing Relative Motion

Poster - Stefano Vercellati, Physics Department of the University of Udine, 33100, Italy; stefano.vercellati@uniud.it*

Marisa Michelini, Lorenzo Santi, Alberto Stefanel, University of Udine

Relative motions are rarely considered in the training of prospective primary school teachers but, in addition to the importance in physics itself, the description of motion is one of the first problems that children face in their first experiences in the world. The poor preparation of teachers requires a deeper treatment of the topic even with the time constraints imposed in the formative course by the other more traditional topics. In order to enable teachers to address effectively relative motion in the classroom, we designed a formative intervention module that proposes relative motion in the context of composition and decomposition of motions discussing some emblematic cases (like pursuits, boats drag by current, observers on carousels—Coriolis acceleration—and falling objects) and we developed a PCK questionnaire analyzing these specific situations. In this work we present and discuss the results of the PCK test.

* Sponsored by Marisa Michelini and Alberto Stefanel.

PST1B-13: 9–9:45 p.m. Information Fluency: Where to Start?

Poster - Pat T. Viele, Cornell - retired, 4 Dorchester Dr., Geneseo, NY 14454; ptv1@cornell.edu

Learning to find, to evaluate, and to use information ethically is a set of skills called Information Fluency. The information scene has changed drastically since the advent of the Internet and acquiring these skills is more important than ever. This poster presents some logical starting points for gaining Information Fluency skills.

Pre-college/Informal and Outreach

PST1C-01: 9–9:45 p.m. Education Bridge Between Industry and Technology

Poster - Ozden Zorlu, Kucukyali Istanbul, Istanbul, Turkey; ozdenzorlu@gmail.com

Education can be interpreted as a bridge between the industry and technology. The aim of this presentation is generally analyzing the subsets of a universal set society. Three important basics of that universal set can be called education, technology or innovation, and industrial corporations. Qualification and the management of those subsets are important since they together stream into the living organism of the society. Firstly assumptions may be built that an organism survives according to the natural selection rules in a habitat. Even that natural selection is an organized process. However, human beings try to interact with the system subsets within a logic or philosophy. Recently we are changing technology and instantaneously a sudden change is affecting the environment we live in. Certainly it can be said that the main purpose of education is creating a change on a person. Assuming that person is interacting within the body and creativity generates new technology and innovation that is manufactured and visualized on the lines of a factory as a part of the industrial patterns of the process. Exactly this will be the point that I will configure the samples related with physics. To demonstrate that relation it can be said that though we assume that velocity can be determined depending on a precise determination of the position of a moving object. I will try to illustrate that this assumption is just a part of old fashioned point of view of Classical Dynamics in Physics.

PST1C-02: 9:45–10:30 p.m. Femtosecond Electron Diffraction: Generating Student Excitement for Physics

Poster - John E. Clark, Deltona High School, Deltona, FL 32725; jeclark@volusia.k12.fl.us

Femtosecond Electron Diffraction (FED) has the potential for providing atomic resolution of structural changes as they occur, essentially watching atoms move in real time but explaining how that process works to a high school or middle school student is a challenge. It was a challenge that the mentors of my Research Experience for Teachers program had not solved. At the National High Magnetic Field Lab, student tours, open houses, and community outreach programs are part of the fabric of this national lab. For the PhD research team that I was assigned to work with, these opportunities to talk about their work to students was an activity in frustration. It took me three weeks to understand what our research was about, but once I did I was able to put together a poster and a powerpoint that the research team could use to explain their work in just a few minutes.

PST1C-03: 9–9:45 p.m. Interactive Laser Displays*

Poster - Patricia A. Sievert, Northern Illinois University, DeKalb, IL 61010;psievert@niu.edu

Northern Illinois University STEM Outreach used funds from LaserFest.org to design, build, and share several interactive laser displays in 2010. The poster will display some of the items and assessment of the activities.

* www.niu.edu/stem, www.stemfest.niu.edu

PST1C-04: 9:45–10:30 p.m. The PhysicsBowl: A Contest for High Schools

Poster - Michael C. Faleski, Delta College, University Center, MI 48710; michaelfaleski@delta.edu

The PhysicsBowl is an annual contest for high school students for which prizes are awarded to high scoring students and schools. The contest is given during the month of April and can serve as a good review for any physics class, including those taking AP or IB curricula. This informational poster will include copies of last year's exam, the equation sheet, the solutions, and the list of winners in an attempt to increase the awareness of this contest for both students and schools.

Labs/Apparatus

PST1D-01: 9-9:45 p.m. Computer Programming in an Introductory Mechanics Course

Poster - Timothy A. French, Harvard University, Cambridge, MA 02138; french@fas.harvard.edu

Corry L. Lee, Logan S. McCarty, Joon Pahk, Vinothan N. Manoharan, Harvard University

Computers are necessary in a modern scientific laboratory, and the ability to program is an increasingly important skill for experimental scientists to possess. With this goal in mind, we introduced the Sage programming environment (www.sagemath.org) in our introductory mechanics course during the fall 2008 semester. Sage utilizes a text-based language similar to Python, which makes it very approachable for students who have never been previously exposed to programming. Students were provided with an interactive Sage worksheet that taught the basic ideas of programming (e.g., pseudocode, declaring variables, loops, arrays, etc.) for reference. This doubled as a prelab assignment for a lab using Monte Carlo simulations to approximate uncertainties in lines of best fit; this method and the programs written in this lab were used throughout the semester. Along with the procedure, difficulties encountered and suggestions for future implementation will also be discussed.

PST1D-02: 9:45–10:30 p.m. A Polarimetric Imaging Lab for Introductory Physics

Poster - Adam S. Green, University of St. Thomas, St. Paul, MN 55105; asgreen@stthomas.edu

Paul R. Ohmann, Nick E. Leininger, University of St. Thomas

For several years we have included discussions about insect vision in the optics units of our introductory physics courses. This topic is a natural extension of demonstrations involving Brewster's reflection and Rayleigh scattering of polarized light because many insects heavily rely on optical polarization for navigation and communication. Students, especially those majoring in the life sciences, tend to find the conversation intriguing because of its interdisciplinary context. To make it even more appealing, we recently created a laboratory component that allows students to use digital cameras, polarizing filters, and ImageJ software to create polarization maps of environmental scenes and insect bodies.

PST1D-03: 9–9:45 p.m. Measuring Planck's Constant with LEDs as Light Sources

Poster - Maximilian F. Heres, University of West Georgia, Carrollton, GA 30118; mheres1@my.westga.edu

Bob Powell, Robert Moore, University of West Georgia

A widely used experiment for upper-level laboratory experiments is the determination of Planck's constant. The Daedalon EP-05 Photoelectric Effect Apparatus is available for the required measurements of the stopping voltage versus wavelength using selected wavelengths of light from various sources. In this study, six light emitting diodes (LEDs) (660nm, 605nm, 595nm, 524nm, 470nm, 400nm) and four lasers (633nm, 612nm, 594nm, 544nm) were used as light sources. Planck's constant determined with the LED sources had an average percent error of less than 0.3% compared to 1.3% for the laser sources, for which there were fewer sources and no sources at the short wavelengths. While LEDs do not have as narrow a spectral profile as do lasers, they are still excellent sources for discrete wavelengths, yield excellent results for the photoelectric effect, and much less expensive than lasers.

PST1D-04: 9:45–10:30 p.m. Experiential Learning Supports Conceptual Understanding of Mechanical Physics

Poster - Carly Kontra, University of Chicago, Chicago, IL 60615; ckontra@uchicago.edu*

Neil B. Albert, Shu Ju Yang, Sian L. Beilock, University of Chicago
Susan Fischer, DePaul University

This work is a collaborative effort between cognitive scientists and physicists, with the goal of improving high school and college students' physics proficiency. Our first experiment investigates the utility of specific laboratory experiences in enhancing students' concept of angular momentum. Recent work has shown that access to sensorimotor information enhances conceptual understanding (Beilock et al 2008). We hypothesized that direct experience feeling changes in torque and angular momentum would give students this information, and perhaps lead to subsequent recruitment of sensorimotor brain areas when students were later asked to reason about these concepts. Our results support this hypothesis, with students who saw a demonstration of angular momentum showing poorer understanding of force quantities than those who felt the effects of angular momentum. Subsequent work explores whether these differences are indeed due to differential reliance on sensorimotor brain systems when students reason about physics concepts.

* Sponsored by Susan Fischer.

PST1D-05: 9–9:45 p.m. Web Cam Spectroscopy of Laser Induced Fluorescence of Play-Doh

Poster - Mark F. Masters, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Eric Tomek, Jacob Millspaw, IPFW

Short-wavelength laser pointers are readily available, dangerous and very affordable. Using 635nm, 532nm and 405nm laser pointers, we examine the fluorescence spectra of various color Play-Doh samples. The spectra are analyzed using a simple spectrometer made of a web-cam and a section of DVD. We present the spectrometer, and the laser induced fluorescence of the Play-Doh as an activity that helps students understand color, spectra, laser spectroscopy, and the energy of light.

PST1D-06: 9:45–10:30 p.m. A Mechanical Analog of NMR

Poster - Mark F. Masters, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Nathan Cheviron, IPFW

Construction of a mechanical model of Nuclear Magnetic Resonance (NMR) is described to help students gain insight into the complex physics in what is generally a "black-box." We will present specific details of how the apparatus was built, the mechanical model and the results, correlation of these results with NMR, and comparison with the usual descriptions of the NMR process.

PST1D-07: 9–9:45 p.m. Helping Students Understand the Work-kinetic Energy Theorem through Laboratory

Poster - Mark F. Masters, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Eric Ayars, California State University, Chico
Brian Bauman, Jacob Millspaw, IPFW

We present a simple investigation using a modified "fan cart" that allows students to explore and discover the relationship between work and kinetic energy. The fan cart is modified so that it can be turned on at one location and turned off at a second location. Launching the cart along a track so that it has an almost constant speed, and then triggering the fan for a known distance while monitoring its position using a sonic position sensor allows us to determine a relationship between the force exerted by the fan, the distance traveled, and the final speed of the cart (after the fan has been turned off).

PST1D-08: 9:45–10:30 p.m. There Might be Giants?

Poster - Jacob Millspaw, IPFW, Fort Wayne, IN 46805; millspaj@ipfw.edu*

Mark Masters, IPFW

Ever ask a student about giants? What happens as people get extraordinarily tall? Is there a limit to a person's maximum height? Sure, we developed a simple experiment for students to do using some lab weights and lots of spaghetti. The spaghetti is used as a model for bones and the students can examine the strength of the bones varying the length and the cross section. This simple lab allows students to explore the question of giants (...the limitations on human growth). While exploring this question, the students are introduced to a variety of lab-related skills: measurement, data taking, uncertainty, and graphical data analysis.

* Sponsored by Mark Masters.

PST1D-09: 9–9:45 p.m. Teaching Physics through Medicine

Poster - Sytil K. Murphy, Kansas State University, Manhattan, KS 66506; smurphy@phys.ksu.edu

Dyan L. McBride, Mercyhurst College
Bijaya Aryal, University of Minnesota - Rochester
Spartak Kalita, Lomonosov Moscow University
Dean A. Zollman, Kansas State University

As part of the Modern Miracle Medical Machines project at Kansas State University, activities teaching modern physics concepts in the context of medicine have been developed. The activities cover topics associated with wavefront aberrometry, positron emission tomography scans, and magnetic resonance imaging, among others. Each worksheet-based activity incorporates both hands-on learning and a computer visualization. Some of the activities are research-based while others are informed by existing research. All the activities are tested and refined after implementations with students either in an interview or classroom setting. Most of them are available at http://web.phys.ksu.edu/mmmm. This work was supported by the National Science Foundation under grant DUE 04-26754.

PST1D-10: 9:45–10:30 p.m. Plasma Acoustic Speaker

Poster - Michael J. Rowland, The Citadel, Charleston, SC 29409; berlinghieri@citadel.edu*

Russell O. Hilleke, Erik Rooman, Joel C. Berlinghieri, The Citadel

A plasma arc is regulated so as to produce various musical tones. The device can be used as a not too practical but interesting acoustic speaker. An electronic circuit controls the current used to produce the plasma arc that heats the surrounding air and thus produces or reproduces sound. The fidelity of this sound is investigated and the sound pressure levels as well as the temperature and luminosity of the arc are measured. Correlation between these measured physical quantities and corresponding acoustic tones are described.

*Sponsored by Joel C. Berlinghieri.

PST1D-11: 9–9:45 p.m. Examining Forced and Damped Oscillations using Sound and Spectrum Analysis

Poster - Joseph J. Trout, Drexel University, Philadelphia, PA 19104; joseph.trout@drexel.edu

Forced and damped oscillations are examined using spectral analysis.

PST1D-12: 9:45–10:30 p.m. Industry Challenge-based Learning to Build STEM Pathways

Poster - Sergio Flores, University of Texas at El Paso, El Paso, TX 79968; sflores17@utep.edu

Rafael Gutierrez, University of Texas at El Paso
Fernando Tovia, University of Philadelphia
Mariano Olmos, El Paso Community College

The University of Texas at El Paso (UTEP), Philadelphia University (PU), and El Paso Community College (EPCC) are proposing to integrate an alliance to develop an innovative pedagogical approach to teach core mathematics, physics, and engineering courses that focuses on increasing recruitment and retention of highly qualified underrepresented minorities. It is important to note that UTEP and EPCC serve primarily underrepresented Hispanic and Afro American minorities. This alliance will provide an innovative pedagogical approach of learning core math, physics, and engineering courses in real life contexts. It means that the students must construct their scientific knowledge based on their own experience with the real world. To accomplish it, the students must interact directly with a learning situation (projects and real word industry-based problems) using the mathematical and physical knowledge as cognitive tools. This proposal will also focus on developing a well- structured STEM-project based learning model that can be replicated at other institutions.

PST1D-13: 9–9:45 p.m. Analysis of Ionizing Radiation from Granite by the Cloud Chamber

Poster - Jiyeong Kim, Hansung Scicence Highschool, Seoul 135-808 South Korea; jhunys@snue.ac.kr

People usually think that radioactive substances are dangerous enough because they think of the atomic bomb. However, they can be easily found around us in everyday life. A radioactive substance is a substance within the process of radioactive decay. This means that the atom's nucleus is not stable and sends off ionizing energy. This makes it reach a lower energy state and transform. Radioactive rays are not dangerous in a certain condition. We are analyzing radioactive substances radiated from granites which are from the most radioactive place at Goesan-gun in South Korea. Many people are living near granites that generate radioactive rays. It means that radioactive substances are not dangerous. We gather the granites at Goesan-gun areas, and measure the amount of the radioactive rays that are three main types of ionizing radiation—alpha, beta, and gamma. We make a map that can be used to figure out how strong the radiation is.

PST1D-14: 9:45–10:30 p.m. Temperature Logging and Control with the Basic Stamp Microcontroller

Poster - William R. Heffner, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

Jordan Davis, Oakwood University

The Parallax Basic Stamp microprocessor provides a relatively simple, low cost platform for data logging and temperature control appropriate for the high school or college laboratory. Basic Stamp utilizes an easy to learn Basic language for programming and there are a variety of sensors with associated sample code. A very popular robotics platform (BOEBOT) has already has been developed around these microprocessors by Parallax Inc., but we focus on their use in the science classroom and laboratory. We present here applications of the Stamp for measuring temperature and voltages, for logging the data directly into Excel and for simple temperature control of experiments. These basics are sufficient to enable the student to design their own sophisticated experimental investigations into a wide range of topics. One application included here is a home-built, temperature controlled hot stage for the study of crystallization and melting.

Monday night

Astronomy

PST1E-01: 9–9:45 p.m. Understanding and Counteracting Effects of Triboelectricity in Planetary Exploration Systems

Poster - Andrew Carnes, The Citadel, Charleston, SC 29409; berlinghieri@citadel.edu*

Luke Sollitt, Joel C. Berlinghieri, The Citadel

Results in modeling and mitigating effects of triboelectric charging of regolith particles in sample-handling systems deployed on the surface of Mars will be presented. The modeling work updates previous results of Anderson et al (2009) by including the effects of particle-on-particle triboelectric charging in the simulation. Triboelectric charging of regolith particles is a major obstacle to analysis of samples by landed platforms on planets such as Mars or the Moon. The triboelectric effects can hinder the ability to analyze regolith samples on different planets due to the cross-contamination of the left over regolith on the walls of the sample containers. The effects of particle-on-particle interactions as described by Forward, Lacks, and Sankaran (2009) may explain the problems that were observed. Additionally, laboratory efforts at NASA's Jet Propulsion Laboratory in Pasadena, CA, to observe if different radiation types and activity levels could counteract the effects of triboelectric charging will be described.

* Sponsored by Joel C. Berlinghieri.

PST1E-02: 9:45–10:30 p.m. Investigating Student Understanding of the Universe: Age and Expansion

Poster - Geraldine L. Cochran, Florida International University, Miami, FL 33199; gcoch001@fiu.edu

Kim Coble, Virginia L. Hayes, Melissa Nickerson, Chicago State University
Janelle Bailey, University of Nevada, Las Vegas

At Chicago State University we are reforming our introductory astronomy course. As a part of this effort, we seek to bring the tools and advances of recent cosmological research to the classroom by developing curricular materials that support students in learning cosmological topics using real data and cosmological research methods. Analysis of pre-course surveys, pre-course essays, and pre-instructional interviews indicate that students bring to the classroom an array of incorrect ideas. Analysis of assessments, post-instructional interviews, and student comments on laboratory activities indicate that their ideas on this topic have changed to be more in line with scientific evidence. Yet, students are still unable to perform the measurements and calculations necessary to determine the age of the universe or explain the expansion of the universe after instruction. This project is part of a larger study; see our posters on student ideas about the structure of the universe and dark matter.

PST1E-03: 9–9:45 p.m. Investigating Student Understanding of the Universe: Structure

Poster - Virginia L. Hayes, Chicago State University, Dept. of Chemistry and Physics, Chicago, IL 60628; virginialenisehayes@yahoo.com

Kim Coble, Melissa Nickerson, Chicago State University
Geraldine L. Cochran, Florida International University
Janelle M. Bailey, University of Nevada, Las Vegas
Kevin M. McLin, Lynn R. Cominsky, Sonoma State University

Chicago State University (CSU) offers an introductory astronomy course that services students from a variety of majors including pre-service teachers. At CSU, we have been investigating methods and tools that will improve student conceptual understanding in astronomy for this diverse group of students. We have analyzed pre-course surveys, pre-course essays, exams, and interviews in an effort to better understand the ideas and difficulties in understanding that students have in regards to the structure of the universe. Analysis of written essays has revealed that our students do have some knowledge of the objects in the universe, but interviews inform us that their understanding of the structure of the universe is superficial. This project is a part of a larger study; see our posters on student ideas about dark matter and the age and expansion of the universe as well.

PST1E-04: 9:45–10:30 p.m. Investigating Student Understanding of the Universe: Dark Matter

Poster - Melissa Nickerson, Chicago State University, Dept. of Chemistry and Physics, Chicago, IL 60628; melissan25@hotmail.com

Kim Coble, Virginia L. Hayes, Chicago State University
Geraldine L. Cochran, Florida International University
Janelle M. Bailey, University of Nevada, Las Vegas
Kevin M. McLin, Lynn R. Cominsky, Sonoma State University

Student pre-course surveys reveal that students who enter the classroom have little knowledge or understanding of the concept of Dark Matter (DM). At Chicago State University, we enthusiastically introduce this concept to students through interactive tutorials and hands-on inquiry-based laboratory activities. We have analyzed pre- and post-laboratory assessments and student interviews to determine the extent to which these tutorials have helped our students to gain a more robust understanding of the topic. The results of this work will be presented. This project is a part of our efforts at CSU to reform our introductory astronomy course. This project is part of a larger study; see our posters on student ideas about the age and expansion of the universe and the structure of the universe as well.

PST1E-05: 9–9:45 p.m. Webcam-based Spectroscopy for General Education Astronomy Laboratory

Poster - David M. Kuehn, Pittsburg State University, Pittsburg, KS 66762; dkuehn@pittstate.edu

Joy N. Scales, Blacksburg (Virginia) High School

Spectroscopy is arguably the most important astronomical diagnostic tool in that it can provide information about an object's motion as well as physical condition. In our general education astronomy laboratory at Pittsburg State University, we have revamped our basic spectroscopic laboratory with inexpensive web cams and plastic transmission diffraction gratings. The students assemble, test, and calibrate their spectroscope and then use it to identify two unknown gases by their spectral signature. Use of commonly available software allows the students to make a plot of spectral intensity versus CCD column number (providing a direct connection between images of spectra and spectral graphs) and a "best-fit" line giving the calibration equation for their spectroscope. Use of their calibration equation lets the student make a quick identification of the unknown gases. Students seem to enjoy this lab exercise much more than our previous version using visual spectroscopes with an angular vernier.

PST1E-06: 9:45–10:30 p.m. Drilling for Supernovae in Ice Cores

Poster - Doug Lombardi, University of Nevada, Las Vegas, NV 89123; lombar37@unlv.nevada.edu

Donna M. Young, Chandra X-ray Observatory EPO
Pamela B. Perry, Lewiston High School

Variability in nitrate concentrations found in ice cores provide a record of many scientific phenomena. Astronomers have suggested that some nitrate anomalies (spikes) found in ice cores could be a record of supernovae because cosmic X-rays ionize atmospheric nitrogen, producing excess nitrate that may be later deposited in ice layers. One ice core drilled in Greenland, covering a 430-year period, has revealed nitrate spikes at the times of the Tycho and Kepler supernovae. The Greenland core may have also recorded supernova Cassiopeia A's occurrence. This would pinpoint the year of Cassiopeia A, which has not been documented in other astronomical records. We have developed a classroom activity for high school and college students in which they examine several lines of evidence in the Greenland ice core, discriminating between nearby volcanic activity, solar events, and supernovae. Students assume the role of a scientist to infer the date of the Cassiopeia A supernova.

PST1E-07: 9–9:45 p.m. GAVRT and Radio Jove: K-12 Science Teacher Training

Poster - Chuck Higgins, Middle Tennessee State University, Murfreesboro, TN 37132; chiggins@mtsu.edu

Jim Thieman, NASA - Goddard Space Flight Center
Ben Nakamura, Ryan Dorcey, Lewis Center for Educational Research

The Goldstone Apple-Valley Radio Telescope (GAVRT) program (http://www.lewiscenter.org/gavrt) and The Radio Jove Project (http://radiojove.gsfc.nasa.gov) have a recent partnership to train K-14 teachers to use radio astronomy telescopes as vehicles for science education. The partnership is part of the NASA Juno mission to Jupiter (2011 launch) education and outreach program. Teachers attend training workshops to operate a 34-meter radio telescope and/or build or operate their own simple radio telescope, both of which can be used directly in the classroom. Corresponding lesson plans and curriculum material are available on the websites. Three teacher training workshops for the GAVRT/Jove program were held in 2010 and the results of the training and usage in the classroom will be reviewed. We plan to expand teacher opportunities in 2011 by offering web-based training programs.

PST1E-08: 9:45–10:30 p.m. Search for Life in Universe: Astrobiology Applications for Learning Physics

Poster - Mary Ann Kadooka, University of Hawaii Institute for Astronomy, Honolulu, HI 96817; kadooka@ifa.hawaii.edu

Michael Nassir, University of Hawaii Institute for Astronomy

The growing field of astrobiology, search for life in the universe, fascinates everyone. As one of 14 NASA Astrobiology Institute (NAI) teams, the UH Institute for Astronomy has conducted national Astrobiology Laboratory Institute for Instructors (ALI-I) teacher summer workshops since 2004. Teachers learn about the integration of science concepts in physics, chemistry, geology, astronomy, oceanography, biology, etc. Astrobiology topics related to physics principles can motivate students learning science. Spectroscopy is applied to composition of asteroids and rocks. Gravitational forces affect comet orbits. Energy sources influenced the metabolism of ancient microbial life. Extrasolar planets demonstrate the dynamic nature of science. Physics teachers can use astrobiology to show students how all sciences depend upon physics principles. The ALI-I program promotes this effort with secondary science teachers to go beyond their specific content areas. Our NAI scientists, actively involved with this program, have contributed to the strength of ALI-I.

PST1E-09: 9–9:45 p.m. Heliophysics: Electromagnetism Outreach and Space Weather

Poster - Mary Ann Kadooka University of Hawaii Institute for Astronomy, Honolulu, HI 96817; kadooka@ifa.hawaii.edu

Kathryn Whitman, Ilia Roussev, University of Hawaii Institute for Astronomy

How much do you really know about the Sun and how it affects us? Solar storms produce beautiful auroras, yet can cripple our nation by causing"electrical" blackouts. Likewise, during solar cycle minimum when very few sunspots are visible, harmful cosmic rays can more easily penetrate our heliosphere which protects our solar system, analogous to our Earth's magnetosphere protecting us. Our C2H2 (Center for Computational Heliophysics in Hawaii) team at the UH Institute for Astronomy investigates coronal mass ejections through modeling and related research. They represent the core of our NASA CA$HEd (Center for Advancing Systemic Heliophysics Education) program to promote learning electromagnetism and waves to understand the Sun-Earth connection and space weather. Teacher/student workshops and classroom visitations are conducted on islands of Hawaii. Master teachers charged with mentoring teachers on their respective islands and student research projects are other components of this program which will be described.

PST1E-10: 9:45–10:30 p.m. Approach Students' Misconceptions in Physics head-on to Maximize their Success

Anju Taneja, The Hotchkiss School, Lakeville, CT 06039; ataneja@hotchkiss.org

Since most students in American high schools study physics for a year (while they have at least two years of biology or chemistry) their depth of understanding of physics concepts is very limited. In addition, it is difficult for a greater percentage of the students in a class to think at an advanced level of conceptualization as compared to students from other countries (in the same age group) who have had at least two years of high school physics education. The challenge for a physics teacher in the American high school is to develop conceptual thinking along with mathematical sophistication in the one year that students take the course, so that their students are competitive with students coming from other curricula (e.g the I.B. or the A-levels). In this session I will share examples of how I have introduced and reinforced concepts across units in high school physics (in one academic year) to ensure that my students have the same level of conceptual and mathematical sophistication as the students I have taught in the two-year I.B. or the A-levels physics program. The session will include examples of teaching approaches that begin with addressing general misconceptions in the minds of students about physics principles, so that a greater time is spent by students on thinking correctly about the principles of physics and being able to extrapolate their understanding to explain unfamiliar situations. I will share some of my labs, lecture notes and demonstrations that focus on course goals to maximize success in the subject.

Tuesday, January 11

Richtmyer Award	11 a.m	Grand Ballroom 4
Nucelar Power Plenary	9:40 a.m	Grand Ballroom 4
Symposium on Education Policy	3:30 p.m.	Grand Ballroom 4
Living History of Marie Curie	6:30 p.m.	River Terrace 1

DA: Bridging the Gap Between Diverse Levels of Preparation of Incoming Graduate Students in Physics

Location: City Terrace 5
Sponsors: Graduate Education in Physics Committee, Physics in Undergraduate Education Committee
Date: Tuesday, January 11
Time: 8–9 a.m.

Presider: Marianne Breinig, University of Tennessee - Knoxville

DA01: 8–8:30 a.m. Preparation of Incoming Graduate Students at the University of Florida

Invited - James N. Fry, University of Florida, Gainesville, FL 32606-8440; fry@phys.ufl.edu*

The physics graduate program at the University of Florida typically receives 300 to 400 applications from dozens of countries around the world. I will discuss our experience evaluating students with diverse levels of preparation from diverse backgrounds, before and after admission.

*Invited by Marianne Breinig.

DA02: 8:30–9 a.m. Graduate Physics Education Is Boring

Invited - Thomas H. Troland, University of Kentucky, Lexington, Lexington, KY 40506; troland@pa.uky.edu

It is no secret that interest in physics is low among bright young people today. Biology and other science fields hold much more appeal. There is a simple explanation for this trend. Physics education is boring. Most of our courses at the undergraduate and graduate levels cover concepts and techniques that are 80 to 300 years old, even the courses on “modern” physics. As a result, physics education often has the look and feel of a 1930s film, not without value but quaint, dated, and colorless. If we are to appeal to a diverse population of students at the graduate level, we will need to revitalize the traditional graduate physics curriculum to make it more relevant to students and to their futures. We will need more flexible course requirements, earlier involvement in research, and new courses that model the way physics is actually practiced today.

DB: Teaching with Technology - II

Location: Grand Ballroom 1
Sponsor: Educational Technologies Committee
Date: Tuesday, January 11
Time: 8–9:10 a.m.

Presider: Andy Garvin, Indiana Univ Purdue Univ. Indianapolis

Contributed session focused on innovations and best practices in the use of technology for physics education.

DB01: 8–8:10 a.m. Research Designs to Test and Refine the Pathway Active Learning Environment

Christopher M. Nakamura, Kansas State University, Manhattan, KS 66506; cnakamur@phys.ksu.edu

Sytil K. Murphy, Dean A .Zollman, Kansas State University
Michael Christel, Scott M. Stevens, Carnegie Mellon University

The Pathway Active Learning Environment (PALE) is an online synthetic tutoring system based on interactive video. The system responds to student queries with pre-recorded video responses from experienced tutors. Additional multimedia images and video can be used to support the tutor’s replies. The PALE logs queries and student responses with a time stamp for later analysis. Encouraging use of the system by students in large-enrollment classes allows us to get general information about common usage patterns, in natural settings of the students choosing. Observing students’ use of the PALE in an interview setting allows observation, and discussion of the finer details in individuals’ use and perceptions of the system, in a more controlled setting. Recent work studying PALE usage with large-enrollment classes and in an interview setting will be presented. This work is supported by the U.S. National Science Foundation under Grants REC-0632587 and REC-0632657.

DB02: 8:10–8:20 a.m. The ICT for IST Project: Using Technology for Innovative Science Teachers

Ewa Kedzierska, University of Amsterdam, Amsterdam,1090 GE, Netherlands; e.kedzierska@uva.nl

Ton L. Ellermeijer, University of Amsterdam

The project involves a partnership of six universities in the EU and is funded within the Leonardo da Vinci programme of the Life Long Learning Programme of the European Commission. Resource materials for teachers and teacher trainers are developed illustrating how data-logging, modelling, simulation and video measurement in science teaching facilitate the type of thinking and discussion which leads to better understanding. Each module focuses on a single science topic and includes teachers’ notes that support the implementation of the activities. They also include commentaries intended to develop teachers’ pedagogical understanding of the new methods using ICT to investigate phenomena. Example modules applying the Coach learning environment will be presented. This software environment offers integrated tools for data collection with sensors, measurements on digital videos and images, processing and analyzing data, modeling (system dynamics approach), animations and authoring of activities by teachers and students (texts, multimedia components, hyperlinks, etc.).

DB03: 8:20–8:30 a.m. Remote Sensing, Image Processing, and a Little Physics

Ralph E. Oberly, Marshall University, Huntington, WV 25755; oberly@marshall.edu

James O. Brumfield, Marshall University

For 30 years courses have been jointly offered from the Physics and Biology Departments that cover traditional topics in Remote Sensing and Image Processing. These courses include significant physics content to illustrate the manner in which satellite and aerial data are collected and the problems of processing such data. The courses are highly project oriented. The students must identify a problem of interest to their major study area; define the problem; specify the spatial and spectral resolution of data needed to solve the problem; identify software processes that will assist in problem solving; and show their results. It is believed that knowledge of the physical principles involved helps in all phases of the problem definition and solution process.

DB04: 8:30–8:40 a.m. Using Technology to Transform PSET into a Large Enrollment Course

Edward Price, California State University San Marcos, San Marcos, CA 92096; eprice@csusm.edu

Fred Goldberg, San Diego State University
Steve Robinson, Tennessee Technological University
Rebecca Kruse, BSCS
Danielle Harlow, University of California Santa Barbara

The LEarning Physical Science (LEPS) curriculum shares the same content focus and research-based learning principles as the Physical Science and Everyday Thinking (PSET) curriculum, [1] but with a significant difference in how the course is offered. PSET is an inquiry-based, hands-on, physical science curriculum that was developed for small enrollment discussion/lab settings. LEPS is intended for use in large, lecture-format classes or other settings where hands-on experimentation and whole class discussions are difficult. To overcome these limitations, LEPS incorporates technology such as class response systems, video of experiments, online homework, and computer simulations. This talk will describe how these technologies are used in the LEPS curriculum.

1. F. Goldberg, R. Kruse, S. Robinson, V. Otero, and N. Thompson, Physical Science and Everyday Thinking, It's About Time: Armonk, NY, 2007.

DB05: 8:40–8:50 a.m. The 18mm^2 Classroom

Toni D. Sauncy, Angelo State University, San Angelo, TX 76909; toni.sauncy@angelo.edu

Tim Dallas, Logan Hancock, Gabriel Ramirez, Ashwin Vijayasai, Texas Tech University

A collaborative effort between Texas Tech University Electrical Engineering and Angelo State University Physics with regional high school teachers and students has been aimed at the development of a multi-component micro-electro-mechanical (MEMS) chip. The chip, measuring only 6mm x 3mm, features a variety of MEMS devices with differing functions. The objectives of using this teaching tool are first to bring cutting-edge technology into the high school classroom in a realizable way and second, to use the multifunctional micro-machines to demonstrate fundamental introductory physics principles.

DB06: 8:50–9 a.m. Teamworks: A Web-based System for Writing Collaborative Lab Reports*

Robert B. Teese, Rochester Institute of Technology, Rochester, NY 14623; rbtsps@rit.edu

Teamworks is a web-based lab report writing system designed to encourage students to make individual contributions to collaboratively written reports, to read and evaluate their teammates' contributions during the process, and give instructors data that will help them grade the reports. Individual students in a team work on a lab report through their own web browsers, and the team decides collectively what sections need revision and when the report is done. The Teamworks software is being written by undergraduate student programmers at RIT. Several unexpected challenges that occurred during development will be discussed in the talk. Classroom testing of Teamworks is beginning this year.

*Supported by National Science Foundation grant 0633570.

DB07: 9–9:10 a.m. Classroom Collaborative Effort to Author a Cosmic Ray Book

Gillian Winters, Smithtown High School, St. James, NY 11780; gwinters@smithtown.k12.ny.us

Helio Takai, Brookhaven National Laboratory

Two classes, for a total of 42 high school students, collaborated to research and then write a book about cosmic rays. Students had virtually no prior knowledge of cosmic rays, so groups of students started by researching their chosen subtopic, using the Internet. Their initial entries on a wiki were sketchy, but included basic information, pictures, and links or references. The students refined their knowledge for PowerPoint presentations to the rest of the class, and finally they updated their wiki entries to complete their projects. The final book, made by collating the pages of the wiki, provides fairly complete background information relating to many aspects of cosmic rays.

DC: Increasing the Number and Diversity of Physics Majors

Location: City Terrace 4
Sponsors: Physics in Undergraduate Education Committee, Teacher Preparation Committee
Date: Tuesday, January 11
Time: 8–9:30 a.m.

Presider: Monica Plisch

APS, AAPT, and SPS have called for increasing the number of physics majors under the Doubling Initiative, especially by increasing the participation of students in underrepresented groups. This session will highlight exemplary programs with innovative efforts that have increased the number and diversity of physics majors.

DC01: 8–8:30 a.m. Building an Educational Ecosystem that Fosters Growth of Physics Majors

Invited - Eric Brewe, Florida International University, Miami, FL 33199; eric.brewe@fiu.edu

Laird H. Kramer, George E. O'Brien, Florida International University

During the previous seven years, Florida International University's physics majors have grown from 37 declared majors in 2003 to 119 in 2009. In this talk we consider several factors that seem related to this growth: implementation of Modeling Instruction in introductory physics, emergence of a learning community, and emergence of advocates for physics. These three factors together influence the classroom experience that students encounter, but also the broader educational environment, which establishes an ecosystem that is inclusive and supportive of student success. Further, because this growth has taken place at FIU, a research intensive Hispanic Serving Institution, we consider the context of FIU in building this inclusive ecosystem.

DC02: 8:30–9 a.m. Physics of Medicine: Increasing the | Number/Diversity of Upper-Level Physics Students

Invited - Nancy L. Donaldson, Rockhurst University, Kansas City, MO 64110; nancy.donaldson@rockhurst.edu

This session will describe the development and implementation of a Physics of Medicine (POM) Program at Rockhurst University. The POM Program is designed to deepen pre-health students' understanding of physics principles and the applicability of those principles to medicine and the professional health-care fields. Upon completion of two semesters of introductory physics and calculus I, students can enter the POM Program and choose to declare either a Physics of Medicine Minor or a Physics Major in Medical Physics. The POM Program provides excellent preparation for graduate study in Medicine, Physical Therapy, Kinesiology, Medical Physics, Occupational Therapy, Communication Science Disorders, and related graduate science programs. Upper-level physics courses are designed with an inquiry-based, student-centered pedagogy that enables students to build a strong physics foundation upon which they can branch successfully into health-care applications. The curriculum incorporates active classroom learning, practical experimentation, undergraduate research, and health-related service learning opportunities.

DC03: 9–9:30 a.m. Recruiting Majors into Physics

Invited - Sacha E. Kopp, University of Texas, Austin, TX 78712; kopp@hep.utexas.edu

John Rice, Common Sense Communications

Like many colleges and universities around the country, the University of Texas at Austin has a solid physics program that prepares students bound for graduate physics study. For a variety of reasons, the number of students choosing to major in physics is small, just 200 students in an undergraduate population of about 35,000 (0.6%). When compared to other majors on campus, this population was experiencing negligible growth. Retention from freshman to senior year was at 50%. I will describe a campaign launched in our department aimed at recruiting and retention of majors. This campaign includes actual programmatic changes in the curriculum and instruction of majors. Additionally, it includes a direct marketing campaign that attempted to change student attitudes about physics and its relation to their current major. Finally, it includes a program to reach out to local high schools and engage students in a discussion about their career choices before they apply for college. While the campaign is relatively new, it is possible to share some numerical and attitudinal data that suggests positive changes in the student population.

DD: Transitions from High School to Two-Year and Four-Year Colleges

Location: City Terrace 7
Sponsors: Physics in Undergraduate Education Committee, Physics in Two-Year Colleges Committee
Date: Tuesday, January 11
Time: 8–9:30 a.m.

Presider: Renee Lathrop, Dutchess Community College

There are several programs at the high school level that prepare students for college-level work (Bridge Programs, Dual Enrollment, AP courses, etc.) or attempt to advance students through their physics curriculum. This session will focus on and address the following questions: what are high schools doing to prepare and motivate students to stay interested in physics for their transition to a two-year and four-year programs? Is there still a significant "leaky pipeline" at this transition point? How do AP courses prepare students to continue in the physics curriculum at the two-year and four-year colleges?

DD01: 8–8:30 a.m. Students' Learning Attitudes and Motivation to Learn in an Interactive Learning Environment*

Invited - Edgar Corpuz, The University of Texas-Pan American, Edinburg, TX 78539; ecorpuz@utpa.edu

Liang Zeng, The University of Texas-Pan American
Rolando Rosalez, Edinburg Consolidated Independent School District

The Department of Physics and Geology at the University of Texas-Pan American has been implementing a web-based interaction system in selected physics and physical science classes in which students use personal digital assistants (PDAs) to interact with their instructor during lecture. In this presentation, we will provide an introduction to the In-Class web-based interaction system, describe our implementation, and document how the attitudes of students in this interactive classroom environment compare with that of students in a traditional lecture class as measured by the Colorado Learning Attitude About Science Survey[1] (CLASS). We will likewise present how students' motivation to learn, as measured by the Science Motivation Questionnaire[2] (SMQ), evolves over time.

*This work is supported in part by the National Science Foundation under grant DUE-0737375.

1. http://www.colorado.edu/sei/class/
2. Glynn, Shawn. M. and Koballa, Thomas. R., Jr. (2006). Motivation to learn college science. In Joel J. Mintzes and William H. Leonard (Eds.) *Handbook of College Science Teaching* (pp. 25-32). Arlington, VA: National Science Teachers Association Press.

DD02: 8:30–9 a.m. Motivating Students to Continue in Science through Specialized College Course*

Invited - Kathleen M. Koenig, Wright State University, Dayton, OH 45435; kathy.koenig@wright.edu

Michael Edwards, Wright State University

Poor retention of STEM majors is widespread across the nation. At Wright State only one-third of incoming science majors earn a related degree in six years, with most dropping out of the major their freshman year. As part of an NSF STEM retention initiative, a new course for incoming science majors was developed at WSU that addresses those scientific and mathematical reasoning abilities deemed necessary for student success in the sciences while maintaining student motivation. This talk will provide specific course details and present several years of data that demonstrate the impact of the course on improving student abilities along with significant first-to-second year retention in the major (i.e. 76% retention for those who took the course versus 47% for those who didn't across two cohorts of students). The challenges of implementing and sustaining such a course will be presented along with how the course is tailored for physics majors.

*Supported in part by NSF Grant DUE 0622466

DD03: 9–9:30 a.m. On the Question of "Leaks" in the Transition from High School to College Physics.

Invited - Mark Stone, Northwest Vista College, San Antonio, TX 78230; mstone32@alamo.edu

As students progress from high school to a college or university environment, they experience discontinuities in course content and delivery, as well as discrepancies between their own and their instructors' expectations of what is required to be academically successful. Students' difficulty in overcoming these disparities often propels them toward easier subjects, thus generating apparent leaks in the K-16 system. The author identifies specific areas where these disparities occur, describes how they arise, and offers possible solutions to address them. Specific attention will be given to the training of (or lack of) instructors at both levels, reacting to the more "tech-savvy" student, and evaluation methods that may help improve student retention and foster deeper conceptual understanding.

DE: Computational Physics from the Freshman to the Senior Year - II

Location: Grand Ballroom 2
Sponsors: Physics in Undergraduate Education Committee, Educational Technologies Committee
Date: Tuesday, January 11
Time: 8–9:30 a.m.

Presider: Aaron Titus, High Point University

Computational physics is becoming an essential component of the standard curriculum for physics majors. Sometimes computational physics is integrated into courses, sometimes it is a stand-alone course, and sometimes there is a track or a major in computational physics that includes many courses. This session will include invited and contributed papers describing various ways to teach computational physics in the undergraduate curriculum for physics majors.

DE01: 8–8:30 a.m. The Computational Core of the Undergraduate Physics Curriculum

Invited - Jan Tobochnik, Kalamazoo College, Kalamazoo, MI 49006; jant@kzoo.edu

Harvey Gould, Clark University
Wolfgang Christian, Davidson College

Much has been written on computational physics as a third way of doing physics. There are now a number of textbooks on computational physics and computer simulations. In addition, many physics textbooks now include computational-based problems, and a few discuss some basic algorithms. We will discuss what every undergraduate physics major should know about computational physics, including essential algorithms, minimal level of programming experience, and computational ways of thinking (when to use the computer and when not, how to obtain insight from computational activities, and new ways of thinking about models). We also will propose that the AAPT adopt a resolution recommending that computational physics become an integral part of the undergraduate physics curriculum.

DE02: 8:30–9 a.m. Twenty Years of Computational Physics at Wooster

Invited - John F. Lindner, The College of Wooster, Wooster, OH 44691; JLindner@Wooster.edu

I describe how Wooster physics majors create computer simulations as part of their coursework, summer research, and year-long senior thesis projects, and I illustrate the corresponding synergy between pedagogy and research. Simulation is a powerful tool that can elucidate physical phenomena otherwise inaccessible and often outside the traditional undergraduate curriculum. Simulations can be C programs or Mathematica notebooks; they can be polished applications created from scratch or from an evolving set of readily modified and easily extended shell programs that provide sophisticated graphical user interfaces; they can be simple UNIX shell programs running concurrently on a classroom of otherwise idle computers. The programming experiences leverage Mac OS X, which combines the power of UNIX with the ease-of-use of a Macintosh, including the free Xcode development tools and Xgrid parallel computing environment.

DE03: 9–9:30 a.m. Using an eTextBook to Provide Blended, Multimodal Education in Computational Physics*

Invited - Rubin H. Landau, Oregon State University, Corvallis, OR 97331; rubin@science.oregonstate.eduM

Manuel J. Paez, University of Antioquia, Medellin, Colombia
Cristian Bordeianu, University of Bucharest, Romania
Sally Haerer, Oregon State University

Work over the last 15 years in developing textbooks for Computational Physics and multimedia enhancements to the texts has culminated in the creation of an eTextbook that is much more than just a digital version of the paper text, "A Survey of Computational Physics" (Princeton 2008). The eText contains video-based modules with synchronized lectures and slides, interactive Python programs, animations, sounds, fully linkages, and exploratory features such as dynamic mathematics (MathML) that can interface to symbolic manipulation programs and figures (concept maps) containing active links. The text may find use in blended courses in which instructors spend time, which might otherwise be spent in lectures, in the labs instead. Much of the talk will be a demonstration.

*Work supported by National Science Foundation, CCLI, DUE-0836971

DF: Gender Perspectives in PER

Location: City Terrace 9
Sponsors: Women in Physics Committee, Research in Physics Education Committee
Date: Tuesday, January 11
Time: 8–9 a.m.

Presider: Anne Cox, Eckerd College

DF01: 8–8:30 a.m. Gender in PER: A Retrospective

Invited - Laura McCullough, University of Wisconsin-Stout, Menomonie, WI 54751; McCulloughL@uwstout.edu

In PER studies today, it is common for researchers to examine gender as a variable. While not everyone includes gender in their analyses, gender analysis is accepted and valued by the PER community. In this talk, I will present a retrospective of gender analysis in physics education research: its beginnings, its growth, its current status. From articles to AAPT presentations, where has gender research fit into PER?

DF02: 8:30–9 a.m. Investigating Gender Differences in Introductory Physics

Invited - Lauren E. Kost-Smith, University of Colorado at Boulder, Boulder, CO 80309-0390; Lauren.Kost@colorado.edu

Steven J. Pollock, Noah D. Finkelstein, University of Colorado at Boulder

Despite males and females being equally represented at the college level in several STEM disciplines (including biology, chemistry and mathematics), females continue to be under-represented in physics. Our research attempts to understand and address this participation gender gap by focusing on the introductory physics courses. We characterize gender differences in performance, attitudes and beliefs, and retention that exist in Physics 1 and 2.[1,2] We find gender differences in performance can largely be accounted for by differences in the physics and mathematics backgrounds and incoming attitudes and beliefs of males and females. But these background factors do not completely account for the gender gaps. We hypothesize, based on gender differences in self-efficacy, that identity threat is playing a role in our courses. Working with researchers in psychology, we implemented an identity threat intervention, and preliminary results suggest that this brief intervention helps to alleviate the gender gap in performance.

1. L. E. Kost, S. J. Pollock & N. D. Finkelstein, PRST-PER, 5, 010101.
2. L. E. Kost-Smith, S. J. Pollock & N. D. Finkelstein, PRST-PER, 6, 020112.

DG: High School

Location: Grand Ballroom 3
Sponsor: Physics in High Schools Committee
Date: Tuesday, January 11
Time: 8–8:30 a.m.

Presider: Jan Mader, Great Falls High School

DG01: 8–8:10 a.m. Uniform Circular Motion and Sherlock Holmes' "Adventure of the Bruce–Partington Plans"

Igor V. Proleiko, McKinley Classical Leadership Academy, St. Louis, MO 63104; igor.proleiko@slps.org

I have one idea that may lead us far. The man met his death elsewhere, and his body was on the roof of a carriage. In this particular Sherlock Holmes adventure, the solution to the mystery stems from the fact that a body slipped from the roof as the train was coming around a curve. Referencing the map of the London Underground and researching the speed of the Underground trains at the turn of the XX century, Holmes' line of reasoning could be checked by the physics students at a high school level. The exercise could motivate the students who normally do not have interest in physics by providing an inter-disciplinary connection with English literature. It could also give students the experience of reading a text with the intent to mine scientific information.

DG02: 8:10–8:20 a.m. Physics in U.S. High Schools: Dispelling the Myths

Susan White, American Institute of Physics, College Park, MD 20740; swhite@aip.org

Fewer students are taking physics in U.S. high schools ... fact or myth? (Myth!) Physics is not offered in more than 15% of all U.S. high schools ... fact or myth? (Fact ... but ...) We will examine perceptions, misperceptions, facts, and myths. The data come from the Nationwide Survey of High School Physics Teachers which is conducted by the Statistical Research Center (SRC) at the American Institute of Physics (AIP). The first round of this survey was administered in 1987; the most recent data are from the 2008-09 academic year. Thank you to the over 6000 teachers and principals who provided data in the most recent round and to the thousands who have contributed through the years.

DG03: 8:20–8:30 a.m. Formula Recollection through Unique Mnemonic Technique

Shannon A. Schunicht, Texas A&M University, College Station, TX 77845.3005; mnemonicmind@alpha1.net

This presentation is for a worldly recognized mnemonic technique to allow for simplification of complex formulas by their transition into a memorable acronym. The basic technique is to allow each vowel to represent a mathematical operation, that is, the letter a for multiplication to imply @, the letter o to represent division to imply over, the letter i to represent subtraction implying minus, the letter u to represent addition implying plus, and the letter e implying equals. Most constants and variables are indeed consonants, c for the speed of light, and z for altitude, except i build rabbits 4 cats on 2 hats is a acronym for the quadratic equation. Everyone remembers Dr. Seuss? Using this author's mnemonic technique, other acronyms will be shown, as well as those submitted upon attendance. Sample cards to illustrate vowels:mathematical operations will be available. The possibilities of this mnemonic technique are limitless, as Delta X =>0.

DH: Introductory Labs/Apparatus

Location: City Terrace 12
Sponsors: Apparatus Committee, Laboratories Committee
Date: Tuesday, January 11
Time: 8–9:10 a.m.

Presider: Robert Moore

DH01: 8–8:10 a.m. Voltage Generated Across the Wings of an Airplane

Wathiq Abdul-Razzaq, West Virginia University, Morgantown, WV 26506; wabdulra@wvu.edu

Saikat Chakaborty-Thakur, West Virginia University

As an alternative to a traditional experiment on Faraday's law, we developed a lab experiment that mimics the formation of the induced voltage generated across the wings of an airplane when it flies through the magnetic field of the Earth. This experiment shows the application of physics to real-life and provide hands-on, stimulating and interesting curriculum in a laboratory environment. The apparatus for this experiment was built at West Virginia University and its details will be presented.

DH02: 8:10–8:20 a.m. Assessing Research-based Labs through Pre- and Post-Testing

Mark Ellermann, Texas Tech University, Lubbock, TX 79409; mark.ellermann@ttu.edu*

Beth Thacker, Keith West, Texas Tech University

We present the results of pre- and post-testing in both traditional and non-traditional laboratory settings. This project is supported by the NIH grant 5RC1GM090897-02.

*Sponsored by Beth Thacker.

DH03: 8:20–8:30 a.m. The St. Louis Motor

Thomas B. Greenslade, Jr., Kenyon College, Gambier, OH 43022; Greenslade@Kenyon.edu

The St. Louis Motor, invented in 1909, is unique among physics apparatus for being named for a geographical place rather than a physicist. The sturdy little device has never been out of production. Any older school or physics department that has not done a catastrophic house cleaning in the last 20 years will certainly have a small flock of them in the back room. They can still be used for hands-on learning about the motor and generator principles.

DH04: 8:30–8:40 a.m. An Easily Assembled Computed Tomography Experiment

Elliot E. Mylott, Portland State University, Portland, OR 97215; emylott@pdx.edu

Justin C. Dunlap, Ryan Klepetka, Ralf Widenhorn, Portland State University

Previous experiments employing lasers have illustrated the concepts of computed tomography (CT). These experiments are designed to teach undergraduate students interested in the physics of medicine. The apparatus in those experiments consists of equipment not always easily acquired in undergraduate laboratories. In addition, the software interface typically requires the instructor to have some computer programming knowledge. Data collection and image reconstruction during these experiments is also largely manual and time consuming. In this work a CT experiment is presented that is designed to be easily implemented by instructors using equipment commonly found in undergraduate laboratories or easily acquired through typical vendors principally a laser pointer and a Vernier photogate. A NI LabVIEW program has been written that can be installed on multiple operating systems and does not require programming knowledge to run. While still conveying the important aspects of CT, this experiment partially automates data collection and image analysis.

DH05: 8:40–8:50 a.m. Quantifying the Electrostatic Force

Scott J. Thompson, Georgia Gwinnett College, Lawrenceville, GA 30043; sthomps1@ggc.edu

In the first semester of the typical college physics sequence, students are able to study Newtonian mechanics using a hands-on approach, where they can visualize and play with the scenario presented in a problem in addition to performing mathematical calculations. The transition to electrostatics in the second semester often marks a departure from this method, since students are not able to physically interact with individual charges like they previously did with masses. This forces students to rely much more on visualizing a problem in their minds and interpreting the mathematical results into the relevant physics, which often represents a challenge to the students. In this presentation, two activities —The Sticky Balloon & The Rotating Meter Stick—are discussed. Each provide a way to connect the skills used during the study of Newtonian Mechanics to Electrostatics and reintroduce the students to modeling problems in a lab setting.

DH06: 8:50–9 a.m. Incorporating Traditional and Non-Traditional Pedagogies in Laboratories

Keith West, Texas Tech University, Lubbock, TX 79409; keith.h.west@ttu.edu*

Beth Thacker, Mark Ellerman, Texas Tech University

We have redesigned our laboratories to incorporate both traditional and nontraditional pedagogies in the laboratories. We discuss the development process, the format of the laboratories and assessment of the effectiveness of the laboratories. This project is supported by the NIH grant 5RC1GM090897-02.

*Sponsored by Beth Thacker.

DH07: 9–9:10 a.m. Science Inquiry through Infrared Imaging

Charles Xie, Concord Consortium, 25 Love Lane, Concord, MA 01742; qxie@concord.org*

Infrared cameras have become more affordable and easier to use. Infrared imaging allows students to see—in real time—temperature distribution and heat flow that are otherwise invisible. Any physical, chemical, and biological processes that produce or absorb heat can be visualized and analyzed, making this tool an extraordinary tool for science inquiry. This paper will demonstrate its power and versatility through more than a dozen carefully designed experiments in which students will discover many important concepts in science using an infrared camera.

*Sponsored by Robert Tinker.

Plenary: Nuclear Power

Location: Grand Ballroom 4
Date: Tuesday, January 11
Time: 9:40–10:30 a.m.

Presider: Jill Marshall

➤ The State of the Art in Nuclear Power: Breeder Reactors and Beyond

Kenneth L. Peddicord, Texas A&M University

Kenneth L. Peddicord

This talk will cover the future trends in the use of nuclear energy around the world, including the new plants that are being built in many countries. In addition, the advanced reactor systems such as breeder reactors that are being pursued on an international basis under the Generation-IV initiative will be described. This will be put into the context of resource availability and current issues such as climate change.

Richtmyer Memorial Award – Presented to Kathryn Moler

Location: Grand Ballroom 4
Date: Tuesday, January 11
Time: 11–11:50 a.m.

Presider: Alex Dickison

Kathryn Moler
Stanford University

➤ Quantum Whirlpools: Tiny Vortices of Tireless Electrons

Kathryn Moler, Associate Professor of Applied Physics and of Physics, Stanford University, Palo Alto, CA

Hurricanes and tornadoes are vortices that can wreak havoc in our everyday lives. Less well known are the tiny (nanoscale) whirlpools of superconducting electrons that can circulate endlessly in some exotic electronic materials. These "quantum vortices" are the most important barrier to technological applications of superconductors.

Quantum mechanics, according to wikipedia, underlies "the most fundamental known description of all physical systems at the submicroscopic scale," yet superconductors display quantum behavior even in macroscopic devices, such as the large superconducting magnets that enable Magnetic Resonance Imaging in medicine. In these devices electrons flow without friction—as long as those pesky quantum vortices don't start moving around!

Perhaps the most basic feature of quantum mechanics is that particles are wavelike. This talk will explain what it means to say that electrons are "wavelike," how we know that they really are, the conceptual difference between wavelike electrons vs. wavelike multielectron states, and why the wavelike nature of the superconducting state means that quantum vortices could exist. We will also talk about the modern tools that let us directly observe and even manipulate these tiny whirlpools of superconducting electrons.

Crackerbarrel 3: PER – Graduate Student Concerns

Location: Grand Ballroom 1
Sponsor: Research in Physics Education Committee
Date: Tuesday, January 11
Time: 12–1 p.m.

Presider: Vashti Sawtelle, Florida International University, Miami, Fl

An informal session for graduate students in Physics Education Research, as well as any post-docs who would like to join the conversation, this gathering will focus on the development of a social network accessible for all PER graduate students.

Crackerbarrel 5: Physics and Society Education

Location: City Terrace 4
Sponsor: Science Education for the Public Committee
Date: Tuesday, January 11
Time: 12–1 p.m.

Presider: Steven Shropshire

Come and share ideas on how to incorporate societal issues into your physics classes. If you have developed a course on energy and the environment, or are interested in doing so, please drop by.

Crackerbarrel 6: Emergency Professional Development – Non Physicists Thrown into Teaching High School Physics

Location: City Terrace 7
Sponsors: Teacher Preparation Committee, Physics in High Schools Committee
Date: Tuesday, January 11
Time: 12–1 p.m.

Brainstorming session on funding mechanisms for emergency high school physics teacher professional development.

EA: Video-based Motion Analysis in the Physics Classroom

Location: City Terrace 4
Sponsors: Physics in High Schools Committee, Educational Technologies Committee
Date: Tuesday, January 11
Time: 1–2 p.m.

Presider: Robert Teese, Rochester Inst. of Technology

Video-based motion analysis can be used in physics courses at all undergraduate levels. This session will be about new techniques, activities, or research on the use of video analysis in the classroom, lab, or for homework.

EA01: 1–1:10 p.m. Unusual "Mini-projects" Involving High Speed Video Capture or YouTube Videos

Priscilla W. Laws, Dickinson College, Carlisle, PA 17013; lawsp@dickinson.edu

A new generation of digital cameras with high-speed video capability and the availability of "doctored" movies on YouTube has opened up intriguing possibilities for original student projects. Some examples of unusual videos taken and/or analyzed by the LivePhoto Physics Workshop participants will be discussed. These include: (1) a close up of how a drop of water absorbs a drop of surfactant; (2) Slinky drop motions; (3) a spectacular barefoot soccer kick; and (4) the analysis of an "Old Spice Man" leap. The presentation will include a discussion of some of the currently available cameras that have high-speed videography capabilities as well as tips on downloading YouTube videos for analysis.

EA02: 1:10–1:20 p.m. Using Video Analysis in Popular Media

Rhett Allain, Southeastern Louisiana University, Hammond, LA 70402; rallain@selu.edu

A block sliding down a plane. A block sliding down a plane with friction. A block sliding down a plane with a pulley attached to a weight. These are important problems for students to get the fundamental physics concepts, but they can be a bit boring. Using video analysis and popular media, interesting examples can be created (such as crazy long basketball shots, hidden motors in bikes, normal people vs. football players).

EA03: 1:20–1:30 p.m. Online Single-Concept Interactive Tutorials in Physics*

David P. Jackson, Dickinson College, Carlisle, PA 17013; jacksond@dickinson.edu

Priscilla W. Laws, Dickinson College
Robert B. Teese, Rochester Institute of Technology

We have created two activities, designed for Web delivery, that combine narration, real-world video segments and analysis tools. They enable students to understand the evidence for accepted theories about the physical phenomena they are studying by helping the students answer questions such as "How do we know?" when they first encounter the phenomena. Each short (five- to 10- minute) tutorial treats a single concept. The projectile motion tutorial is on the independence of horizontal and vertical motion. The refraction tutorial helps students discover the form of Snell's law. These are interactive exercises that center on student observation and analysis of videos of real experiments. The software and videos were developed by the LivePhoto Physics Project. We are currently testing the use of these tutorials as supplemental materials in courses at Dickinson College and RIT.

*Supported in part by National Science Foundation grants 0717699 and 0717720.

EA04: 1:30–1:40 p.m. High-Speed Video Analysis of Arrow

Brielle Spencer, High Point University, High Point, NC 27262; spencb08@highpoint.edu*

Aaron P. Titus, High Point University

Using high-speed video analysis, the net force on an arrow by a compound bow was measured to determine how the force varies as a function of distance while the arrow is in contact with the string. The data showed three distinct regions: (1) an initially rapid increase in the force just after the arrow is released; (2) a nearly uniform, linear increase; and (3) a nearly constant force. This is consistent with the design of the bow that when drawn it is initially difficult to pull, becomes easier to pull, and then becomes very easy to hold when fully drawn. This experiment is a nice application of both a distance-dependent net force and a constant net force that can easily be performed by introductory physics students. The experiment and data analysis, along with its application toward physics teaching, will be discussed.

*Sponsored by Aaron Titus.

EA05: 1:40–1:50 p.m. High-Speed Video Analysis of a Cantilever

Aaron P. Titus, High Point University, High Point, NC 27262; atitus@highpoint.edu

Daniel Short, High Point University

A cantilever is a beam that is fixed at one end and free to oscillate on the other end, and its motion is described by a fourth-order partial differential equation. In this experiment, a cantilever was set up using a long, flat metal beam, and its motion was captured at 600 fps using high-speed video. The video was analyzed to determine how the frequency of oscillation depends on the length of the beam. In addition, the video was studied to determine the relative contribution of different modes of oscillation to the equation of motion of the beam. The high-speed video, the differential equation and solution for the cantilever, and the results of the video analysis are presented.

EA06: 1:50–2 p.m. Versatile Video Measurement to Enhance Physics Teaching

Ton Ellermeijer, University of Amsterdam, Postbus 94224, Amsterdam, 1090 GE, Netherlands; a.l.ellermeijer@uva.nl

Ewa Kedzierska, University of Amsterdam

Video measurement has proven to be a very good tool for bringing real-life situations into the physics classroom. In the Coach Learning Environment developed by the Physics Education Group of the University of Amsterdam we brought together advanced tools: —measurement by hand or automatic tracking of the object(s)—perspective correction—video capturing from different sources—measurement on videos and on pictures Based on classroom results we will report a few authentic projects of high school students, like Bungee jumping, shape of bridges, mathematical analysis of walking and Slinky.

EB: Interactive Lecture Demonstrations: Physics Suite Materials that Enhance Learning in Lecture

Location: City Terrace 4
Sponsors: Educational Technologies Committee, Research in Physics Education Committee
Date: Tuesday, January 11
Time: 2–3 p.m.

Presider: Priscilla Laws, Dickinson College

EB01: 2–2:30 p.m. Interactive Lecture Demonstrations: Active Learning in Lecture

Invited - David R. Sokoloff, University of Oregon, Eugene, OR 97403-1274; sokoloff@uoregon.edu

Ronald K. Thornton, Tufts University

The results of physics education research and the availability of microcomputer-based tools have led to the development of the activity based Physics Suite.[1] Most of the Suite materials are designed for hands-on learning, for example student-oriented laboratory curricula such as RealTime Physics. One reason for the success of these materials is that they encourage students to take an active part in their learning. This interactive session will demonstrate—through active audience participation—Suite materials designed to promote active learning in lecture—Interactive Lecture Demonstrations (ILDs).[2] The demonstrations will be drawn from second-semester topics.

1. E.F. Redish, *Teaching Physics with the Physics Suite* (Wiley, Hoboken, NJ, 2004).
2. David R. Sokoloff and Ronald K. Thornton, *Interactive Lecture Demonstrations* (Wiley, Hoboken, NJ, 2004).

EB02: 2:30–3 p.m. Interactive Lecture Demonstrations: Effectiveness in Teaching Concepts

Invited - Ronald K. Thornton, Tufts University, Medford, MA 02155; csmt@tufts.edu

David R. Sokoloff, University of Oregon

The effectiveness of Interactive Lecture Demonstrations in teaching physics concepts has been studied using physics education research based, multiple choice conceptual evaluations.[1] Results of such studies will be presented. These results should be encouraging to those who wish to improve conceptual learning in lecture.

1. David R. Sokoloff and Ronald K. Thornton, "Using Interactive Lecture Demonstrations to Create an Active Learning Environment," *Phys. Teach.* **35**, 340 (1997).

EC: *Panel:* State of Women in Physics

Location: Grand Ballroom 1
Sponsor: Women in Physics Committee
Date: Tuesday, January 11
Time: 1–3 p.m.

Presider: Mary Kay Patton, Hathaway Brown School

Panelists:

Jacob Clark Blickenstaff, University of Southern Mississippi

Katia Matcheva, University of Florida

Marina Milner-Bolotin, University of British Columbia

Rachel Ivie, AIP, American Institute of Physics

This session presents current perspectives on the status of women in physics. Rachel Ivie, AIP, will present the latest statistics on women's participation at all levels, including participation by women of color. We'll find out whether there is any truth to rumors that the gender gap in physics has finally been closed. Marina Milner-Bolotin, University of British Columbia, will discuss the state of women in physics with regard to family and career trajectories, including the surge of interest in Canada in response to the salary gap between men and women and the lack of women in higher ranks in academia. Jacob Blickenstaff, delegate to the 3rd IUPAP International Conference on Women in Physics, will provide an international perspective on the issue. Finally, Katia Matcheva will report on the University of Florida Physics Department's efforts to create a female-friendly environment, in particular their Female Physics Forum.

ED: The Value of Interdisciplinary Training in Graduate Education in Physics

Location: City Terrace 7
Sponsor: Graduate Education in Physics Committee
Date: Tuesday, January 11
Time: 1–2:30 p.m.

Presider: Chandralekha Singh, University of Pittsburgh

In the 21st century, physics has become highly interdisciplinary. Moreover, only 30% of those with a graduate degree in physics will find long-term jobs in academia. How should graduate education in physics incorporate the interdisciplinary training to prepare the students better for the future? The speakers include physicists from various physics departments that have developed interdisciplinary training programs for their graduate students.

ED01: 1–1:30 p.m. Continuum Mechanics: A Return to the Curriculum

Invited - Michael Dennin, University of California, Irvine, Irvine, CA 92697-4575; mdennin@uci.edu

The graduate physics curriculum is pretty much the same everywhere, and has been that way since the 1950s. The center pieces are courses in classical mechanics, electromagnetism, quantum mechanics, and statistical physics. Though successful in training academic physicists, it is not necessarily the ideal curriculum for the cross-disciplinary nature of many current research areas or non-academic career paths. I will discuss an interdisciplinary graduate program at University of California, Irvine that is based on three main elements: a summer experience, special mathematics training, and changes to the traditional core courses. Especially interesting is the replacement of traditional classical mechanics with a course in continuum mechanics. I will argue that continuum mechanics serves multiple functions in the graduate curriculum and is ideal for cross-disciplinary work.

ED02: 1:30–2 p.m. Leadership Behaviors for Successful Industrial Physicists

Invited - Stefan Zollner, New Mexico State University, Las Cruces, NM 88003; zollner@nmsu.edu

Only about one-third of physics PhDs find employment at colleges and universities, while more than half go into industry.[1] Corporations evaluate employee performance by rating results and behaviors separately. This is quite different from graduate school, where performance is based mostly on results (GPA, comprehensive exam, publications). Does this mean that we set up our students for failure? While there are many different behavior systems, I will describe one used at General Electric and Motorola:[2] Envision, Energize, Edge, Execute, and Ethics. Envision and Execute come naturally to us physicists, but Energize and Edge make the true difference between success and failure in our careers. I will show examples how training for leadership behaviors can be built into graduate physics education.

1. Characteristics of Doctoral Scientists & Engineers in the US, NSF, June 2006.
2. Chris Galvin Interview, *Business Week Online*, 17 April 2000.

ED03: 2–2:30 p.m. The Combined BS/MS Program at the Colorado School of Mines

Invited - Lincoln D. Carr, Colorado School of Mines, Golden, CO 80401; lcarr@mines.edu

The Colorado School of Mines physics department has experienced phenomenal growth over the last 10 years. The undergraduate program is now one of the five largest in the country, with 96% placement within six months after graduation. The graduate program, comprising both PhD and MS degrees, has grown from 27 to 74 students while averaging 13.5 tenure/tenure-track (T/TT) professors since 2000. We describe how our interdisciplinary combined Engineering Physics BS and six track MS program, including Applied Physics, has played a key role in this growth. We present our integrated approach toward improving our department: ABET accreditation and a yearly overhaul of our program; interdisciplinary programs and emphasis throughout our campus; hiring of several lecturers with physics education research training to complement T/TT faculty; and a heavy emphasis on undergraduate research, including a summer field session, two years of lab courses, and a required capstone senior design (senior thesis) course.

EE: Cosmology and Astronomy Education

Location: City Terrace 5
Sponsor: Space Science and Astronomy Committee
Date: Tuesday, January 11
Time: 1–1:30 p.m.

Presider: Janelle Bailey, University of Nevada - Las Vegas

This session will feature the burgeoning area of educational research and best practices in instruction of cosmology.

EE01: 1–1:10 p.m. Ideas for Teaching Cosmology

Katrina Brown, University of Pittsburgh at Greensburg, New Stanton, PA 15672; kwb@pitt.edu

Todd Brown, University of Pittsburgh at Greensburg
Rober Reiland, Shady Side Academy
Cheryl Harper, Greensburg Salem High School

Hubble's law is critical to the foundation of cosmology. However, students often have difficulty understanding why the fundamental concept of the expansion of space requires that far away galaxies appear to move away from us faster than nearer galaxies. They can also have trouble grasping that there is no center to the expansion. We will present an inexpensive activity, developed by the Contemporary Physics Education Project, that helps students understand these two fundamental implications of the Big Bang Theory.

EE02: 1:10–1:20 p.m. Cosmology Before Newton: The Terror of an Infinite Universe

Brian Schwartz, Carthage College, Kenosha, WI 53140; bschwartz@carthage.edu

Many discussions of the history of cosmology give short shrift to non-Aristotelian scientific accounts of the cosmos as it was understood in the West before the Enlightenment. Even worse, Plato, Aristotle, and Ptolemy are sometimes lumped together as "The Greeks" when, in fact, each one advocated a distinct approach to cosmological questions among the wide array of views that were then under discussion. This talk will explore parameters of the debate over the finitude of the universe (in both space and time) during the Greek, Roman, and Christian eras, as well as the lingering effects of this problem in the post-Newtonian world.

EE03: 1:20–1:30 p.m. Correlation Functions for Large-Scale Structure Simulations on a PC*

Daniel M. Smith, Jr., South Carolina State University, Orangeburg, SC 29117; dsmith@scsu.edu

The Lambda-Cold Dark Matter (LCDM) model is firmly established as the most likely scenario for the formation of the Large Scale Structure (LSS) of the universe. There are few educational tools, however, that permit a non-specialist to understand why this model is preferred over other possibilities. A simplified model of LSS growth designed to run on a PC can demonstrate graphically why the CDM model is preferred to a Hot Dark Matter model. Calculating the two-point correlation functions for the simulations given by each model can sharpen the distinction between the two.

*Supported by PAARE NSF award AST-0750814 to South Carolina State University.

EF: Teacher Education and Training

Location: City Terrace 6
Sponsor: Teacher Preparation Committee
Date: Tuesday, January 11
Time: 2–2:30 p.m.

Presider: Jerry O'Conner, San Antonio College

EF01: 2–2:10 p.m. More About the IMPACT2 Program in Marion, Ohio*

Gordon J. Aubrecht,II, Ohio State University, Marion, OH 43302; aubrecht@mps.ohio-state.edu

IMPACT[1] is a program at Marion, Ohio's Grant Middle School that involves almost every science teacher. Some achievements of the second year will be given as well as what is happening in the third year of the grant, with the program spreading to Harding High School. I will give information on some changes middle school teachers have made and indicate how the high school teachers became involved.

*Research supported in part by grants from the Ohio Department of Education, #60018325, 60021887, and 60028273,

1. "Systemic Change Through Embedded Professional Development at a STEM+C Middle School (IMPACT II)"

EF02: 2:10–2:20 p.m. Teacher Concepts of "Good Video" in a Video Club*

Eleanor W. Close, Seattle Pacific University, Seattle, WA 98119; closee@spu.edu

Hunter G. Close, Rachel E. Scherr, Stamatis Vokos, Seattle Pacific University

The video club is a professional development (PD) tool that has been in use and under study for many years. We adapted a video club model (Sherin & Han, 2004)[1] for a series of academic year PD courses in the Energy Project at SPU. For logistical reasons, we elected to show at most a single episode from each teacher's classroom. This approach requires some cooperation with the teachers to identify what sorts of action will be most valuable for consideration by the video club, which depends upon the teachers' idea(s) of what counts as "good video." We (both as researchers and as teacher educators) believe that good video focuses on situations that give students freedom to express their developing thinking. We present some evidence of teachers' concepts of good video (by their selections and their subsequent discussions) and of changes in these concepts over time.

1. Sherin, M., & Han, S. (2004.) Teacher Learning in the Context of a Video Club. Teaching and Teacher Education, 20, 163-183.

*Supported in part by NSF DRL 0822342 and the Seattle Pacific University Science Initiative.

EF03: 2:20–2:30 p.m. Bringing Technology into Physics Classrooms*

CANCELLED

Noureddine Zettili, Jacksonville State University, Jacksonville, AL 36265; nzettili@jsu.edu

We want to present ideas on ways of bringing technology to physics. We focus in particular on our outreach initiative in supporting a number of school districts with ways to improve high school physics education. This initiative is part of Project IMPACTSEED (IMproving Physics And Chemistry Teaching in SEcondary EDucation), a grant funded by the Alabama Commission on Higher Education. This project is motivated by a major local need: A large number of high school physics teachers teach out of field. IMPACTSEED aims at helping high school teachers learn and master the various physics topics they are required to teach. Teachers are offered year-round support through a rich variety of programs: a two-week long summer institute, a series of five technology workshops, and year-round onsite support. Through our hands-on approach, we have identified a number of ways of bringing technology into physics classrooms. A number of technology projects were developed and assigned to the teachers so as to show their students how physics connects to the technological devices around us. IMPACTSEED aims at providing our students with a physics education that enjoys continuity and consistency from high school to college.

*Funded by the Alabama Commission on Higher Education.

EG: Teaching Energy and the Environment

Location: City Terrace 10
Sponsor: Science Education for the Public Committee
Date: Tuesday, January 11
Time: 1–3 p.m.

Presider: Richard Flarend, Penn State Altoona

EG01: 1–1:30 p.m. Teaching About Energy

Invited - John L. Roeder, The Calhoun School, New York, NY 10024; JLRoeder@aol.com

Energy is both a physical concept and a social issue. *Teaching About Energy* is an AAPT/PTRA resource designed to present ways to teach about both aspects of energy to middle school and high school students. This talk will highlight the experiences of the author in developing this resource and the insights that led to the form in which it was eventually published.

EG02: 1:30–2 p.m. Helping Students Develop an Energy Policy for the U.S.

Invited - Pat Keefe, Clatsop Community College, Astoria, OR 97103; pkeefe@clatsopcc.edu

Al Bartlett's video, "Arithmetic, Population and Energy," spells out many of the complex issues related to energy use in our society. Bartlett makes the point that basic arithmetic is the fundamental obstacle preventing us from being able to grasp the relationships between energy production, population, and lifestyles. Although the arithmetic consists of simple mathematical relationships, there are just too many of them that need to be made for students to fully understand the issues. To overcome this problem, I have developed a spreadsheet model that can be used in a variety of ways to help students study energy and society issues. Using the spreadsheet model, students are able to discuss and research energy and society issues more effectively.

EG03: 2–2:30 p.m. Sustainability at MSUM

Invited - Steve Lindaas, Minnesota State Univ - Moorhead, Moorehead, MN 56563; lindaas@mnstate.edu

"Energy and the Environment" is one of many courses that fall under the interdisciplinary "People and the Environment" general education requirement at Minnesota State University Moorhead (MSUM). The creation of more interdisciplinary requirements was part of a general education re-design completed four years ago. The course has gone through many instructor cycles with associated textbook and assignment changes. However, one aspect that has remained constant is a project that requires students to design an energy-efficient living space. This project as well as challenges and successes associated with teaching this general education course will be discussed. In addition, we will highlight the development of a new sustainability major at MSUM, which is a direct consequence of an increased awareness of and interest in sustainability issues.

EG04: 2:30–3 p.m. Summer Energy Academy*

Invited – John Welch, Cabrillo College, Aptos, CA 95003; jowelch@cabrillo.edu

In the summer of 2010, Cabrillo College (a California Community College) hosted the third year of an NSF-funded Summer Energy Academy designed to attract new students to science and engineering. The curriculum included global energy issues, peak oil and climate change issues, basic physics of energy, hands-on experience with electricity and solar electric systems, and a community service project. The class of 24 students met 20 hours per week for one month. The students were at the beginning of their college careers, undecided about their majors, and mostly from underrepresented groups. We used lab activities, games, student projects, field trips, and guest speakers to create a fun and interesting learning environment. In this talk, I will describe our program, share some of the activities we developed, and take questions and comments.

*Funding was provided by an NSF STEP grant: DUE-0757114.

EH: Recent Research in Teacher Education: A PhysTEC Project to Inform Larger Audiences

Location: City Terrace 9
Sponsor: Teacher Preparation Committee
Date: Tuesday, January 11
Time: 1–3 p.m.

Presider: David Meltzer, Arizona State University, Polytechnic Campus

EH01: 1–1:30 p.m. Learning Community Enhances Physics Teacher Preparation and Prevents Attrition

Invited - Eugenia Etkina, Rutgers University, New Brunswick, NJ 08901; eugenia.etkina@gse.rutgers.edu

In this talk I will describe pedagogical practices of the Rutgers Physics/Physical Science Teacher Preparation program. The program focuses on three aspects of teacher preparation: knowledge of physics, knowledge of pedagogy, and knowledge of how to teach physics (pedagogical content knowledge—PCK). The program has been in place for eight years and has a steady production rate of an average of six to eight teachers per year who remain in the profession. The main purpose of the talk is to provide information about a possible structure, organization, and individual elements of a program (including the "after graduation" component) that prepares physics teachers. The philosophy of the program and the coursework can be implemented either in a physics department or in a school of education. I will provide details about the program course work and teaching experiences and suggest ways to adapt it to other local conditions.

EH02: 1:30–2 p.m. Research-based Design Principles and the Physics and Everyday Thinking Curriculum

Invited - Fred Goldberg, San Diego State University, San Diego, CA 92120; fgoldberg@sciences.sdsu.edu

The development of the Physics and Everyday Thinking (PET) curriculum* was guided by research-based design principles. These principles consider learning as building on prior knowledge, as a complex process requiring scaffolding, and as facilitated through interaction with tools, with others, and through the establishment of appropriate behavioral practices and expectations. In this talk I will briefly describe the research-based design principles, describe the structure of the PET curriculum, and illustrate how the design principles play out in practice through a case study of a small group of students working through one of the activities in the curriculum. I will also present some evaluation data indicating the extent to which the curriculum has been able to achieve its goals.

*The development of PET was supported by NSF Grant 0096856. PET is published by It's About Time, Herff Jones Education Division.

EH03: 2–2:30 p.m. A Physics Department's Contribution to Preparing Physics Teachers: Learning Assistants

Invited - Valerie K. Otero, University of Colorado, Boulder, CO 80309; valerie.otero@colorado.edu

Steven J. Pollock, Noah D. Finkelstein, University of Colorado, Boulder

In response to substantial evidence that many U.S. students are inadequately prepared in science and mathematics, we have developed an effective and adaptable model that improves the education of all students in introductory physics and increases the numbers of talented physics majors becoming certified to teach physics. We report on the Colorado Learning Assistant (LA) model and discuss its effectiveness at a large research university. Since its inception in 2003, we have increased the pool of well-qualified K-12 physics teachers by a factor of approximately three, engaged scientists significantly in the recruiting and preparation of future teachers, and improved the introductory physics sequence so that students' learning gains are typically double the traditional average. We will discuss instantiations of the LA model in physics and astronomy and provide data to support claims about its effectiveness in improving undergraduate education as well as in recruiting and preparing physics teachers to teach in high needs school districts.

EI: Best Practices for Teaching with Technology

Location: City Terrace 12
Sponsor: Educational Technologies Committee
Date: Tuesday, January 11
Time: 1–2:10 p.m.

Presider: Vern Lindberg, Rochester Inst. of Technology

Best practices for teaching with technology including clickers, homework systems, social media, computer simulations, mbl curriculum and beyond are covered.

EI01: 1–1:30 p.m. Using Geo-Spatial Technology to Analyze Real-World Motion in the Introductory Physics Courses

Invited - J.B. Sharma, Gainesville State College, School of STEM, Gainesville, GA 30504; jsharma@gsc.edu*

The rapid emergence of geospatial technologies has opened novel possibilities for analyzing real-world motion and to use nature as a laboratory. This can help connect technical concepts with the student's experiential domain. Real-world motion incurred by the student can be captured by hand-held Global Positioning System (GPS) units. This records the real time three-dimensional position vector of real-world motion of the student. This contains all the kinematics of the motion, and if the mass of the moving object is known, the dynamics and energetics can be unfolded. This allows students to calculate energy expenditures incurred in their motion, along with forces that they experienced, and connect this to direct measurement. Software has been developed to interactively animate the real-world student motion with dynamic vector diagrams on Google Earth. Case studies of both human and machine motion will be presented along with some further applications under development.

*Invited by Vern Lindberg.

EI02: 1:30–1:40 p.m. Multiple Clicker Uses in the Introductory Physics Sequence

Michael C. Faleski, Delta College, University Center, MI 48710; michaelfaleski@delta.edu

Clickers are a technology that has been infused into my TYC classroom over the course of the past five years. Initially used only for review questions, the clickers now are integrated into the fabric of my introductory physics classes so that they are utilized in a variety of different ways including exam questions, review games, Socratic questioning during class, challenge questions, and for connections between different topics among others. In this presentation, the implementation into the calculus-based introductory sequence will be discussed in conjunction with results from standard assessment exams (FCI, CSEM, DIRECT) and student attitudes about the usage of the devices in class.

EI03: 1:40–1:50 p.m. The Effect of Supplementary Web-based Multimedia Prelectures in Teaching Introductory Mechanics

Homeyra R. Sadaghiani, California State Polytechnic University, Pomona, Pomona, CA 91768; hrsadaghiani@csupomona.edu

We study the educational value of the Multimedia Learning Modules (MLM)* in teaching introductory mechanics as a preparation for classroom discussion and problem-solving sessions. One hundred fifty nine students were randomly registered in two sections of an introductory mechanics course, one that featured the online multimedia component and one without this component. Both groups participated in class discussion and problem solving examples using a personal response system. The resulting data were analyzed for 39 identical common questions for both classes. The students in the multimedia group out performed the students who did not experience the MLM.

* https://online-s.physics.uiuc.edu/courses/phys211/gtm/No_Login/page.html

EI04: 1:50–2 p.m. Improving Student Learning in Lecture by Using Multimedia Prelectures

Tim Stelzer, University of Illinois, Urbana, IL 61801; tstelzer@illinois.edu

Students' unprecedented access to content on the web is providing a unique opportunity to transform the role lectures in education, moving the focus from content delivery to helping students synthesize the content into knowledge. We have introduced a variety of activities to facilitate this transformation at the University of Illinois, including web-based preflight assessments of student understanding before lecture, peer instruction (clickers) to assess and facilitate student understanding during lecture, and web-based multimedia pre-lectures designed to provide students with content before lecture. In this talk I will discuss the pedagogical motivation for introducing these activities, and the impact they have had at the University of Illinois.

EI05: 2–2:10 p.m. Electricity and Magnetism Self-Testing and Test Construction Tool

John Stewart, University of Arkansas, Fayetteville, AR 72701; johns@uark.edu

This talk presents an online resource for teaching and evaluating introductory electricity and magnetism classes. The resource contains a library of highly characterized, multiple-choice, conceptual and quantitative electricity and magnetism problems and solutions all linked to a free online textbook. The library contains more than 1000 classroom-tested problems. Each problem is characterized by the complexity of its solution and by the fundamental intellectual steps found in the solution. Exam construction, administration, and analysis tools are provided through the resource's website. Problems may be downloaded for use in exams or as clicker questions. Instructors may also design and administer assignments online. A self-testing tool is provided for students or instructors, an excellent tool for brushing up on conceptual electricity and magnetism. Conceptual inventory scores produced by the site are normed against the Conceptual Survey in Electricity and Magnetism. There is no cost associated with using any of the facilities of the site and you can begin to use the site immediately. Supported by NSF - DUE 0535928. Site address http://physinfo.uark.edu/physicsonline.

EJ: Teaching Physics Online

Location: City Terrace 11
Sponsors: Educational Technologies Committee, Physics in Two-Year Colleges Committee
Date: Tuesday, January 11
Time: 1–3 p.m.

Presider: Robert Steiner, American Museum of Natural History

This session will highlight forefront opportunities, challenges, and issues in the teaching of physics in settings that are mostly or entirely online. Exemplars will be drawn from virtual high schools as well as higher education. A range of topics will be covered.

EJ01: 1–1:10 p.m. Transforming Traditional Conceptual Physics into a Hybrid or Blended Course

Paul G. Ashcraft, Penn State Erie, The Behrend College, Erie, PA 6563; pga106@psu.edu

Jonathan Hall, Penn State Erie, The Behrend College

A traditional lecture-based undergraduate conceptual physics course became a blended course by substituting online activities for some of the lectures. Asynchronous student activities, dealing with video analysis or computer simulations, replaced a portion of lectures and/or demonstrations in class. Results of the class will be discussed, including administration encouragement of online and blended courses, appropriateness of materials, which student populations benefited the most and least, and technological issues.

EJ02: 1:10–1:20 p.m. Going Hybrid-online in Freshmen Physics: Newtonian Mechanics via Internet

Barbara M. Hoeling, California State Polytechnic University, Pomona, Pomona, CA 91768; bmhoeling@csupomona.edu

We present the first hybrid-online version of our general physics course for scientists and engineers at Cal Poly Pomona. The class met twice a week for a 50-minute face-to-face lecture, while the third 50-minute in-class meeting was replaced by a video-taped lecture. The course material, Newtonian Mechanics, had been restructured into 10 Learning Units, and was made available through the course's Blackboard site. Students were required to take short online multiple choice reading quizzes on Blackboard before the start of each face-to-face lecture. The online homework system MasteringPhysics was used, and "virtual" office hours were offered via Adobe Connect Meeting. The experiences with these online components and the students' acceptance of the hybrid format will be reported, as well as a comparison of student learning in this hybrid-online and in a face-to-face version of the course.

EJ03: 1:20–1:30 p.m. Designing Non-online Labs for Online Courses

Jacob Millspaw, IPFW, Fort Wayne, IN 46805; millspaj@ipfw.edu*

Mark Masters, IPFW

Online courses are out there and it looks like they are here to stay. I contend that online classes lack in labs. In physics, labs are an important part of the learning experience. This is where students get a chance to learn physics hands on, test concepts and reinforce their understanding. Instead of trying to design online-based labs, we are working to develop simple at-home lab kits that could bring the labs off of the screen and onto the table. The students can work through the experiments then discuss their results in small online groups comparing observations and developing a stronger conceptual understanding of the material.

*Sponsored by Mark Masters, IPFW

EJ04: 1:30–1:40 p.m. An Open-Source Mechanics Course Targeting Problem-Solving Expertise

Raluca E. Teodorescu, Massachusetts Institute of Technology, Cambridge, MA 02139; rteodore@mit.edu

Analia Barrantes, Carolin N. Cardamone, Saif Rayyan, David E. Pritchard, Massachusetts Institute of Technology

We are developing and testing an online environment to allow teachers to easily adopt and adapt our Modeling Applied to Problem Solving pedagogy.[1] This pedagogy stresses a systems, interactions, and models approach to facilitate organization and transfer of syllabus knowledge to problem solving in an expert-like manner. (The syllabus is for a standard calculus-based Newtonian mechanics course.) A central collection of multi-level research-based homework sets organized by topic and cognitive complexity is supplemented by integrated open-access WIKI-text, videos, worked examples, simulations, and tutorials. Our Integrated Learning Environment for Mechanics (ILEM) involves an open-source WIKI-text that is integrated with the tutors LON-CAPA and ANDES, and also contains material for classroom use. The assessment will include a new instrument to assess strategic knowledge as well as the CLASS. Results from applying this course at MIT and at Whatcom Community College (Seattle) will be discussed. Users and collaborators are welcome to use our framework or its parts.

1. A. E. Pawl, A. Barrantes and D. E. Pritchard, "Modeling applied to problem solving," in Proceedings of the 2009 Physics Education Research Conference, Ann Arbor, MI, 2009.

EJ05: 1:40–3 p.m. Teaching Physics Online with Florida Virtual School

Panel – Kimberly A. Cloran, Florida Virtual School, Vero Beach, FL 32967; kcloran@flvs.net

In this presentation, I will share my thoughts on my five years of experience teaching online Physics with Florida Virtual School. I will also share information on my use of Elluminate Live as my virtual classroom and the use of various simulations to offer quality lab experience in online physics.

EJ06: 1:40–3 p.m. Computer-based Physics for Gifted Students: EPGY's First 20 Years

Panel - Gary Oas, EPGY, Stanford University, Stanford, CA 94305-4101; oas@epgy.stanford.edu

James R. Holmes, EPGY, Stanford University

Since 1990 the Education Program for Gifted Youth at Stanford University has been providing computer-based distance learning courses in math and physics. This program evolved from earlier computer-based education research going back to the early 1960s. The EPGY Online High School was formed in 2006 offering a complete high school curriculum online, recently receiving a six-year WASC accreditation. EPGY now offers nine physics courses ranging from middle-school physics through university-level quantum mechanics. For students matriculating at Stanford, EPGY university-level math and physics courses taken in high school can be applied to their undergraduate degree. We will briefly discuss the history of EPGY physics and share the experiences of creating computer-based and online physics courses. Emphasis will be on modalities better suited for an online environment and challenges of offering a rigorous and effective laboratory experience.

EJ07: 1:40–3 p.m. Teaching Physics Online

Panel - Andy Veh, Kenai Peninsula College / University of Alaska Anchorage, Soldotna, AK 99669; aveh@uaa.alaska.edu

The presenter has taught online classes in Astronomy, Chemistry, and Trigonometry for up to 12 years and has started teaching a Conceptual Physics and an algebra-based physics class a year ago. The presentation shows how physics lectures, online resources, quizzes, exams, and labs are facilitated.

EJ08: 1:40–3 p.m.

Panel - Richard Lindarch, Department of Physics, University of Virginia

EK: PER: Investigating Classroom Strategies

Location: Grand Ballroom 3
Sponsor: Research in Physics Education Committee
Date: Tuesday, January 11
Time: 1–3:10 p.m.

Presider: David Brookes, Florida International University

EK01: 1–1:10 p.m. Is ISLE Learning Cycle Applicable to Solving Real World Problems?

Tiberiu Dragoiu-Luca, Hillsborough High School, Hillsborough, NJ 08844; tdragoiu@eden.rutgers.edu

Eugenia Etkina, Rutgers University

ISLE (Etkina and Van Heuvelen, 2001, 2007) is a physics teaching philosophy in which student learning of physics mirrors the doing of physics. When learning physics through ISLE, students observe natural phenomena, find patterns using various tools, and explain them in multiple ways and then test those explanations by predicting the outcomes of new experiments. They later apply the explanations that were not ruled out to solve complex problems. Why might it be beneficial for the students to learn physics by following and practicing the ISLE cycle? During 2009-10 school year I interviewed various professionals from different fields of work. In this talk I will present the similarities I found between the ISLE cycle and the real world.

EK02: 1:10–1:20 p.m. Conversion to Guided Inquiry Laboratories in Introductory Physics Courses

Delena Bell Gatch, Georgia Southern University, Statesboro, GA 30460; dbgatch@georgiasouthern.edu

Georgia Southern recently converted its introductory physics courses into a new format—integrating lecture and laboratory courses into a single course in which most of the class time is devoted to inquiry-based learning. During the conversion period, the effects of traditional and inquiry-based laboratories on student learning were assessed, primarily focusing on problem-solving skills. Traditional laboratory students continued to use the departmental laboratory manual, which was very "cook-book" in nature, while inquiry-based students completed guided inquiry laboratories. Assessment included identical post-laboratory quizzes completed by students in both courses immediately following select laboratory exercises over a two-semester period. Post-laboratory quizzes were evaluated using a problem-solving rubric that focused on the following categories: useful description, physics approach, specific application of physics, mathematical procedures, and logical progression. Results indicated inquiry-based students performed much better on the post-laboratory quizzes than students in traditional laboratories.

EK03: 1:20–1:30 p.m. Understanding an Individual's Sense of Community

Renee Michelle Goertzen, Florida International University, Miami, FL 33199; goertzen@gmail.com

Eric Brewe, Laird Kramer, Florida International University

We report on a study of the factors that contribute to introductory undergraduate physics students' sense of community at Florida International University (FIU). In previous work, we have reported gains in conceptual learning and attitudes about learning science in those students enrolled in the introductory courses at FIU taught with Modeling Instruction, which operates in a collaborative learning environment.[1] The establishment of a community of learners has been supported by the availability of Modeling Instruction and the Physics Learning Center (PLC), a set of rooms available for student-initiated groupwork. Using video recordings of the Modeling Instruction classes and selected students' work in the PLC, along with interviews with selected students, we explore how the larger community of learners creates a sense of community for a single individual in that community.

1. Brewe, E., Kramer, L., & O?Brien, G. (2009). Modeling Instruction: Positive attitudinal shifts in introductory physics measured with CLAss. Physical Review Special Topics– Physics Education Reseasrch, 5, 013102.

EK04: 1:30–1:40 p.m. Finding Evidence for Teachers' Intentions in Video using Participation Frameworks

Benedikt W. Harrer, University of Maine, Orono, ME 04469; benedikt.harrer@maine.edu

Rachel E. Scherr, Seattle Pacific University
Michael C. Wittmann, Brian W. Frank, University of Maine
Hunter G. Close, Seattle Pacific University

One of the means by which teachers (consciously and unconsciously) position themselves relative to their students is by their literal spatial positioning and orientation. A teacher sits in a circle around a whiteboard with her students, showing that she is part of the learning community. Another instructor steps out of the circle, intending the learners to take ownership in the learning environment. As researchers who analyze these interactions, we benefit from our own lived experiences with human behavior as we make inferences about the meaning of verbal and gestural utterances. These inferences that are grounded in empirical (video) data can be further supported through the use of established theoretical models of interaction, such as participation frameworks theory. We analyze video using participation framework theory to find evidence for instructional intentions in an episode from a teacher professional development course within the SPU Energy Project.

EK05: 1:40–1:50 p.m. Doubling the Learning of 1st-Year University Science Students in the Classroom

Ellen N. Schelew, University of British Columbia, Vancouver, BC V6T 1Z1; eschelew@phas.ubc.ca

Louis Deslauriers, Carl Wieman, University of British Columbia

In this study, we directly compared the effectiveness of two pedagogical techniques on the performance of first-year physics students during a portion of a first-year E&M course. The instructor in one section of the course used a traditional/passive teaching technique while the instructor in the other section used a completely interactive style of teaching. Both instructors agreed beforehand as to exactly what topics and learning objectives would be covered during this portion of the course. Furthermore, both instructors also agreed beforehand on the content and format of the test used to measure student learning. Students in the highly interactive section scored 0.74 +/-0.01 while students in the traditional section scored 0.41 +/- 0.01. Their only exposure to the material and thus opportunities to learn were confined to the classroom. In this way, this study cleanly isolated the effect of a particular classroom pedagogical technique on student learning.

EK06: 1:50–2 p.m. Preparation for Future Learning: Effects of Innovation on Student Discourse

Gregory H. Suran, Graduate School of Education, Rutgers University, New Brunswick, NJ 08901-1183; hsuran@raritanval.edu

James Finley, Eugenia Etkina, Graduate School of Education, Rutgers University

The "Preparation for future learning" transfer studies show that when students innovate in searching of their own solutions for the ill-structured lab tasks, they develop the initial knowledge that can be "transferred in" to make sense of the following reading passage. Innovation activities make consequential learning more effective than traditional efficiency-based lab tasks that use well-structured instructions written by experts in the normative language. We conducted discourse analysis of the answers of three groups of 18 students to the questions related to the thermal conductivity to find the differences in the ways of thinking and in conceptual understanding of students who had different lab experiences working in groups on traditional and innovational labs before learning from the same text. We analyzed student discourse from the perspectives of the levels of cognitive activities, structure of knowledge, normativity of language, and conceptual understanding.

EK07: 2–2:10 p.m. If They Can't Do This, What Can They Do?

Karen Cummings, Southern Connecticut State University, New Haven, CT 06515; cummingsk2@southernct.edu

Jeffrey D. Marx, McDaniel College

We have developed an instrument to help assess students' ability to solve textbook-style problems. Following initial beta-testing of the instrument in the fall of 2009 and spring of 2010, we have revised the assessment and collected additional data. This talk will be a brief update on the status of the project and a report on insights gained from the additional beta-test data.

EK08: 2:10–2:20 p.m. Problem Categorization: Can Computer-based Feedback Impact Performance and Similarity Criteria?

Jennifer L. Docktor, University of Illinois at Urbana-Champaign, Beckman Institute, Urbana, IL 61801; docktor@illinois.edu

Jose P. Mestre, Brian H. Ross, University of Illinois at Urbana-Champaign

Problem categorization tasks are commonly used as a measure of expertise, but they might also be useful pedagogical tools for highlighting the concepts and principles needed to solve problems. In this one-hour experiment, students were presented with pairs of physics problems on a computer screen and asked to judge whether they would be solved similarly. Four types of problem pairs were used, matching on one of the following criteria: surface features only, deep principles only, both surface and deep, or neither. One group of students received feedback on their choices that emphasized concepts and principles applicable to each problem, whereas a second group only received feedback on the correctness of their choice. We will discuss categorization performance, the criteria students reported using to make their decisions, and how both of those were influenced by the type of feedback they received.

EK09: 2:20–2:30 p.m. Freeze Frame Representations

Bashirah Ibrahim, Kansas State University, Manhattan, KS 66506-2601; bibrahim@phys.ksu.edu

The paper reports on introductory physics students' application of "freeze frame" representations when solving problems in a representation-rich kinematics course. The study was conceptualised for students who are academically and scientifically underprepared. "Freeze frame" representation is a new method introduced for portraying objects in motion. It is based on the idea of stroboscopic photographs and used to describe the motion of an object whose positions are recorded at equal time periods apart. This visual conceptual model was used as a representational bridge for translating physics information between different representational modes as well as for eliciting qualitative information. Analysis of the 24 paper and pencil instruments revealed that "freeze frame" representations did support the interpretation and derivation of appropriate qualitative information but play no prominent role as a representational bridge. The reasons underlying these outcomes and the implications for the teaching and learning of kinematics at introductory level are discussed. Special thanks to Andy Buffler (University of Cape Town, South Africa) and Fred Lubben (University of York, United Kingdom) for their valuable comments and guidance on the project.

EK10: 2:30–2:40 p.m. Mapping Student Solution Rubric Categories to Faculty Perceptions

Andrew J. Mason, University of Minnesota, Twin Cities, Minneapolis, MN 55454; ajmason@umn.edu

Brita Nellermoe, University of Minnesota,Twin Cities; University of St. Thomas

We examine a categorization of artifacts generated by 30 faculty members (Yerushalmi et al. 2007, Henderson et al. 2007) and determine how both the individual concepts themselves and the categories in which they are placed map to categories of a rubric designed for analysis of student problem solutions (Docktor 2009). The results suggest that the rubric categories for student problem solutions designed by Docktor emerge naturally from faculty perceptions. Categories are subject to differing levels of focus according to level of institution, and potential differences between the categories and the individual artifacts are suggested.

EK11: 2:40–2:50 p.m. Assessment of Integrated Contrast and Compare Activities Using Non-Traditional Physics Problems

Frances A. Mateycik, Penn State Altoona, Altoona, PA16601; fam13@psu.edu

Students in an introductory algebra-based physics course were asked to explicitly compare and contrast physical cases in both homework and laboratory settings. Students were required to communicate similarities and differences between selected problems on each weekly homework assignment and also collaboratively communicate similarities and differences between specific laboratory observations and specific homework problems. Data were collected from examinations to assess whether the compare and contrast activities affected students' performance on three different types of non-traditional physics problems. The three research-based non-traditional problem types were problem posing, text-editing, and physics jeopardy tasks, and they were integrated in all four in-class examinations. This talk will present the results from the examination performance.

EK12: 2:50–3 p.m. Tutorials to Facilitate Students' Learning of Integration in Physics

N. Sanjay Rebello, Kansas State University, Manhattan, KS 66506; srebello@phys.ksu.edu

Dong-Hai Nguyen, Kansas State University

Several problems in calculus-based introductory Electricity and Magnetism (E&M) use integration. In our previous study, we found that students had a lot of difficulties with integration in physics problems, and hence were unable to solve most problems in introductory Electricity and Magnetism. Based on these findings, we developed problem-solving tutorials to facilitate students to learn integration in the context of physics problems, and tested the effect of these tutorials on students' performance on problems on several topics in introductory Electricity and Magnetism. We found that students using these tutorials, to some extent, outperformed students learning with traditional materials in E&M problems involving integration. We report on the components and structure of the tutorials and their effect on students' learning of integration.

*This research is supported in part by NSF grant 0816207.

EK13: 3–3:10 p.m. Research Exploring TAs' Knowledge About Student Problem Solving*

Joshua S. Von Korff, Kansas State University, Manhattan, KS 66502; vonkorff@phys.ksu.edu

Dehui Hu, Sanjay Rebello, Kansas State University

Instructors who understand their students' problem solving abilities will be better able to compose and assign effective problems. Different groups of students may be ready for different types of homework and test problems. A common method for discerning students' problem-solving ability is to test the students themselves, but this would not help us to discern the instructor's understanding of the students' ability. Our study interviews teaching assistants (TAs) in a focus group format, inviting them to predict students' ability to solve homework and test questions. Tas' quantitative and qualitative responses are recorded. Because discussion takes place in a focus group, the TAs can share ideas and learn more rapidly. This allows us to investigate the TAs' ability to learn to make predictions.

*This research is supported in part by NSF grant 0816207

Education Policy: Having an Impact, Improving the Landscape

Location: Grand Ballroom 4
Sponsor: AAPT
Date: Tuesday, January 11
Time: 3:30–5 p.m.

Noah Finkelstein, University of Colorado, Boulder, chair

SYMPOSIUM on Physics Education

Policy makers make decisions everyday that impact curriculum, standards, funding, and many other aspects of physics education at all levels. AAPT works with partners to keep policy makers informed on the views of physics educators and to suggest appropriate policy options within our sphere of influence. This session brings together individuals who play pivotal roles in helping to shape policies and who provide information to policymakers. We hope to provide a look at how the "sausage is made" as well as where you might help contribute some of the ingredients.

– *U.S. Congressman Vernon J. Ehlers*

– *Michael Lach, Special Assistant for Science, Technology, Engineering, and Mathematics Education, U.S. Department of Education*

– *Third speaker to be determined*

U.S. Congressman Vernon J. Ehlers

Michael Lach

PST2: Poster Session 2

Location: Outside Exhibit Hall
Date: Tuesday, January 11
Time: 8:30–10 p.m.

Odd number poster authors will be present 8:30–9:15 p.m.
Even number posters will be present 9:15–10 p.m.
(Posters should be set up by 9 a.m. Tuesday and taken down by 10:30 p.m. Tuesday)

Technologies, Physics Education Research, Upper Division and Graduate, Lecture/Classroom

PST2A-01: 8:30–9:15 p.m. Electricity and Magnetism Self-Testing and Test Construction Tool

Poster - John Stewart, University of Arkansas, Fayetteville, AR 72701; johns@uark.edu

This poster presents an online resource for teaching and evaluating introductory electricity and magnetism classes. The resource contains a library of highly characterized, multiple-choice, conceptual and quantitative electricity and magnetism problems and solutions all linked to a free online textbook. The library contains more than 1000 classroom-tested problems. Each problem is characterized by the complexity of its solution and by the fundamental intellectual steps found in the solution. Exam construction, administration, and analysis tools are provided through the resource's website. Problems may be downloaded for use in exams or as clicker questions. Instructors may also design and administer assignments online. A self-testing tool is provided for students or instructors, an excellent tool for brushing up on conceptual electricity and magnetism. Conceptual inventory scores produced by the site are normed against the Conceptual Survey in Electricity and Magnetism. There is no cost associated with using any of the facilities of the site and you can begin to use the site immediately. Supported by NSF - DUE 0535928. Site address: http://physinfo.uark.edu/physicsonline.

PST2A-02: 9:15–10 p.m. Guided Inquiry Computer Games as a Preparation for Future

Poster - Anna Karelina, Occidental College, Los Angeles, CA 90041; anna.karelina@gmail.com

Rajesh Jha, SimInsights Inc.

We present the first results and possible applications of using guided inquiry computer games in learning physics. The games are designed to help students explore physical phenomena prior to classroom instruction. The game challenges the student to help the lead character Tommy get out of difficult situations such as crossing a river. Successful game play requires the player to investigate a specific physics concept by following some of the processes of the scientific inquiry: making observations of the situation, looking for patterns, proposing hypotheses, constructing a model and finally testing the model. Such games provide almost individual scaffolding to the player. The scaffolding depends on the current game level, the number of previous failures, and so forth. We believe that these games are most beneficial if followed by summarizing and reflective discussions in the classroom. In another way, they "prepare students for future learning*."

*D.L. Schwartz & T. Martin, Inventing to prepare for future learning: The hidden efficiency of students' own production, *Cognition Instruc.* 22, 129-184, 2004.

PST2A-03: 8:30–9:15 p.m. Wiimote Experiments for Reinforcing Vector Concepts in Introductory Mechanics

Poster - Minjoon Kouh, Drew University, Madison, NJ 07940; mkouh@drew.edu

Alae Kawam, Drew University

We present the usage of a versatile, low-cost accelerometer (Wiimote for the Nintendo Wii gaming system) for performing two introductory lab experiments. They are designed to help the students in an introductory physics course to develop better understanding of the vector concepts (addition and decomposition of force), within the contexts of two classic physics problems: inclined plane and uniform circular motion. These experiments are fun and easy to perform, and they provide an example of how this relatively new technology can be used as an innovative and effective teaching tool.

PST2A-04: 9:15–10 p.m. Computational Experiments for Physics Education

Poster - Charles Xie, Concord Consortium, Concord, MA 01742; qxie@concord.org*

The new National Science Education Standards call for a new science curriculum to fix the "mile-wide-inch-deep" problem. Exactly how this goal can be achieved is a critical question. This poster will present a possible technological solution that involve using computational experiments to reorganize the curriculum. Three examples will be demonstrated. As these computational experiments are strictly based on first principles in physics, they open up many opportunities of inquiry and design for exploring a breadth of science concepts. The examples show that it is possible to create a science curriculum that is both deep and wide.

*Sponsored by Robert Tinker.

PST2A-05: 8:30–9:15 p.m. Physics Teaching Web Advisory (Pathway): Web-based Assistance for Physics Teachers*

Poster - Dean A. Zollman, Kansas State University, Manhattan, KS 66506-2601; dzollman@phys.ksu.edu

Sytil K. Murphy, Kansas State University
Scott Stevens, Michael Christel, Carnegie Mellon University

The Physics Teaching Web Advisory (Pathway) uses a unique interactive web-based tool "the Synthetic Interview" to provide teachers with information about pedagogical issues in physics. Pathway's natural language interface enables teachers of physics to "discuss" ways of teaching various topics in physics with four different experienced teachers. The interview database of more than 6000 different recorded answers includes information on most topics covered in a high school physics course. In addition, a collection of videos that are related to the interview questions can be used directly in the classroom. Pathway is available at http://www.physicspathway.org.

*Supported by the US National Science Foundation under Grants 0455772 & 0455813.

PST2A-06: 9:15–10 p.m. World Conference on Physics Education, 2012

Poster - Dean A. Zollman, Kansas State University, Manhattan, KS 66506 2601; dzollman@phys.ksu.edu

A.J. Ellermeijer, University of Amsterdam
Pratibha Jolly, Miranda House, University of Delhi

The International Commission on Physics Education (ICPE) and Groupe International de Recherche sur l'Enseignement de la Physique (GIREP) are in the planning stages of establishing a series of World Conferences on Physics Education. The plan is to hold a conference once every four years and use the World Conference on Physics and Sustainable Development (WCPSD) as a general model. The first conference in the series is tentatively scheduled for Istanbul in July 2012. The theme will be "The Roles of Context, Culture and Representations in Physics Teaching & Learning." The conference will have three to four strands devoted to various topics related to this theme. GIREP & ICPE envision the conference as a working conference that would generate plans of action and teams that would carry out the actions. As plans develop, we will be inviting other national and international physics education organizations to become part of the conference.

PST2A-07: 8:30–9:15 p.m. Physical Media: Using New Media to Explore Science Through Game Design

Poster - Anthony Schultz, CUNY Graduate Center, New York, NY 10016; tony.schultz@gmail.com

We present the use of a dataflow visual programming language and video game controller for investigating physics in the context of game design. The programming language allows real-time simulation, analysis and graphical display of a physical system while integrating accelerometer data from the controller to affect the system. Specifically, a multi-player flight simulation with a central gravitational field is developed.

Physics Education Research

PST2B-01: 8:30–9:15 p.m. Development of a Faculty Perceptions Survey*

Poster - Wendy K. Adams, University of Northern Colorado, Greeley, CO 80631; wendy.adams@colorado.edu

Brett Gilley, University of British Columbia

We have developed a Faculty Perceptions Survey that addresses a wide range of perceptions about teaching and students that both education researchers and teaching faculty value. We have conducted faculty interviews in a range of science departments in both the U.S. and Canada as part of this development. The Initial results suggest that experienced teaching faculty and education researchers agree on most of the areas addressed by the survey. With this research, we are hoping to provide a tool to learn more about faculty's perceptions of teaching, offer one measure of change and facilitate partnerships between education researchers and teaching faculty such as those created by the Carl Wieman Science Education Initiatives in Colorado and British Columbia.

*This work is supported in part by the Carl Wieman Science Education Initiative at the University of British Columbia

PST2B-02: 9:15–10 p.m. Gender Bias and the Force Concept Inventory

Poster - Richard D. Dietz, University of Northern Colorado, Greeley, CO 80639; rdietz@unco.edu

Matthew R. Semak, Robert H .Pearson, Courtney W. Willis, University of Northern Colorado

Is the well-established fact that males tend to outperform females on the Force Concept Inventory (FCI) evidence of gender bias? A question is biased only if factors other than ability determine a student's performance on that question. Using the total score on the FCI as a proxy for ability, we describe and employ a variety of statistical techniques in an effort to identify which questions on the FCI may be accused of gender bias.

PST2B-03: 8:30–9:15 p.m. Measuring Individual Cognitive Load During Isomorphic Mathematic Problems

Poster - Thomas M. Foster, Southern Illinois University Edwardsville, Edwardsville, IL 62026-1654; tfoster@siue.edu

Jessica Klopfenstein, Southern Illinois University Edwardsville

Since the 1950s, cognitive scientists have known that humans can only work with 7±2 ideas at any given moment. Some ideas are simple, like phone numbers, and others require the development of expertise, like driving a car. But still there are only 7±2 memory slots to work with. Cognitive Load Theory (CLT) postulates that learning is only possible if there is free capacity in the working memory. One application of CLT is in physics instruction that requires students to work their solutions algebraically, while the students prefer to substitute numbers as soon as possible. We hypothesize, within the CLT framework, that students prefer numbers because they use fewer working memory slots than algebra. Furthermore, as students develop expertise in algebra, this preference fades. However, no research has been done to test either hypothesis. The purpose of this study is to examine the cognitive load of students while they solve arithmetic and algebraic problems to measure and evaluate any differences in the measurement.

PST2B-04: 9:15–10 p.m. Understanding an Individual's Sense of Community

Poster - Renee Michelle Goertzen, Florida International University, Miami, FL 33199; goertzen@gmail.com

Eric Brewe, Laird Kramer, Florida International University

We report on a study of the factors that contribute to introductory undergraduate physics students' sense of community at Florida International University (FIU). In previous work, we have reported gains in conceptual learning and attitudes about learning science in those students enrolled in the introductory courses at FIU taught with Modeling Instruction, which operates in a collaborative learning environment.[1] The establishment of a community of learners has been supported by the availability of Modeling Instruction and the Physics Learning Center (PLC), a set of rooms available for student-initiated groupwork. Using video recordings of the Modeling Instruction classes and selected students' work in the PLC, along with interviews with selected students, we explore how the larger community of learners creates a sense of community for a single individual in that community.

1. Brewe, E., Kramer, L., & O?Brien, G. (2009). Modeling Instruction: Positive attitudinal shifts in introductory physics measured with CLAss. *Physical Review Special Topics – Physics Education Reseasrch*, 5, 013102.

PST2B-05: 8:30–9:15 p.m. The Productivity of Substance-based Reasoning in Physics

Poster - Ayush Gupta, University of Maryland, College Park, MD 20742; ayush@umd.edu

Andrew Elby, Luke D. Conlin, University of Maryland

Many science education researchers have argued that learners' commitment to a matter-ontology impedes the learning of scientific concepts such as force and heat: students tend to classify these concepts as substances or properties of substances leading to robust misconceptions. To teach correct conceptions of these physics ideas, it has been suggested that instruction should steer novices away from substance-based reasoning. We argue that substance-based reasoning, grounded in physical experiences, forms the seeds for sophisticated understanding of these very same physics concepts. We will present data from a teacher professional development workshop, where a group of elementary school science teachers build a sophisticated explanation for why objects of different masses have the same acceleration due to gravity, starting from substance-based metaphors for gravity. Instructional interventions should focus on tapping these productive matter-based resources rather than categorizing them as misconceptions.

PST2B-06: 9:15–10 p.m. Finding Evidence for Teachers' Intentions in Video using Participation Frameworks

Poster - Benedikt W. Harrer, University of Maine, Orono, ME 04469; benedikt.harrer@maine.edu

Rachel E. Scherr, Hunter G. Close, Seattle Pacific University
Michael C. Wittmann, Brian W. Frank, University of Maine

One of the means by which teachers (consciously and unconsciously) position themselves relative to their students is by their literal spatial positioning and orientation. A teacher sits in a circle around a whiteboard with her students, showing that she is part of the learning community. Another instructor steps out of the circle, intending that the learners take ownership in the learning environment. As researchers who analyze these interactions, we benefit from our own lived experiences with human behavior as we make inferences about the meaning of verbal and gestural utterances. These inferences that are grounded in empirical (video) data can be further supported through the use of established theoretical models of interaction, such as participation frameworks theory. We analyze video using participation framework theory to find evidence for instructional intentions in an episode from a teacher professional development course within the SPU Energy Project.

PST2B-07: 8:30–9:15 p.m. Implementing Multi-Touch Technologies to Improve Physics Education

Poster - Carolina C. Ilie, State University of New York at Oswego, Oswego, NY 13126; carolina.ilie@oswego.edu

Mark Potter, Damian Schofield, SUNY Oswego

Advancements in technology have opened multiple doorways to build new teaching and learning methods. Through conjunctive use of these technologies and methods, a classroom can be enriched to stimulate and improve student learning. The purpose of our research is to ascertain whether or not multi-touch technology enhances students' abilities to better comprehend and retain the knowledge taught in physics. At their basis, students learn via visual, aural, reading/writing, and kinaesthetic styles. Labs provide for all four styles, while lectures neglect kinesthetic learning. Pedagogical research indicates that kinesthetic learning is a fundamental, powerful, and ubiquitous learning style.[1] By using multi-touch technology in lecture, a wider spectrum of students can be ushered to improving overall learning.

1. Wieman, C.E, Perkins, K.K., Adams, W.K., Oersted Medal Lecture 2007: Interactive Simulations for teaching physics: What works, what doesn't and why", *Am. J. Phys.* **76,** 393-99.

PST2B-08: 9:15–10 p.m. Student Errors With Right Hand Rule Problems

Poster - Mary Bridget Kustusch, North Carolina State University, Raleigh, NC 27695-8202; mbkustus@ncsu.edu

Robert J. Beichner, North Carolina State University

Understanding the difficulties that students have with the direction of cross products and right- hand rules requires examining their performance on these problems from several perspectives. Previous research[1] explored the relationship between qualitative measures of student performance (correctness and response time) and factors such as participant spatial ability and differing problem features. The current study presents a more qualitative analysis that identifies the types of errors students make while attempting to solve right-hand rule problems (e.g. using the left hand, neglecting the sign of the charge, treating the cross product as commutative, etc.). This analysis also explores how these errors relate to the methods students use, the features of the problems, and more quantitative measures of performance.

1. Kustusch, M.B. & Beichner, R. Student difficulties with right hand rules. Contributed Poster: AAPT & PERC, Portland, OR, 17-22 July 2010

PST2B-09: 8:30–9:15 p.m. Research on Student Model Formation and Development in Physics

Poster - Mark Lattery, University of Wisconsin Oshkosh, Oshkosh, WI 54901; lattery@uwosh.edu

How can scientific models and modeling be used to enhance science learning? How and why do student models change? This project examines student model formation and development in a university-level physical science course. The essence of my research method is to engage students in a modeling task involving a two-way trip of a fan cart (analogous to a vertical ball toss). Following classroom experiments and discussion, students are placed in pairs to articulate and defend their models in writing. Each student pair receives an anonymous peer review and an opportunity for rebuttal. To clarify student views, students render their models electronically using an interactive simulation program called Modeling Aid. The results contribute insights into student model formation and development in mechanics. This research is supported by the Spencer Foundation (Grant #200800161) and the University of Wisconsin System Office of Professional and Instructional Development.

PST2B-10: 9:15–10 p.m. Students' Problem Similarity Ratings Used to Assess Course-Integrated Contrast and Compare Activities

Poster - Frances A. Mateycik, Penn State Altoona, Altoona, PA 16601; fam13@psu.edu

Sean Elward, Penn State Altoona

Students in an algebra-based physics course were asked to explicitly compare and contrast physical cases in both homework and laboratory settings. Students were required to communicate similarities and differences between selected problems on each weekly homework assignment and also collaboratively communicate similarities and differences between specific laboratory observations and specific homework problems. Data were collected to assess students' emphasis on deep-structure at the beginning and end of the spring 2010 semester using similarity ratings surveys. Each survey asked students to rate the similarities between eight pairs of problems of varying similarity, and then defend each of their ratings with a two- or three-sentence statement. This poster will present a comparison of students' similarity ratings scores before and after treatment. Student performance on all laboratory assignments and in-class examinations were also collected to determine if there existed any significant correlation between performance and similarity ratings.

PST2B-11: 8:30–9:15 p.m. A Method for Classifying Students' Understanding of Conceptual Structure*

Poster - Mojgan Matloob Haghanikar, Kansas State University, Manhattan, KS 66506; mojgan@phys.ksu.edu

Sytil Murphy, Dean Zollman, Kansas State University

While investigating the impact of interactive learning strategies on pre-service elementary teachers, we designed a protocol to assess students' responses to written examination questions. As a part of our protocol, we classify concepts into three types: Descriptive, Hypothetical, and Theoretical, [1] in order to explore how students relate those concepts. This procedure follows an approach by Neiswandth and Bellemo[2] for analyzing students' conceptual structure in biology. We devised questions that require the use of concepts from all three levels as well as a knowledge of their relationships. Then we classify students' responses in terms of the represented conceptual structure. Less sophisticated responses with only descriptive concepts or some connections between theoretical and descriptive concepts were more commonly exhibited. The occurrence of more sophisticated responses with multi-level links among concepts (theoretical-descriptive-hypothetical) was rare. In this poster we compare the analysis of students' conceptual structure for traditional and inquiry-oriented courses.

*Supported by NSF grant ESI-055 4594.

1. L.W. Anderson & D.R. Krathwohl, A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman (2001)
2. M. Nieswandt & K. Bellomo, *J. of Research in Science Teaching* **46**(3), pp. 333-356 (2009)

PST2B-12: 9:15–10 p.m. Lunar Phases Project: Combining Mental Model Building with Students' Observations

Poster - Angela O. Meyer, Florida Gulf Coast University, Fort Myers, FL 33967; ameyer@fgcu.edu

Manuel J. Mon, Florida Gulf Coast University

The cause and process of the lunar phases is a difficult concept for undergraduate non-science majors to grasp. Using an inquiry-based instructional method such as Mental Model Building (MMB) can be more effective in increasing students' conceptual understanding of the lunar phase cycle and process, especially when coupled with observations made by students. We utilize this methodology in the Lunar Phases Project for non-science major undergraduate students in General Education Astronomy and Physical Science courses. Each student completes a "portfolio" consisting of weekly observations, final predictions, and observations, and a final model of the lunar phases summarized in one drawing along with a written explanation of the phases of the Moon. We report the latest results of the Lunar Phases Project, covering three semesters and more than 150 students.

PST2B-13: 8:30–9:15 p.m. Examining the Effects of Single-Sex Education on College Physics Students

Poster - Mary E. Mills, Miami University, Oxford, OH 45056; millsme2@muohio.edu

Jennifer Blue, Miami University

Previous research has shown that young women can benefit from taking their science classes in single-sex classrooms (e.g., Robinson & Gillibran 2004, Stowe 1991).[1, 3] Further, women's colleges produce a disproportionate number of female scientists (Sebrechts 1992).[2] There is less research on the effect of single-sex education on young men. In the present study, we investigate the effects of single-sex education on the self-efficacy of college physics students by surveying students at four colleges. The schools included two women's colleges, one men's college, and one coeducational college. The surveys asked questions about the students' self-efficacy and self-confidence in physics, their thoughts about attending single-sex and coeducational colleges, as well as information about their previous schooling. Results of the survey will be presented.

1. Robinson & Gillibran (2004). *International Journal of Science Education* **26**(6), 659.
2. Sebrechts (1992) Initiatives **55**(2), 45.
3. Stowe (1991) *TPT* **26**(6), 380.

PST2B-14: 9:15–10 p.m. REU Students' Perceptions of Scientific Ethics

Poster - Sytil K. Murphy, Kansas State University, Manhattan, KS 66506; smurphy@phys.ksu.edu

Dean A. Zollman, Kansas State University

The National Science Foundation is now requiring ethics training as a part of every funded program that includes the education of students or post-docs, including the Research Experience for Undergraduates (REU) program.[1] Previous data[2] collected through the online Survey of Undergraduate Research[3] indicates that biology and physics students perceive different amounts of benefits due to their REU experience. To investigate this situation further, we conducted entrance and exit interviews with physics and biology REU students at Kansas State University. The analysis of these data can help us attempt to understand what these students feel are ethical considerations in their own field and research and how their views change as a result of participation in the REU program. The REU programs are supported by grants from NSF: for physics, PHY-0851599 and for biology, DBI-0851835.

1. Federal Register, August 20, 2009, http://edocket.access.gpo.gov/2009/E9-19930.htm
2. D. Lopatto. Personal communication.
3. http://web.grinnell.edu/sureiii/

PST2B-15: 8:30–9:15 p.m. Students' Difficulties with Integration in Introductory Electricity and Magnetism*

Poster - Dong-Hai Nguyen, Kansas State University, Manhattan, KS 66506; donghai@phys.ksu.edu

Elizabeth Gire, University of Memphis
N. Sanjay Rebello, Kansas State University

Integration is a powerful mathematical tool widely used in physics, especially in Electricity and Magnetism. However, setting up an integral from a physics scenario and computing that integral are not simple tasks for most students at the introductory physics level. We conducted individual teaching/learning interviews with 15 students enrolled in an introductory Electricity and Magnetism course. In these interviews, students solved problems in which they had to set up integrals to calculate physical quantities. Verbal hints were given by the interviewer to help students overcome the difficulties they encountered when solving the problems. We found that student difficulties with integration included inabilities to set up an integral describing a physical quantity, to distinguish variables and constants in an integral, to determine the limits of an integral, and to evaluate an integral using the area under the curve of the integrand.

*This research is supported in part by NSF grant 0816207.

PST2B-16: 9:15–10 p.m. Assessing a Students' Understanding Using the Semantic Space

Poster - Nic Rady, University of North Texas, Huntsville, TX 77340; nrady@unt.edu

While there are ample resources to assess a students' conceptual understanding of physics, critics have claimed that these assessments may be so contextual based that the results may not be valid. For the last year, preliminary research has been conducted to create a tool that will allow one to create a multi-dimensional map of a students' semantic space to assess their knowledge without contextual underpinnings. Results from an initial study conducted in the summer of 2010 will be presented and future work will discussed.

PST2B-17: 8:30–9:15 p.m. Self-Efficacy in Physics Problem Solving Tasks

Poster - Kimberly A. Shaw, Columbus State University, Columbus, GA 31907; shaw_kimberly@colstate.edu

Self-efficacy is often described as a person's belief in her/his ability to accomplish a specific task, and is both content and context dependent. Self-efficacy is both informed by past performance (of the individual and of those considered to be peers), and can impact current performance levels. This may be especially important for female students in science, who tend to drop out of science classrooms with much better performance records than their male counterparts. Work has been under way to develop an instrument to examine self-efficacy beliefs of students on their problem solving abilities in physics, paralleling work in math self-efficacy literature. Analysis of student self-efficacy ratings on physics problem solving tasks as they correlate with performance measures will be presented.

PST2B-18: 9:15–10 p.m. Rebels in Physics Classes

Poster - Christopher Sirola, University of Southern Mississippi, Hattiesburg, MS 39406; Christopher.Sirola@usm.edu

One of the movements in physics education is to place students together in groups or teams in order to promote learning. However, not all students wish to work in such an environment, nor necessarily agree with the decisions of their respective groups. By way of cooperative group activities in college-level introductory physics classes, we examine the fraction of students that "rebel" against their respective groups, and look at which students are most likely to rebel. This can have implications for how instructors form student groups. Finally, does it pay to rebel against one's teammates?

PST2B-19: 8:30–9:15 p.m. TRUSE Conference: Integrating Undergraduate Physics, Chemistry and Mathematics Education Research*

Poster - John R. Thompson, University of Maine, Orono, ME 04469-5709; john.thompson@umit.maine.edu

Warren M. Christensen, North Dakota State University
Chris L. Rasmussen, San Diego State University
Marcy H. Towns, Purdue University

In June 2010, the first of two biennial conferences on Transforming Research in Undergraduate STEM Education (TRUSE) brought together researchers in undergraduate physics, mathematics, and chemistry education to transform and integrate research across disciplines. The format included plenary talks, working groups, poster sessions and substantial unstructured time to network with colleagues and build capacity for future investigations. Research described included projects that exemplify particular disciplinary approaches; work on trans-disciplinary topics such as transfer, representations, and reasoning strategies; and investigations on content topics that cross one or more disciplinary boundaries. After the conference, mini-grants were solicited for seed projects that could lead to longer-term interdisciplinary collaborations. A summary of the conference will be given with descriptions of sample presentations and implications for PER. The organizers will be running the conference again in 2012 with at least one more discipline being included.

*Conference supported by NSF grants DUE-0941515 and -0941191. http://www.chem.purdue.edu/Towns/TRUSE/

PST2B-20: 9:15–10 p.m. Development of a Standard Fluids Assessment

Poster - DJ Wagner, Grove City College, Grove City, PA 16127; djwagner@gcc.edu

Sam Cohen, Adam Moyer, Jason Wetstone, Grove City College

We are developing an FCI-style assessment covering hydrostatic topics commonly included in introductory physics courses. Students from all three introductory tracks (conceptual-, trig-, and calculus-based) at Grove City College have completed draft versions of our assessment, both pre- and post-instruction. This poster will display our current version of the assessment, along with analysis of the questions and plans for the future. We're particularly interested in receiving suggestions from other educators and in recruiting beta-testers. Stop by and chat!

PST2B-21: 8:30–9:15 p.m. Electric Field Concept: Some Research Results

Poster - Genaro Zavala, Tecnologico de Monterrey, Monterrey, NL 64849; genaro.zavala@itesm.mx

Alejandro Garza, Tecnologico de Monterrey

Over the past 30 years there has been extensive research on students' understanding of physics concepts. There has been research from mechanics concepts in the first introductory physics course to concepts in physics majors' upper-level courses. Electricity and magnetism is not an exception among the topics that have been investigated. However, students' understanding of the electric field concept has not been studied thoroughly. This presentation is a contribution to research on students' understanding of the electric field. We are presenting the results on how students reason in electric field questions in the presence of conductors and no conductors and the difference in their responses when using an electric field representation.

PST2B-22: 9:15–10 p.m. Toward a Learning Path on Modeling

Poster - Ton L. Ellermeijer, University of Amsterdam, Amsterdam, 1090 GE Netherlands; a.l.ellermeijer@uva.nl

Onne van Buuren, University of Amsterdam

The use of modeling with computers and of measuring with video and sensors in teaching seems to be promising. However, results are not always as good as had been expected. Students do not automatically connect models, experiments, and the underlying theories and concepts with each other. The main research question is: How can a combination of measuring and modeling help to bridge the gap between realistic contexts and the mathematical and physical concepts? Educational materials have been developed for the lower and upper level of Dutch secondary school. As an educational tool we used Coach 6, because in Coach modeling can be combined with experimenting and animation. Results indicate that the willingness for students to use a representation depends on how familiar they feel with it. Also it appears that many students tend to study the aspects of a model that they are asked to study, but not much more.

PST2B-23: 8:30–9:15 p.m. More Letters to the Editor – A Scientist Influencing the Public

Poster - Gordon J. Aubrecht, Ohio State University, Marion, OH 43302; aubrecht@mps.ohio-state.edu

This is the next installment of the author's letters to the editor of his local paper trying to explain what science is and how scientists work in response to letters demonstrating ignorance of those characteristics.

PST2B-24: 9:15–10 p.m. Identifying Non-science to Raise Scientific Awareness

Poster - Sadri Hassani, Illinois State University, Normal, IL 61790; hassani@phy.ilstu.edu

I will discuss the content of a couple of courses that I have developed to raise the scientific awareness of general students. While presenting physical ideas and emphasizing modern physics, I use them to controvert the baseless claims of New Agers, mind/body healers, some philosophies of science, and academicians who hold science responsible for the evil of the world.

PST2B-25: 8:30–9:15 p.m. Characters of Scientists Problem Finding and Solving Activities

Poster - Eugene Kang, Pusan National University, Geumjeong-Gu, Jangjeon-Dong, Busan, Republic of Korea; Eugenea2010@GMAIL.COM

Jina Kim, Pusan National University

Most of the science curriculum for secondary school emphasizes the ability of scientific problem solving. Korean national curriculum also accentuates improvement in scientific problem solving. In the line with the national curriculum, many educational studies have been made in science education. Most of them have studied how secondary students solve the scientific problem that was proposed by precedent scientists. What scientists find and solve are scientific knowledge, and what scientists authentically perform are scientific activities. Therefore, it needs to study and categorize the scientists' activities to make guidelines for students in relation to scientific problem solving. This is the study to interview the present scientists. They were asked what was most important to find their scientific problems, which criteria made them find and modify their problems, what strategy was chose to solve their problems, and what similarities and differences were between inquiry process and their process.

PST2B-26: 9:15–10 p.m. Student Perceptions and Use of the Pathway Active Learning Environment*

Poster - Christopher M. Nakamura, Kansas State University, Manhattan, KS 66506; cnakamur@phys.ksu.edu

Sytil K. Murphy, Dean A. Zollman, Kansas State University
Michael Christel, Scott M. Stevens, Carnegie Mellon University Entertainment Technology Center

The Pathway Active Learning Environment is an online learning environment that combines lessons covering Newton's laws, with an interactive multimedia system that answers students' questions using prerecorded video responses from expert tutors to produce a synthetic tutoring system. This fall, students from an algebra-based physics course at Kansas State University worked with the lessons in an interview setting. Each student participated in three 1.5-hour interviews. The students were assigned to one of seven groups. Each group accessed a different configuration of tutor and multimedia. During each of the interviews, the students spent the first hour working through the lessons and interacting with the tutor. The remaining time was spent discussing students' use of the system, their perceptions of it, and their understanding of the relevant physics. This poster summarizes the students' comments.

*This work is supported by the U.S. National Science Foundation under Grants REC-0632587 and REC-0632657.

PST2B-27: 8:30–9:15 p.m. Rotational Motion Equations for Introductory Physics by Use of Analogy

Poster - Stephen G. Armstrong, 112 Forset Lake Blvd. Apt. 416, Daytona Beach, FL 32119; stephenarm@gmail.com

Joseph M. Mosca, Embry Riddle Aeronautical University

Teaching rotational mechanics to elementary physics students often involves hand-waving arguments to obtain equations. They are often not required to understand the source even when they grasp the algebra. This can lead to a less than satisfactory situation where more interested students are left to doubt the validity of results. Here we present a self-contained, simplified approach to introducing rotational equations by use of a set of analogies to both review the derivations of translational motion and introduce the corresponding rotational concepts in a way that just about any student can follow and use with confidence.

PST2B-28: 9:15–10 p.m. Physics Concepts Instructional Approach Based on in-lab Videos

Poster - Sergio Flores, University of Juarez, Ciudad Juarez, Chih Mexico 32310; sflores17@utep.edu

Monica Quezada, Juan E. Chavez, Oscar Ruiz, University of Juarez
Maria D. Gonzalez, Tecnologico de Juarez

Many introductory physics students have understanding problems when they try to learn physics concepts through the knowledge real representation during lab sessions. The research group named Physics and Mathematics in Context from the University of Ciudad, Juarez, Mexico, has developed an instructional approach based on videos to help students to recognize and learn the properties of concepts as forces, Newton's second law, and tension force. These videos are projected during the lab sessions to allow a direct interaction between the object knowledge (physical concepts) and the knowledge subject (the students). These videos show the materials, instruments, procedures, and the corresponding description of the cognitive and physical abilities students demand to develop the labs successfully. This didactic design is based on the theories of mathematical representations and visualization. We will show and describe samples of these videos and their possible understanding outcomes.

PST2B-29: 8:30–9:15 p.m. Overview of the Pathway Active Learning Environment*

Poster - Sytil K. Murphy, Kansas State University, Manhattan, KS 66506; smurphy@phys.ksu.edu

Chris M. Nakamura, Dean A. Zollman, Kansas State University
Michael Christel, Scott M. Stevens, Carnegie Mellon

The Pathway Active Learning Environment is an online system combining lessons on Newton's laws with a synthetic tutor, based on synthetic interview (SI) technology. Students can interact with the SI by either choosing from a list of quick start questions or by typing a question. There are seven possible system variations, including one with no SI, created by varying the SI persona (one of two people) and the support materials referenced in the SI response (no extra materials, static images, or video). The lessons are based on a three-stage learning cycle, with video-based exploration and application activities in which students are asked to make observations, predictions, and measurements. Most student interactions with the system are logged, including questions submitted to the SI and responses to lesson materials.

*This work is supported by the U.S. National Science Foundation under Grants REC-0632587 and REC-0632657.

PST2B-30: 9:15–10 p.m. LivePhoto Workshops: Active Learning through Analysis of Real World Phenomena

Poster - Robert B. Teese, Rochester Institute of Technology, Rochester, NY 14623; rbtsps@rit.edu

Priscilla W. Laws, Maxine C. Willis, Dickinson College
Patrick J. Cooney, Millersville University

The LivePhoto Physics Project* team has been creating video clips and classroom-tested video analysis activities that can be used for interactive lecture demos, in-class exercises, labs, and homework. A preliminary study showed learning gains when video-analysis materials were added to an introductory physics course at Dickinson College. Next summer, the project team will offer a five-day workshop for college and university physics instructors at RIT. Participants will learn about various ways to use video analysis in teaching and about action research and findings from physics education research related to video analysis. In addition, workshop participants will be invited to join a multi-year controlled study of the effectiveness of selected video-analysis curricular materials at diverse institutions.

*Supported by NSF grants 0424063, 0717699 and 0717720. http://livephoto.rit.edu/

PST2B-31: 8:30–9:15 p.m. Teaching Physics Through Modeling the Physics Research Community

Poster - Angela Little, University of California, Berkeley, Berkeley, CA 94703; little@berkeley.edu

Badr Albanna, University of California, Berkeley

In this poster, we will present on The Compass Project, a program created at the University of California, Berkeley, five years ago to support physics students during the critical freshman transition into college. Drawing on physics education research, we had two major goals in creating a two-week summer program for incoming freshmen: building community and helping students develop productive beliefs about what physics is and how to learn it. The poster will focus on a newly developed semester-long course that follows the summer program. One focus of both the summer program and the course is developing the students' capacity to see the world through physics models; students also hone their ability to communicate and collaborate productively with their peers. We will present some students' work and show some of the successes and challenges of introducing college freshmen to our model of a physics research community.

Lecture/Classroom

PST2C-01: 8:30–9:15 p.m. Physics in Portraits (A Mnemonic device)

Poster - Mikhail M. Agrest, College of Charleston, Charleston, SC 29424; agrestm@cofc.edu

Numerous visual mnemonic devices with elements of humorous flavor were designed to relate the concepts and so to remember them. Tested in class for students and exposed to teachers at a regional SACS AAPT meeting, [1] most of these devices excited both categories of audiences. The Great unique minds like Newton and Pascal, Galileo Galilei and Einstein, Pierre and Marie Curie, and many others were capable of uncovering the hidden meaning of events. Educators' job is to profess the uncovered concepts as well as the role of great physicists and how they came up with those ideas. In our mnemonic devices Portraits of Scientists whose names are given to the units of physical values act as those values. Reanimation of their portraits does not only pay tribute to the authors of great ideas but also trigger students' interest in history and philosophy of physics.

1. Mikhail M. Agrest. Physics in Portraits of Great Physicists - A Mnemonic device. Aiken, SC: SACS AAPT Spring 2010 Meeting. http://sacs-aapt.org/Meetings/Meeting_S10/Agrest.zip

PST2C-02: 9:15–10 p.m. Teaching About UV Radiation and Skin Cancer in Danish schools

Poster - Frank Bason, SolData Instruments, Silkeborg, DK-8600 Denmark; soldata@soldata.dk

In recent years the incidence of skin cancer due to excessive exposure to ultraviolet radiation from sunshine or from artificial sources has increased substantially in Denmark. In particular the incidence among young Danish women has increased dramatically. In cooperation with the Danish Cancer Society, teaching materials have been developed to present the following subject matter in a general physics course at the secondary level: ultraviolet radiation sources, the properties of ultraviolet radiation, the biological effects of ultraviolet radiation. To facilitate teaching this material a "UV demo-set" has been developed. It consists of four packages with materials for demonstration experiments and laboratory exercises on this subject matter. The materials are packaged in a convenient small suitcase and accompanied by ready-to-use teacher's aids with background information and instructions for laboratory experiments. The materials have been used primarily at the secondary level in Denmark, but they can also be useful to science teachers in primary education. The modern science or physics teacher is expected to be an authority on many aspects of his or her field. Skin cancer is an ailment which many young people have heard about or experienced among friends or family. It is therefore very important to provide teachers with the resources and demonstration tools to address this issue as it relates to the teaching curriculum.

PST2C-03: 8:30–9:15 p.m. Moving Worked Physics Examples from the Classroom to YouTube

Poster- Warren M. Christensen, North Dakota State University, ND 58102; warren.christensen@ndsu.edu

Despite overwhelming evidence of the effectiveness of interactive engagement methods in the physics classroom, even the most reformed classes may include a number of traditional features. Many instructors in large-lecture courses still work out sample problems to meet student expectations, even though the physics education research literature indicates that this passive activity does little to promote conceptual understanding. One way to address this issue is to relegate the passive problem-solving observation medium to instructor-created YouTube videos. Using a simple tripod and personal digital camera, I record myself working out sample problems on paper. Roughly four to five problems per homework set are available for students to watch at their leisure, as often as they would like. I will cover my approach for these clips and some very user-friendly features of YouTube that allow for quick annotations that minimize the need for multiple re-takes.

PST2C-04: 9:15–10 p.m. Ed Psych for Physics Teachers: Using Touchstone Physics Learning Exemplars

Poster - Daniel L. MacIsaac, SUNY Buffalo State College Physics, Buffalo, NY 14222; macisadl@buffalostate.edu

Kathleen A. Falconer, SUNY Buffalo State Elementary Education & Reading

We describe some standard ideas taken from typical introductory Educational Psychology courses for pre-service physics teachers, and illustrate them with touchstone situations reported in Physics Educational Research (PER) literature. We attempt to make ideas from educational psychology appealing, interesting, relevant, and immediate to future physics teachers, and introduce pedagogical content knowledge (PCK) from PER into the professional vocabulary of these new colleagues to be.

PST2C-05: 8:30–9:15 p.m. Learning Physical Science: An Active-Learning Physical Science Curriculum for Large Enrollments

Poster - Edward Price, California State University San Marcos, San Marcos, CA 92096; eprice@csusm.edu

Fred Goldberg, San Diego State University
Steve Robinson, Tennessee Technological University
Rebecca Kruse, BSCS
Danielle Harlow, University of California Santa Barbara

The LEarning Physical Science (LEPS) curriculum is interactive, student-centered, and collaborative, but is intended for use in large, lecture-format classes or other settings where hands-on experimentation and whole class discussions are difficult. LEPS incorporates class response systems, interactive demonstrations, online homework, and computer simulations. The curriculum focuses on core conceptual themes of energy, forces, and the atomic-molecular theory of matter. In addition, LEPS explicitly engages students in learning about the nature of science and learning. LEPS is based on the Physical Science and Everyday Thinking curriculum.[1] Pre-post assessments show significant gains in conceptual understanding and positive shifts in attitudes and beliefs about physics and learning physics. This poster will present example materials and findings from field tests.

1. F. Goldberg, R. Kruse, S. Robinson, V. Otero, and N. Thompson, Physical Science and Everyday Thinking, It's About Time, Armonk, NY, 2007.

PST2C-06: 9:15–10 p.m. Better Problem Solving in Introductory Physics

Poster - Renee Lathrop, Dutchess Community College, Poughkeepsie, NY 12601; lathrop@sunydutchess.edu

Problem solving is a big part of introductory physics. Additionally assessing students' abilities to problem solve is a possibility when trying to measure the student's ability to think critically in a physics course. For the past five years I have been using the following method (classify, draw a picture/graph, write initial equations, solve for variables, and evaluate results) to teach my students how to approach and communicate their understanding of physics through problem solving. While there are drawbacks to this method, the benefit of requiring students to explain and justify how they solve word problems is worth the time and energy when you can see and correct misconceptions.

PST2C-07: 8:30–9:15 p.m. Putting Photon and Quantum Effects Back into Undergraduate Biophysics

Poster - Thomas M. Nordlund, University of Alabama at Birmingham, Birmingham, AL 35294-1170; nordlund@uab.edu

Coverage of the physical processes of photosynthesis in recent textbooks used for general biochemistry, biophysics, and biological physics courses has decreased to about 20% of that in the 1980s. In light of the present need for training of students in solar-energy technology, this lack of treatment would seem inopportune. Most undergraduate biophysics textbooks also have little or no quantitative description of quantum and photonic processes in biosystems, even though these lie at the heart of enzyme activity and the properties of biological nanosystems. If undergraduate students from physics, chemistry, biology and engineering need to learn "biophysics" in the same one-semester course—a necessity at many colleges—how can we effectively teach these important biological photon and quantum effects? We propose a focus on diagrams and more diagrams, the de Broglie wavelength (and other quantum principles familiar to most junior-level science students) and use of pre-prepared simulations using common spreadsheet software.

PST2C-08: 9:15–10 p.m. Item Response Theory: A Comparison of Algorithms

Poster - Lin Chen, School of Electronic Science and Engineering, Southeast University, Jiangsu, China; chenli.seu@163.com

Jing Han, Lei Bao, Ohio State University
Jing Wang, Yan Tu, Eastern Kentucky University

Item Response Theory (IRT) is a popular method to investigate the item features and students' performance in education. Several software packages such as R, MULTILOG, PARSCALE, etc. are commonly used to do IRT analysis. In this study, we use R and MULTILOG to compare their performance on the 3-parameter IRT model with college students' FCI data collected at The Ohio State University. A comparison between the fit goodness using various estimations is discussed. The results showed that consistent error exists in both methods. The performance of R is better than MULTILOG at the low level of proficiency, while it's not as good as MULTILOG when the proficiency increases.

Wednesday, January 12

Plenary– Nuclear Medicine	10:30 a.m	Grand Ballroom 4
Presidential Transfer	12:30 p.m.	Grand Ballroom 4
Jacksonville Walking Tour	2:30 p.m.	

FA: Making Physical Meaning with Mathematics

Location: City Terrace 4
Sponsor: Research in Physics Education Committee
Date: Wednesday, January 12
Time: 8:30–10:30 a.m.

Presider: Corinne Manogue, Oregon State University

This session is focused on research that looks at how students use their understanding of mathematics to make sense out of and solve physics problems at a variety of physics levels.

FA01: 8:30–9 a.m. The Cognitive Dynamics of Mathematical Sense-Making

Invited - Ayush Gupta, University of Maryland, College Park, MD 20742; ayush@umd.edu

Andrew Elby, Mike Hull, Eric Kuo, University of Maryland

In interviews with students in a calculus-based introductory physics course, we find a strong correlation between students' explanations of equations and approaches to problem-solving: Students who blend conceptual meaning with mathematical structure in the explanation of the kinematics-velocity equation are much more likely to "see" the expert route to solving a related problem. We find that the use of such integrated conceptual and mathematical knowledge, referred by Sherin (2001) as symbolic forms, is context-dependent. In our analysis of a clinical interview with one introductory-physics student, designed to cue multiple contexts, we report how affect and epistemology are coupled to the activation dynamics of symbolic forms based reasoning.

FA02: 9–9:30 a.m. Making Meaning of Quantum Operators*

Invited - Elizabeth Gire, University of Memphis, Memphis, TN 38152; egire@memphis.edu

Corinne A. Manogue, Oregon State University

Operators play a central role in the formalism of quantum mechanics. We explore students' understandings of operators that represent measurable quantities and how students use these operators in calculations involving measurements. We conducted think-aloud problem solving interviews with upper-level physics students at two large, four-year research universities with different curricular approaches — a "spins first" approach and a "wave functions first" approach. We will discuss the results of these interviews and the connection between students' understandings of linear transformations and their understandings of quantum operators.

*This work is supported in part by NSF grant DUE 0618877.

FA03: 9:30–10 a.m. Investigating Math-Physics Connections in Upper-Division Thermal Physics*

Invited - John R. Thompson, University of Maine, Orono, ME 04469-5709; john.thompson@umit.maine.edu

We have been conducting physics education research and developing curricular materials in upper-division thermal and statistical physics, identifying and addressing student difficulties with physics concepts. Part of our work includes exploring student understanding of the mathematics associated with or underlying the physics. We have focused on three main areas: integrals in the context of analyzing thermodynamic processes with PV diagrams; partial differentiation in conjunction with material properties; and probability distributions in statistical and thermodynamic systems. Our findings suggest that some documented physics difficulties may have some roots in mathematics, while in other cases the math is much more sophisticated than the students recognize. The role of particular representations is also being explored in some cases. These findings will be interpreted through some of the research literature on undergraduate mathematics education.

*Supported in part by NSF grants DUE 0817282 and DUE 0837214.

FA04: 10–10:10 a.m. Intertwining Physics and Mathematics to Facilitate a Better Understanding of Both

Kastro M. Hamed, 3862 Regents Way, Oviedo, FL 32765; Kastro-Hamed2010@gmail.com

Proportional reasoning is a very powerful mathematical tool with many applications. This talk describes a hands-on activity that builds on and extends some of the ideas of PIPS' (Powerful Ideas in Physical Science) activities. The objective of the activity is to build a physical intuition of proportional reasoning and scaling. Students then use the activity to gain a firmer understanding of density, scaling, and even some of the properties of nano-particles. While working on this activity, the students seem to gain a better appreciation of how strongly math and physics are intertwined. Math acquires a sense of concreteness that makes it a simplifying conceptual tool. It is worth adding here that the students we are referring to here are pre-service elementary teachers who expressed both dislike and discomfort with both physics and math.

FA05: 10:10–10:20 a.m. Exploring Physics Students' Claims of "Understanding" Physics Equations

Richard P. Hechter, University of Manitoba, Department of Curriculum, Teaching, and Learning, Winnipeg, MB R3T 2N2; hechter@cc.umanitoba.ca

Secondary-level physics courses include a plethora of mathematically expressed concepts through multifaceted equations. These equations are often revealed through varying instructional sequences and pedagogical progressions aimed at addressing student epistemology toward enhanced learning. Throughout the physics course, students will often claim to understand the equations they have learned in class. But what exactly do students mean when they say they, "understand the equation?" I present results of a small-scale, mixed-methods study that probes student articulation through their written and interview responses of what they actually claim to "understand." I discuss the thematic response groupings and their relationships to epistemological framing and the interpretation of mathematical equations in secondary-level physics.

FA06: 10:20–10:30 a.m. Differences in Student Application of Integrals in Introductory Electromagnetism*

Jeffrey M. Polak, North Carolina State University, Raleigh, NC 27695-8202; jeff_polak@ncsu.edu

Applying the calculus concept of integration to physical situations is a challenging task for most students in introductory physics courses. An understanding of how students connect this mathematical concept with physical situations will help to guide future instructional development. Students in introductory electromagnetism use integrals to calculate electric fields from charged objects and to calculate changes in electric potential along paths through regions of electric field. By comparing how students deal with integrals in these two different contexts, we can better understand their application of this mathematical tool. We conducted individual interviews and recorded students talking through their solutions for problems involving integration in both situations. Evidence from these interviews suggests that students invoke integration differently in the two physical contexts of electric field and electric potential difference.

*Support for this project comes from NSF Award DUE-0618504

FB: Emerging Technology

Location: City Terrace 7
Sponsors: Physics in Two-Year Colleges Committee, Educational Technologies Committee
Date: Wednesday, January 12
Time: 8:30–9:40 a.m.

Presider: John Griffith, Mesa Community College

This session will focus on coming trends and technologies as they relate to physics instruction.

FB01: 8:30–9 a.m. Developing Physics Apps for the iPhone and the iPad

Invited - Andrew Duffy, Boston University, Boston, MA 02215; aduffy@bu.edu

A significant fraction of students own an iPhone, an iPod Touch, or an iPad, for which apps can be downloaded from the App Store. Creating physics apps gives us a way to provide students with a new way to learn some physics, as well as to enhance our own coolness factor. This talk will present one physicist's experience of developing physics apps for student use. Attendees will hear about the app development environment; see some apps in action; and discuss the relative merits of using Apple's devices to deliver educational content. In addition, a lucky few attendees will receive a code so they can download an app for free. Website: http://physics.bu.edu/~duffy/classroom.html

FB02: 9–9:30 a.m. Teaching and Grading on the TabletPC

Invited - Paul J. Marquard, Casper College, Casper, WY 82601; marquard@caspercollege.edu

Classroom presentation has evolved over the years from the chalkboard to the whiteboard and now to electronic systems like the SmartBoard. But each of these systems share one disadvantage, the teacher is restricted in position to the location of the board. The TabletPC, connected wirelessly to a projector system, allows the instructor to move around the classroom and engage the student more directly, more personally. In addition, notes written on the TabletPC can be saved to a file and uploaded to a website for student access at a later time. After class the TabletPC can be used to hand write notes, homework and exam solutions, create written and audio comments on papers, and hold electronic office hours using any number of different eboard systems. The versatility of this tool sets it above the rest and makes it a powerful tool for teaching and learning in the modern classroom.

FB03: 9:30–9:40 a.m. Moving Worked Physics Examples from the Classroom to YouTube

Warren M. Christensen, North Dakota State University, Fargo, ND 58102; warren.christensen@ndsu.edu

Despite overwhelming evidence of the effectiveness of interactive engagement methods in the physics classroom, even the most reformed classes may include a number of traditional features. Many instructors in large-lecture courses still work out sample problems to meet student expectations, even though the physics education research literature indicates that this passive activity does little to promote conceptual understanding. One way to address this issue is to relegate the passive problem-solving observation medium to instructor-created YouTube videos. Using a simple tripod and personal digital camera, I record myself working out sample problems on paper. Roughly four to five problems per homework set are available for students to watch at their leisure, as often as they would like. I will cover my approach for these clips and some very user-friendly features of YouTube that allow for quick annotations that minimize the need for multiple re-takes.

FC: Reforming the Introductory Physics Course for Life Science Majors IV

Location: City Terrace 5
Sponsor: Physics in Undergraduate Education Committee
Date: Wednesday, January 12
Time: 8–10:20 a.m.

Presider: Juan Burciaga, Denison University

The physics community has been holding a series of discussions (cf., http://www.phys.gwu.edu/iplswiki/index.php/Main_Page) over the last few years about the challenges and problems associated with reforming the introductory physics course for life science majors. This session will continue the discussion by focusing on the application of physics paradigms in the biological sciences.

FC01: 8–8:30 a.m. Why Biology Students Have Such Trouble Using Physics in Biology Courses*

*Invited - Todd J. Cooke,** University of Maryland, Dept. of Cell Biology and Molecular Genetics, College Park, MD 20742; tjcooke@umd.edu*

Kristi L. Hall, Janet E. Coffey, Jessica E. Watkins, Edward F. Redish, Jeffrey Jensen, University of Maryland, College Park

The NRC report BIO 2010 and the Association of American Medical Colleges report Scientific Foundations for Future Physicians are transforming undergraduate biology education. These reports advocate increased incorporation of fundamental math, physics, and chemistry into biology courses; increased relevance of general science courses for biology students; and the change from required courses to specified competencies. Physicists, biologists, and science educators at UM are working together on implementing these reforms in a principles-based, introductory biology class BSCI 207 Principles of Biology III: Organismal Biology and an algebra-based, IPLS sequence PHYS 121/122 Fundamentals of Physics I/II. This talk will address the some of the major disciplinary, curricular, pedagogical, and epistemological issues that appear to interfere with effective reforms in these courses. We conclude that successful IPLS reforms will unavoidably depend on the ability to implement coordinated reforms in introductory biology courses.

*Partial support from NSF-CCLI grant 09-19816.
**Sponsored by Juan Burciaga.

FC02: 8:30–9 a.m. Student Expectations for Learning Mathematics and Physics in Biology*

Invited - Jessica Watkins, University of Maryland, College Park, MD 20742; jessica.e.watkins@gmail.com

Kristi L. Hall, Andrew Elby, Janet E. Coffey, Todd J. Cooke, Edward F. Redish, University of Maryland, College Park

In a collaborative effort with biology and physics education researchers, we are examining student expectations about and responses to the use of mathematics and physics in their introductory biology course. While the common perception is that biology students do not like mathematics and equations, our results suggest that students' views are more nuanced and context-dependent. In this talk, we present data from student interviews that document students' shifts in attitudes over time and point to the intellectual resources students have for learning the mathematics and physics needed to understand biology. We discuss the implications of this research for introductory physics courses for the life sciences and instructors who are interested in how to bring a more quantitative perspective to biology.

*This effort is supported in part by NSF-CCLI grant 09-19816.

FC03: 9–9:30 a.m. Using Cell Biology to Teach Introductory Physics

Invited - Jane Kondev, Brandeis University, Waltham, MA 02454; kondev@brandeis.edu

I will describe a lecture-based course, typically taken by first year students at Brandeis University, in which we teach concepts from introductory physics using problems in molecular and cell biology. For example, swimming of bacteria is used to illustrate concepts such as momentum, force, work, and energy, and how they relate to each other. Regulation of gene expression leads to a discussion of the Boltzmann formula and elements of statistical mechanics. Electrophysiology of nerve cells provides the motivation for introducing electrical potential, capacitance, and current, while photosynthesis does the same for elements of quantum mechanics. Throughout the course, each physics unit is introduced as a tool for solving a particular problem posed by a biological phenomenon. I will conclude the presentation with a discussion of the prospects for turning this course into a proper, year-long introductory physics sequence for life-science students.

FC04: 9:30–10:20 a.m. Capstone Examples for Second Semester IPLS: Confocal Microscopy, Nerve Signaling

Poster - Catherine H. Crouch, Swarthmore College, Swarthmore, PA 19081; ccrouch1@swarthmore.edu

In the second semester of calculus-based introductory physics for the life sciences (IPLS) at Swarthmore College, optics and electricity are each taught moving toward a capstone example. For optics, the technique of confocal microscopy serves as a capstone example, bringing together key principles from both geometric optics and wave optics. For electricity, nerve signal propagation serves as a capstone example, encompassing key principles in both electrostatics and circuits. This poster will present these two instructional sequences as well as candidate capstone examples for magnetism.

FC05: 9:30–10:20 a.m. Increasing Student Retention in College Physics Courses

Poster - Daryao S. Khatri, University of the District of Columbia, NW, Washington, DC 20008; dkhatri@udc.edu

The student dropout rate is at an all-time high in introductory college physics courses; it exceeds 70% at many colleges and universities. At the University of the District of Columbia, we have achieved close to 100% retention in these and other math and science courses during the last five years or so. The author will discuss strategies that have contributed to this phenomenal success in terms of students' retention and their learning. Specifically, the author will describe: (1) negative factors contributing to the high dropout rates; (2) outdated techniques used in teaching physics courses; (3) organization of content in textbooks that leads to teacher-comfortable deductive rather than effective inductive approaches to teaching; (4) importance of review, practice homework; and "exit" questions; (5) presentation of course content and problem solving in parallel for better understanding of subject matter; (6) benefits of "priming" homework at the end of each class day; and (7) examples and importance of an instructional unit for each day of class.

FC06: 9:30–10:20 a.m. IPLS at Appalachian State University

Poster - Patricia E. Allen, Appalachian State University, Boone, NC 28608; allenpe@appstate.edu

At Appalachian State University, a new IPLS (Introductory Physics for the Life Sciences) course is currently being piloted with 24 students. In consultation with various on-campus pre-professional health-care programs, the author attempts to integrate the BIO2010 and SFFP recommendations with existing departmental resources to generate a course appropriate for future health-care professionals. For example, the overarching topic for the first semester course is ultrasound imaging, diathermy, and surgery. The role of physics, physiology, and materials are introduced into the course as they are needed. The presentation will include course topics (including the order of coverage), resources for lecture and lab, and preliminary student performance for the pilot course. In addition, some of the issues associated with scaling up this type of course will be discussed.

FC07: 9:30–10:20 a.m. Modeling the Action Potential

Poster - Eric C. Anderson, UMBC Department of Physics, Baltimore, MD 21250; andersoe@umbc.edu

Lili Cui, Amita Rajani, Paul Corbitt, Weihong Lin, UMBC

In collaboration with biology faculty, the UMBC physics department is currently reforming the introductory algebra-based physics sequence which primarily serves life science majors. To that end, we have developed an interdisciplinary laboratory activity which aims to bridge basic elements of electricity and the biology of neural signaling. Specifically, the activity guides students to apply modeling skills, proportional reasoning and scaling ideas, and knowledge of electric circuits to explain some features of the action potential. These include the need to regenerate the signal, its finite speed of propagation, and adaptations for speedier propagation. We describe the laboratory activity, how it's integrated into the course, and preliminary results.

FC08: 9:30–10:20 a.m. Within Biological Context: Exploring New Directions in Inquiry and Problem Solving Skills

Poster - Nancy Beverly, Mercy College, Dobbs Ferry, NY 10522; nbeverly@mercy.edu

For over 10 years, the Mercy College introductory physics curriculum has approached every physics topic in the context of biological process or human functioning, integrated with life-oriented lab activities. Student motivation and appreciation of physics relevance is evident, but it is not enough. As the learning goals for these students have been continually evolving, the corresponding student assessments and homework practice have increasingly veered away from the "problem-solving skills," as typified by end-of-chapter text problems. The AAMC-HHMI report on pre-med competencies does not mention problem-solving skills. What kinds of "problems" do life science students need to "solve"? What problem-solving skills do they need? Examples of assessment, homework, and inquiry that seek to address this discrepancy will be presented.

FC09: 9:30–10:20 a.m. Mathematical Modeling in Introductory Physics for Biologists

Poster - Paul Corbitt, University of Maryland, Baltimore County, Baltimore, MD 21250; pcorbi1@umbc.edu

Eric Anderson, Lili Cui, UMBC

Both the Bio2010 and AAMC HHMI reports emphasized the importance of mathematical modeling for future biologists and physicians. We noticed biology students are proficient at manipulating algebraic equations, but are uncertain of what the numbers in the equations mean. In our reform of algebra-based introductory physics sequence at UMBC, the course taken by biological sciences majors, we introduce basic mathematical models. These models are: linear, quadratic, inverse, inverse square and exponential. Models are presented in lecture and applied in lab. Lab homework extends the models to applications in biology. We want students to realize that the numbers in a mathematical model have physical meanings.

FC10: 9:30–10:20 a.m. Pedagogical Reform Encouraging Preparation for Class*

Poster - Andrew Duffy, Boston University, Boston, MA 02215; aduffy@bu.edu

This poster will report on a pedagogical reform of the first-semester introductory physics class for life science majors at Boston University. Clicker questions, worksheets, and a focus on concepts had been incorporated into the instruction in previous years. In fall 2010, we focused on having the students come to class prepared, after having read relevant sections of the textbook and/or having viewed an introductory video for a particular class session. After preparing, the students submitted answers to a quiz on WebAssign before most classes. The answers and student comments were reviewed by the instructors before class. The assumption in class was that the students had learned the basic definitions through their preparation, allowing more class time to be devoted to probing concepts, going through examples, and addressing issues raised by the pre-session quizzes.

*Introductory videos can be found on YouTube by searching for "PY105."

FC11: 9:30–10:20 a.m. Planning the Intensity Modulated Radiotherapy in Introductory Modern | Physics Laboratory

Poster - Tatiana A. Krivosheev, Clayton State University, Morrow, GA 30260; tatianakrivosheev@mail.clayton.edu

We present our experience of using the Intensity Modulated Radiation Treatment (IMRT) planning system in the Introductory Modern Physics Laboratory. Students create radiation treatment plans based on CT information for prostate cancer case. Students are introduced to several concepts commonly used in discussion of radiation treatment such as dose volume histograms (DVH), mean doses delivered to primary target volume (PTV) and organs at risk (OAR), and normal tissue complication probabilities (NTCPs). The latter ones are used to predict and evaluate the severity of radiation-induced complications.

FC12: 9:30–10:20 a.m. An Open-Source Mechanics Course Targeting Problem-Solving Expertise

Poster - Raluca E. Teodorescu, Massachusetts Institute of Technology, Cambridge, MA 02139; rteodore@mit.edu

Analia Barrantes, Carolin N. Cardamone, Saif Rayyan, David E. Pritchard, Massachusetts Institute of Technology

We are developing and testing an online environment to allow teachers to easily adopt and adapt our Modeling Applied to Problem Solving pedagogy.[1] This pedagogy stresses a systems, interactions, and models approach to facilitate organization and transfer of syllabus knowledge to problem solving in an expert-like manner. (The syllabus is for a standard calculus-based Newtonian mechanics course.) A central collection of multi-level research-based homework sets organized by topic and cognitive complexity is supplemented by integrated open-access WIKI-text, videos, worked examples, simulations, and tutorials. Our integrated learning environment for mechanics (ILEM) involves an open-source WIKI-text that is integrated with the tutors LON-CAPA and ANDES, and also contains material for classroom use. The assessment will include a new instrument to assess strategic knowledge as well as the CLASS. Results from applying this course at MIT and at Whatcom Community College (Seattle) will be discussed. Users and collaborators are welcome to use our framework or its parts.

1. A. E. Pawl, A. Barrantes and D. E. Pritchard, "Modeling applied to problem solving"in Proceedings of the 2009 Physics Education Research Conference, Ann Arbor, MI, 2009.

FD: Upper-level Undergraduate Physics

Location: City Terrace 6
Sponsor: Physics in Undergraduate Education Committee
Date: Wednesday, January 12
Time: 8:30–9:50 a.m.

Presider: Mary Lowe, Loyola University - Baltimore

FD01: 8:30–8:40 a.m. An Idea for Introducing Students to Statistical Mechanics: Dice-landing Probabilities

Gary D. White, American Institute of Physics, College Park, MD 20740; gwhite@aip.org

Is snake-eyes more likely than boxcars in dice? If the die has holes drilled for its dots, there should be a slight shift of the center of mass making double ones more likely than double sixes. What is the probability that a nickel will land on its edge? Does it matter whether the surface is hardwood or felt? I have occasionally used dice experiments for introducing probability and statistics to students in a variety of settings. Here I show a set of results involving experimental and theoretical treatments of dice of various shapes, and some ideas for incorporating these results into the classroom.

FD02: 8:40–8:50 a.m. Redesigning the Experimental Curriculum

Ian G. Bearden, Niels Bohr Institute, Blegdamsvej 17, Copenhagen, Den 2100 Denmark; bearden@nbi.dk

We are currently redesigning the experimental component of our curriculum. This has grown from a desire to ensure that all students master what we consider the basic experimental skills and competencies required of physicists. This talk will focus on the initial stages of this process, in particular on the consensus reached among faculty and students regarding which skills and competencies are, in fact, most important and how we plan to change our curriculum to focus on them.

FD03: 8:50–9 a.m. Teaching for 21st Century's Job Market

Nayer Eradat, San Jose State University, San Jose, CA 95192-0106; nayereh@msn.com

Ramen D. Bahuguna, San Jose State University

Traditional upper-division physics courses focus on fundamentals of a field without much attention to skill building. For example, optics is taught from a historical perspective using highly simplified examples for presenting individual concepts. In doing so, however they fail to build the skills students need to be competitive in the job market such as computational modeling, proposing an optical design for an application, interfacing with the environment, selecting components, identifying vendors, etc. We introduce an innovative method for teaching optics that provides university graduates not only with the basic knowledge but also with the skills demanded by employers in the field. We will present how these changes can be done without compromising the fundamentals of the optical physics. We will share our experience of project-based teaching at SJSU and invite you to join us on applying these techniques to the rest of upper division physics courses.

FD04: 9–9:10 a.m. The Delta Function in the Introductory Quantum Mechanics Course

Walter S. Jaronski, Radford University, Radford, VA 24142; wjaronsk@radford.edu

Most undergraduate quantum mechanics textbooks include some discussion of the delta function. After reviewing the standard textbook treatment, we will explore a little more deeply the history of the delta function and the use of improper functions more generally in physics. We will then discuss some topics related to the delta function that are not normally encountered in the introductory course. For example, although the delta-function well is a commonly treated topic, the double delta well is rarely covered, but the analysis of the latter has interesting features and allows us to introduce students to the little-known W function. There are also several general features of quantum mechanics, such as completeness, time evolution, and localization, which may be illustrated using the eigenfunctions of the delta-function potential. The inclusion of some of these topics in the introductory course may be profitable.

FD05: 9:10–9:20 a.m. Unification of Forces-Interactions Using the Feynman Diagrams

George E. Kontokostas, University of Athens, Pedagogical Department, Athens,17562 Greece; gakon67@hotmail.com

Purpose: Teaching unification of the forces-interaction using Feynman diagrams with interactive technology. Results: Understanding what is the standard model. Using simple rules we can teach how the particles interact and we can measure easily these interactions. Using special pedagogical methods (separating the students of the university into two groups, the first group was taught unification without Feynman's diagrams and the other group was taught using Feynman's diagrams) with the help of technology, we note that the students in the second group were able to understand better the unification of three interactions and to predict the formula of each interaction.

FD06: 9:20–9:30 a.m. Active Learning in Upper Division and Graduate Physics Classrooms

Ramon E. Lopez, University of Texas at Arlington, Arlington, TX 76019; relopez@uta.edu

Ximena Cid, University of Texas at Arlington

In recent years there has been considerable research in undergraduate physics education regarding the application to classroom instruction of techniques that are generally referred to as active engagement techniques. However, in very few cases have such pedagogical strategies been applied to upper division or graduate-level instruction. In this presentation we describe the application of a variety of active engagement techniques in traditional classroom settings as well as at the graduate summer school conducted by the Center for Integrated Space Weather Modeling, a Science and Technology Center funded by the National Science Foundation. We will also present the results of interviews with a group of graduate students who experienced a sample of this kind of instruction. We believe that the examples presented here can serve as a guide to others contemplating revisions to upper division science education, as well as graduate education.

FD07: 9:30–9:40 a.m. Special Relativity on a Racetrack: Who Needs Light?

Achin Sen, Eastern Washington University, Cheney, WA 99004; asen@edu.edu

Kira Burt, Eastern Washington University

We present a simple thought-experiment to derive some of the kinematic results of the special theory of relativity without using the second postulate (constancy of the speed of light) explicitly. Our analysis involves the study of a simple race between two cars viewed from the perspectives of the flag person at the finish line and the drivers of the two cars. We shall demonstrate that the reciprocity principle (zeroeth postulate) together with the principle of relativity (first postulate) demands either the universality of the time interval (Newtonian relativity) or the existence of a universal, frame independent speed leading to the special relativistic results. Some standard results of one-dimensional relativistic kinematics such as the velocity addition law and the Lorentz transformation formulas will then be derived. Ours is possibly the simplest version of "relativity without light" and can be used even in an algebra-based freshman level course.

FD08: 9:40–9:50 a.m. Learning Objectives for Writing-in-Physics Courses

Jean-Francois S. Van Huele, Brigham Young University, Provo, UT 84602-4681; vanhuele@byu.edu

Writing-in-physics courses aim at teaching physics majors to write well in their discipline. They often also result in a clearer understanding of physics content through the reflective writing process. Current good practice expects instructors to formulate clear learning objectives and develop appropriate instruments for implementation and assessment. How should we balance these two aspects of writing-in-physics courses when developing curricular tools? I will describe current efforts to come up with practical learning objectives that reflect all aspects of the writing-in-physics experience in a course offered to physics students writing their senior thesis and taught exclusively by physics and astronomy faculty.

FE: The New AP Physics B Test and Other HS Issues

Location: City Terrace 10
Sponsors: Physics in High Schools Committee, Physics in Undergraduate Education Committee
Date: Wednesday, January 12
Time: 9–10:10 a.m.

Presider: Jan Mader

FE01: 9–9:30 a.m. A First Look at the New AP Physics B Curriculum*

Invited - Deborah M. Roudebush, Oakton High School, Vienna, VA 22181; dmroudebush@fcps.edu*

The focus of this presentation is to introduce the new two-year curriculum that will be replacing the AP Physics B exam. The new courses, AP Physics 1 and AP Physics 2, will split the old curriculum across two years. AP Physics 1 is designed to be a first course in physics that covers the college physics material from first semester. AP Physics 2 is designed as a second year course that covers the college physics material for the second semester. Learn about the timeline for implementation and the shift in curriculum implementation.

*Supported by College Board

FE02: 9:30–10 a.m.

Invited - Stacy Gwartney, Jacksonville HS, 1204 Deleware Ct., Jacksonville, TX 75766; sgwartney@jacl.sprnet.org

FE03: 10–10:10 a.m. Secondary School Students Learning Quantum Concepts

Marisa Michelini, University of Udine, via delle Scienze 208, UDINE, IT 33100 Italy; marisa.michelini@uniud.it

Lorenzo Santi, Alberto Stefanel, Physics Department of the University of Udine

A research-based proposal on Quantum Mechanics (QM) in upper secondary school was designed focalizing on the building of theoretical thinking according with Dirac approach. By means of simple light polarization experiments the peculiar aspects of the quantum behavior (as: entanglement, non locality) is explored, focusing on the concepts of quantum state, superposition principle, non-epistemic indeterminism and measurement process. Fourteen research-based formative interventions were carried out involving 340 students of different Italian upper secondary schools to explore how students face basic quantum knots using the proposed approach. Data collected were crossed with different instruments (worksheets, questionnaires, audio-analysis). The students' learning path from classical concepts to the quantum evidenced a relevant role of ideas nuclei coherent with alternative interpretation of MQ. Data give additional information about how students link specific formal aspects to concepts as the scalar product and the quantum probability; the vectors and the quantum state.

FF: Introductory Courses

Location: Grand Ballroom 2
Date: Wednesday, January 12
Time: 8:30–9:40 a.m.

Presider: Ann Brandon, Joliet West High School

FF01: 8:30–8:40 a.m. Large-scale Assessment of Lecture/ Lab Integration in Introductory Physics Courses

Kelvin Cheng, Texas Tech University, Lubbock, TX 79409; kelvin.cheng@ttu.edu*

Amy Pietan, Hani Dulli, Keith West, Beth Thacker, Texas Tech University

We discuss a large-scale assessment of the effectiveness of implementing Lecture/Lab Integration in increasing the students' understanding of physic concepts, and improving their problem-solving skills by using a multitude of conceptual and problem-solving inventories. Various strategies of using Peer-Instruction in the lecture and the use of concept-based materials in both lecture and lab to achieve Lecture/lab synergism will be discussed. Both net and subscale analysis of the assessment results will be presented.

*This project is supported by the NIH grant 5RC1GM090897-02. Sponsored by Beth Thacker.

FF02: 8:40–8:50 a.m. Out of this World – Linked Courses for First Year Experience

Terry L. Ellis, Jacksonville University, Jacksonville, FL 32211; tellis@ju.edu

In order to ease the transition from high school to college and increase freshmen retention, Jacksonville University's Freshmen Interest Network (FIN) places new students in cohorts with linked courses and a peer scholar. The peer scholar teaches time management and study skills, while the professors of the linked courses coordinate assignments and lessons around a common theme in courses that fulfill the general education (core) requirements. "Out of this World" links Astronomy and Astronomy Laboratory with the computer course Personal Productivity Using Technology. Students use their new computing skills to analyze laboratory data, write assignment papers and lab reports, and research a location in space where they will "build" a space station. The capstone assignment for both courses is a presentation describing the space station. FIN students learn skills essential for success as a college student, while forming bonds that help them acclimate to the college environment.

FF03: 8:50–9 a.m. A Profile of Introductory Aviation Physics

W. Brian Lane, Jacksonville University, Jacksonville, FL 32211; wlane@ju.edu

The success of university aviation programs has resulted in an increasing demand for a single-semester Introductory Aviation Physics (IAP) course. Teaching such a course presents many opportunities for educational innovations; for example, because most aviation students acknowledge the strong connection between physics and their major, the instructor is able to engage these students with specifically relevant laboratory exercises and case studies. However, IAP instructors also face many challenges; for example, results from the Colorado Learning Attitudes about Science Survey indicate that aviation students begin IAP with somewhat conflicting beliefs about physics. We present the ongoing efforts of Jacksonville University physics faculty to address the opportunities and challenges of teaching this course by writing a new textbook for IAP, developing a series of rocket-based laboratory exercises, and implementing research-based coaching by upper-level physics majors.

FF04: 9–9:10 a.m. Recreational Physics as Outreach and Motivation for Introductory Level Students

Ronald S. MacTaylor, Salem State University, Salem, MA 01970; rmactaylor@salemstate.edu

Samantha L. Lord, Jodie L. Gutierrez, Salem State University

An overview and highlights from the work of two Salem State University honors students preparing their honors thesis projects: "The Physics of Skydiving" and "The Physics of ATV track design" will be presented and discussed. Strategies to use these and similar ideas from the world of recreational physics to engage and motivate the introductory physics audience will be explored. Both research projects included literature research, data collection / data analysis as well as production of video segments. Clips from these video segments will also be presented.

FF05: 9:10–9:20 a.m. Using Kinematics and I LOVE LUCY to Teach Doppler Shift

Joseph M. Mosca, Embry Riddle Aeronautical University, Daytona Beach, FL 32114; moscaj@erau.edu

Michael Hickey, Bereket Berhane, Embry Riddle Aeronautical University

One way of helping students become better problem solvers is to help them discover for themselves connections between various quantities and arrive at conclusions. It is our experience that most students find the Doppler shift formulas confusing despite the abundant "everyday examples" we cite. It is common to discuss the examples such as the possible change in pitch of a siren either at rest or moving relative to an observer (either at rest or moving). These do not help students figure out in which cases the wavelength and thus the frequency (pitch) changes, the nature of the change and in which cases it doesn't change. The most common errors occur in sign usage. We present a kinematics problem very useful in explaining Doppler shift and selection of the correct sign.

FF06: 9:20–9:30 a.m. Learning to Think About Gravity

Esther L. Zirbel, 52 Salisbury Rd., Watertown, MA 02472; ezirbel@gmail.com

Instructors of introductory courses for nonscience majors widely teach Newton's 300-year-old gravitational theory, despite the fact that gravity was radically reinterpreted by Einstein about 100 years ago. This is a missed opportunity since students are often more interested and motivated to learn about Einstein than about Newton. This paper describes a constructivist approach to teaching the gravitational theories of Aristotle, Newton, and Einstein in a comparative fashion. To examine exactly how students learn, we ask them to complete a rubric where they describe in their own words how each thinker would account for free fall, projectile motion, and orbital motion. The analysis of these rubrics indicates that the majority of students are indeed capable of understanding the fundamentals of Einstein's interpretation. In fact, many students actually find Einstein's theory more intuitive than Newton's theory. We conclude that the basics about Einstein can and should be taught in introductory classes.

FF07: 9:30–9:40 a.m. What Can Physics Students Learn from Designing a Model Rocket?

Swapnil Tripathi, UW-Barron County, Rice Lake, WI 54868; Swapnil.tripathi@uwc.edu

In this talk I discuss how model rocketry can be used to teach physics concepts to students. Design of a model two-stage rocket can be used to teach concepts of acceleration, momentum, impulse, simple harmonic motion, center of mass and mechanical stability. Conservation of momentum and energy are used to determine timing for firing second stage of the rocket to achieve maximum height. Physics modeling and simulation to determine parameters for maximum height provide good learning avenues for advanced undergraduate students. Work with simulation softwares like RockSim can help students develop physical intuition for the system in a fun way.

FH: PER: Topical Understanding and Attitudes

Location: Grand Ballroom 3
Sponsor: Research in Physics Education Committee
Date: Wednesday, January 12
Time: 8:30–10 a.m.

Presider: Steve Shropshire, Idaho State University

FH01: 8:30–8:40 a.m. Development of a Standard Fluids Assessment: Evaluating Question Alterations

Sam Cohen, Grove City College, Grove City, PA 16127; cohensj1@gcc.edu

Jason Wetstone, Adam Moyer, DJ Wagner, Grove City College

We are developing an FCI-style assessment covering hydrostatic topics commonly included in introductory physics courses. Our goal is for the assessment to provide meaningful analysis of student learning for a wide range of populations, from conceptual-based courses through honors calculus-based courses. Students from all three introductory tracks (conceptual-, trig-, and calculus-based) at Grove City College (GCC) have completed draft versions of our assessment, both pre- and post-instruction. This poster presents how the results for specific questions were affected when the wording or format of the question was changed to promote clarity. The results of chi-squared analysis suggest that most of our minor alterations did not significantly change the response distributions. We also analyzed the discrimination and difficulty of the assessment questions for each population.

FH02: 8:40–8:50 a.m. Development of a Standard Fluids Assessment: Is This Question Legit?

DJ Wagner, Grove City College, PA 16127; djwagner@gcc.edu

Sam Cohen, Adam Moyer, Jason Wetstone, Grove City College

We are developing an FCI-style assessment covering hydrostatic topics commonly included in introductory physics courses. Students from all three introductory tracks (conceptual-, trig-, and calculus-based) at Grove City College have completed draft versions of our assessment, both pre- and post-instruction. One question probes understanding of Archimedes' principle by asking students how raising a treasure chest from a lake bottom to a (floating) ship will affect the water level of the lake. Contrary to the trend on other diagnostic questions, the calculus-based students far underperform the other two populations on this question post-instruction, although no group does particularly well. We believe the difference is because the conceptual- and trig-based students completed a specific hands-on activity on the subject, while the calculus-based students do a tutorial instead. This talk will address the implication of these results for the continued inclusion of this question on the diagnostic exam.

FH03: 8:50–9 a.m. Development of a Standard Fluids Assessment: Formulating Questions on Pressure

Adam J. Moyer, Grove City College, Grove City, PA 16127; moyer37@gmail.com

Jason Wetstone, Sam Cohen, DJ Wagner, Grove City College

We are developing an FCI-style assessment covering hydrostatic topics commonly included in introductory physics courses. Our goal is for the assessment to provide meaningful analysis of student learning for a wide range of populations, from conceptual-based courses through honors calculus-based courses. One hydrostatic topic students in these populations should understand is how the pressures at different points in a fluid compare. This poster presents our efforts to craft a series of questions that distinguishes correct physical understanding from common misconceptions expressed by students.

FH04: 9–9:10 a.m. Progress on Developing a Conceptual Survey of Fluids: Buoyancy

James Vesenka, University of New England, Biddeford, ME 04005; jvesenka@une.edu

Matthijs van den Berg, University of New England

Physicists simplify analysis by using point particles in Newtonian Dynamics to explain forces between interacting objects. Numerous research-based assessment tools have been used to test student comprehension of mechanics. We are constructing a comprehensive research-based assessment for fluids, concentrating on buoyancy and multiple particle interactions. Even after completion of a comprehensive modeling buoyancy laboratory, our in-house assessment indicates UNE students have trouble understanding the concept of buoyancy. Common preconceptions were identified by written and verbal responses from students to a simple diagnostic: a volleyball held underwater by the student's hand. Our research reinforces that of Loverude and Heron[1]: a thorough understanding of dynamics and density are essential for students to successfully negotiate buoyancy. A new multiple choice buoyancy assessment was constructed from student generated distracters and tested, informing changes needed in our fluids curriculum.

1. Loverude et. al. *AJP* **71**, pp. 1178-1188, Heron et al. *AJP* **71**, pp. 1188-1195

FH05: 9:10–9:20 a.m. Comparing Instructional Effects of Graphics- and Text-based Programming Languages

Kathleen A. Harper, Engineering Education Innovation Center, The Ohio State University, Columbus, OH 43210; harper.217@osu.edu

John T. Demel, Richard J. Freuler, Stuart Brand, Engineering Education Innovation Center, The Ohio State University

Traditionally, programming has been taught via text-based languages where the students use an editor to type in language statements that are compiled into a program. In Ohio State's Fundamentals of Engineering for Honors program, the language of choice has been C++ for many years. Recently, one section of the course was offered that was based upon LabVIEW, a graphically-based platform. We compared the students in the alternate section to a matched sample of students in the text-based class in three ways: 1) performance on identical questions on the final exam, 2) success in learning a subsequent (text-based) language, MATLAB, 3) shift in attitudes during the term, as measured by a modified subset of questions from the MPEX.[1] Results were mixed, but intriguing, setting the stage for a continuation study in winter 2011.

1 E. F. Redish, R. N. Steinberg, and J. M. Saul, "Student Expectations in Introductory Physics," *Am J. Phys* **66**, 212-224 (1998).

FH06: 9:20–9:30 a.m. Adding and Subtracting Vectors: Arrows Can Induce Student Difficulties

Andrew F. Heckler, Ohio State University, Columbus, OH 43210; heckler.6@osu.edu

Thomas Scaife, Ohio State University
Eleanor Sayre, Wabash College

We report on a study of student performance on simple vector addition and subtraction in one and two dimensions in both the vector arrow representation and the formal i-j component representation. The students in the study were enrolled in calculus-based introductory university level physics. In the vector arrow format, the students had little difficulty adding vectors in one or two dimensions, but 40-60% of students were unable to correctly subtract vectors. The common mistake was to add vectors when they were asked to subtract them. Interestingly, performance on subtraction in one dimension was significantly worse when the vectors were in opposing directions than when they were in the same direction. In contrast, in i-j component format, only 5-15% of students had difficulty adding or subtracting vectors in one or two dimensions, suggesting that the vector arrow format may be inducing students to add vectors when they should be subtracting them.

FH07: 9:30–9:40 a.m. Learning and Retention of Quantum Concepts with Different Teaching Methods

Louis Deslauriers, University of British Columbia, Vancouver, BC V6N2Z1; louisd@physics.ubc.ca

Carl Wieman, University of British Columbia

We measured mastery and retention of conceptual understanding of Quantum Mechanics in a modern physics course. This was studied for two equivalent cohorts of students taught with different pedagogical approaches using the Quantum Mechanics Conceptual Survey (QMCS). We measured the impact of pedagogical approach on both the original conceptual learning and on long term retention. The cohort of students who had a very highly rated traditional lecturer scored 19% lower than the equivalent cohort who were taught using interactive engagement methods. However, the amount of retention was very high for both cohorts, showing only a few percent decrease in scores when retested six and 18 months after completion of the course and with no exposure to the material in the interim period. This high level of retention is in striking contrast to the retention measured for more factual learning from university courses and argues for the value of emphasizing conceptual learning.

FH08: 9:40–9:50 a.m. Physics REU Students' Understanding of Ethics

Sytil K. Murphy, Kansas State University, Manhattan, KS 66506; smurphy@phys.ksu.edu

Dean A Zollman, Kansas State University

As a part of their experience, physics Research Experience for Undergraduates (REU) students at Kansas State University participate in a one to two hour per week seminar series on scientific ethics taught by two members of the Kansas State philosophy department. As a portion of their entrance and exit interviews, the REU students are asked what they perceive as ethical behavior and the ethical issues in their research, and how ethics impacts physics. Additionally, we talked with the instructors of the seminar series to determine their instructional goals. Through a comparison of the interview data to the stated goals, we address the question: Do the shifts in the students' perceptions and understanding of scientific ethics correspond to the goals of the ethics seminars they attended? The Physics REU program is supported by NSF grant number PHY-0851599.

FH09: 9:50–10 a.m. The Constructs of a Positive Attitude

Krystal M. Ramos, Georgia Southern University, Statesboro, GA 30460; kr00008@georgiasouthern.edu*

In an effort to improve the quality of introductory physics education, our department has administered pre-/post-surveys to collect data on the attitudes of physics students at Georgia Southern University. The Maryland Physics Expectations Survey (MPEX), administered to Physics I students, offered insights into students' expectations from a physics course and assisted in determining the most effective method for teaching students physics. The Colorado Learning Attitudes about Science Survey (CLASS) characterized student interest in and beliefs about physics, while assisting in improving physics education. It was administered to Physics II students. We have analyzed the MPEX and CLASS data in an effort to make comparisons between the following courses: traditional versus studio physics trigonometry-based versus calculus-based physics courses held at different times of day. Using these comparisons it has been determined which factors have the greatest effect on student attitudes toward physics.

*Sponsored by Delena Bell Gatch; Undergraduate Research mentored by Delena Bell Gatch

FI: Using the T-TEP Report as a Guide for Improving Physics Teacher Education

Location: Grand Ballroom 1
Sponsor: Teacher Preparation Committee
Date: Wednesday, January 12
Time: 9–9:30 a.m.

Presider: Vokos Stamatis

FI01: 9–9:30 a.m. Taking Action: Physics Departments Can Contribute Significantly to National Problems

Invited - Valerie K. Otero, University of Colorado, Boulder, CO 80309; valerie.otero@colorado.edu

More than 750 university physics departments were surveyed throughout 2008-2009 regarding their programs for preparing physics teachers. The findings were alarming. Only a handful of physics or education departments had physics-specific pedagogical programs for future teachers and few departments could demonstrate at least one physics teacher graduate in the past two years. Physics-specific teacher preparation appears to be a lost art and in most cases neither the physics department nor the school of education claimed it as their responsibility. We did find pockets of excellence throughout the nation, although no single university was operating a fully functional physics teacher education program involving the collaboration of both physics and education faculty. I will discuss the findings and recommendations of the Task Force for Teacher Education in Physics and provide suggestions about how to utilize the Task Force Report to improve physics teacher education both locally and nationally.

Join AAPT for a Jacksonville Walking Tour

Wednesday, Jan. 12
2:30–4:30 p.m.
Meet at the Newnan St. Entrance of Hotel

Hear the exploits of past Presidents, the great American architects, and the maker of King Kong as you take a walk through time.

Plenary: State-of-the-Art Nuclear Medicine: Proton Therapy

Location: Grand Ballroom 4
Date: Wednesday, January 12
Time: 10:30–11:30 a.m.

Presider: Mary Mogge, California State Polytechnic University, Pomona

Nancy Mendenhall

Nancy Mendenhall, M.D., Medical Director, University of Florida Proton Therapy Institute, and Associate Chair, Department of Radiation Oncology in Jacksonville

Nancy Mendenhall will describe a state-of-the art use of nuclear particles in medicine: proton therapy. The effects of radiation on human tissue are non-specific: both normal and cancerous tissues incur dose-related radiation damage. The key to successful radiation therapy is dose distribution: maximizing dose to cancer and minimizing dose to normal tissues. Currently, the most common source for radiation therapy is external beam X rays, which leave a path of damage, like a bullet, as they pass through the patient. Protons, in contrast to X rays, deposit most of their energy near the end of their finite range, providing a means to eliminate "exit dose" and minimize "entrance dose" to normal tissues, thereby reducing normal tissue damage. With less risk to normal tissues, cancer doses can be increased. Proton therapy thus promises both decreased treatment related toxicity and increased cancer cure rates. The University of Florida Proton Therapy Institute, one of only eight in the country, treats patients from across the country and around the world.

AAPT Ceremony: Presidential Transfer

Location: Grand Ballroom 4
Date: Wednesday, January 12
Time: 12:30–1 p.m.

David Cook
2010 AAPT President

David Sokoloff
2011 AAPT President

Crackerbarrel 8: Historical Perspectives on the Use of the Laser in the Physics Classroom

Location: Grand Ballroom 2
Sponsors: History and Philosophy in Physics Committee, Apparatus Committee
Date: Wednesday, January 12
Time: 11:30 a.m.–12:30 p.m.

Presider: Hugh Henderson

Join us for the History and Philosophy of Physics Crackerbarrel, where we will feature Thomas Greenslade's insights on the history of the use of the laser in the physics classroom. Come and share your insights as well on how you use the history of physics in your courses.

Crackerbarrel 10: Past and Present Priorities – NSF-DUE CCLI/TUES

Location: Grand Ballroom 3
Sponsor: Physics in Undergraduate Education Committee
Date: Wednesday, January 12
Time: 11:30 a.m. to 12:30 p.m.

Presider: Richard Peterson

NSF-DUE Program Director overview of the CSIP, ILI, CCLI transition to the current TUES program. A chance to share and discuss current TUES priorities—including the past and present role of these programs in contributing to the national instrumentation and apparatus needs of undergraduate physics and astronomy programs.

Crackerbarrel 9: Task Force on Teacher Education in Physics (T-TEP): Developing a National Agenda

Location: City Terrace 7
Sponsors: Teacher Preparation Committee, Research in Physics Education Committee
Date: Wednesday, January 12
Time: 11:30 a.m.–12:30 p.m.

Presider: Stamatis Vokos

GA: Rutherford: His Life and Legacy

Location: Grand Ballroom 1
Sponsors: History and Philosophy in Physics Committee, Apparatus Committee
Date: Wednesday, January 12
Time: 1–2:20 p.m.

Presider: Jill Marshall, University of Texas - Austin

2011 is the 100th anniversary of Ernest Rutherford's nuclear model of the atom. Talks will concern both Rutherford's own life and work and also his legacy in future generations.

GA01: 1–1:10 p.m. Crocodile's Best Man

Genrikh Golin, Touro College, Brooklyn, NY 11224; genrikhgolin@yahoo.com

Among the numerous Rutherford's colleagues and students was a Russian physicist named Peter Kapitza. At age 27, Kapitza was in St. Petersburg when it was rocked by civil war and an epidemic of Spanish flu. He lost his father, wife, and two children. At this tragic moment, his supervisor took him on a scientific voyage abroad. The result of this venture was an internship at the Cavendish Laboratory (1921). This was a prime period for the laboratory, marked by the invention of the mass spectrometer and subsequent discovery of isotopes, discovery of the neutron, and construction of the first particle accelerator. Kapitza became a part of the institution and in 1924 was appointed the deputy director of the laboratory. Kapitza respected Rutherford immensely. He honored him with the nickname "Crocodile", having in mind that this animal never moves back. The friendship of the two physicists was dramatically altered by events several years later. "In fall 1934," Kapitza later recalled, "I took another of my usual trips to the Soviet Union to meet my mother and friends and suddenly found that I couldn't come back to Cambridge. Never more I saw Rutherford, never more I heard his voice and laugh." The Soviets expected Kapitza to work for them, but he refused. Nearly two years later, Rutherford convinced him via correspondence that he should make the best of his situation and continue his work in physics. Kapitza soon established an institute in Moscow, modeled in the spirit of the Cavendish Laboratory and on the principles worked out by Rutherford. After World War II Kapitza, following Rutherford's example, refused to work on military projects. He was dismissed and lived in exile.

GA02: 1:10–1:40 p.m. Rutherford's Geophysicists

Invited - Greg Good, American Institute of Physics, College Park, MD 20740; ggood@aip.org

Ernest Rutherford's fame rests on his studies of radiation, radioactive decay, and the structure of the atom. From his first work with Frederick Soddy at McGill University, Rutherford excelled at the experimental isolation of different "rays" and the identification and characterization of radioactive elements. How is it that two of his students— Patrick Blackett and Edward (Teddy) Bullard—both of whom proved quite adept in Rutherford's physics lab, became prominent geophysicists? This paper explores Rutherford and the Cavendish Laboratory from the unaccustomed angle of its work in geophysics. It then looks closely at the geophysical research of Blackett (1897-1970) and Bullard (1907-1980), who started at the Cavendish in 1920 and in 1929, respectively. Blackett ultimately contributed substantively to cosmic ray studies and to paleomagnetism, and Bullard to the geodynamo and physical oceanography. Both made fundamental contributions to the plate tectonic revolution.

GA03: 1:40–2:10 p.m. Once There Was an Archer: Robert Frost's Interpretation of Rutherford's Discoveries

Invited – Hugh Henderson, Birdville Independent School District, Watauga, TX 76148; hugh.henderson@birdvilleschools.net

Although the American poet Robert Frost (1874-1963) is widely known for his poetry describing rural life and pastoral scenes, he was very interested in the scientific discoveries of the early to mid-20th century, so much so that he wrote several poems about landmark discoveries in physics. For example, his poem "A Wish to Comply" takes a critical look at Millikan's oil drop experiment, and "Version" celebrates Rutherford's discovery of the nucleus of the atom, and foreshadows the complicated relationship between science and society that resulted from it. Some of his other poems also deal with the implications of Rutherford's discovery as well as those of Einstein, Bohr, Davisson and Germer, and several others. In this session, we will explore the work of Rutherford and others through the eyes of Robert Frost.

GA04: 2:10–2:20 p.m. Harriet Brooks, Part of the Legacy of Rutherford

Jill Marshall, University of Texas at Austin, Austin, TX 78703; marshall@mail.utexas.edu

After graduating from McGill University in 1989, Harriet Brooks became one of the first members of Rutherford's research group there. She worked first on a study of electromagnetic oscillations for her masters thesis and then went on to collaborate with Rutherford on a study of the "emanation from uranium." With Rutherford she published papers on the gas emitted from radium. According to Rutherford, her work "assisted in unravelling the complex transformations which occur in [radioactive] deposits." She later worked with Thomson at Cavendish and Marie Curie in Paris. Eventually she faced a choice between continuing her scientific work on the one hand and marrying and raising a family on the other, a choice imposed on her by university policies at the time. Although Rutherford cites her often in his papers and text, her part in Rutherford's legacy is not well known today.

GB: Is There a Need for Assessment in Undergraduate Physics?

Location: City Terrace 4
Sponsors: Physics in Undergraduate Education Committee, Research in Physics Education Committee
Date: Wednesday, January 12
Time: 1–2:30 p.m.

Presider: Aaron Titus, High Point University

This session includes invited and contributed talks on the efficacy of standard assessment in undergraduate physics, including conceptual diagnostic tests, GRE Subject Test, placement tests, Major Fields Test, AP Test and other types of assessment instruments.

GB01: 1–1:30 p.m. Why There is a Need for Assessment in Undergraduate Physics

Invited - Beth Thacker, Texas Tech University, Lubbock, TX 79409; beth.thacker@ttu.edu

I will discuss the need for AAPT, APS, and other physics societies to be involved in the development of an assessment instrument for undergraduate physics. There is a need for a broader, deeper and more inclusive assessment to be used, not just for the assessment of students' understanding, but in order to evaluate our instructional methods. This would be particularly useful for courses undergoing reform, the introduction of new teaching methods, and other aspects of change, both in traditionally and nontraditionally taught courses. It would be useful to have an exam that could be used across universities to give faculty information on their students' performance on problems designed to assess, not just content knowledge, but skills, such as problem solving, modeling, laboratory skills and aspects of critical thinking. It is important that we develop such an instrument in order to both assess our students' understanding and evaluate our teaching methods.

GB02: 1:30–2 p.m. The AP Physics Exam as a Model for Undergraduate Physics Assessment

Invited - Ingrid Novodvorsky, University of Arizona, Tucson, AZ 85721; novod@email.arizona.edu

The College Board offers exams in trigonometry- and calculus-based physics each year. With their focus on assessing conceptual understanding and problem-solving skills, as well as laboratory and data-analysis skills, they may serve as models for an assessment in introductory physics. In this presentation, I will describe how the exams are constructed, how they are scored, and how colleges typically use the resulting scores.

GB03: 2–2:10 p.m. Targeting Scientific Reasoning in the Conceptual Physics Course

James C. Moore, Coastal Carolina University, Conway, SC 29528; moorejc@coastal.edu

Over the past two years, we have begun developing a conceptual physics course that focuses on core scientific reasoning patterns while introducing basic physics content. This course is taught in a lecture setting using modified Physics by Inquiry (PbI) lessons combined with activities explicitly targeting scientific reasoning. In our past courses where we have used PbI exclusively, we see relatively large gains in conceptual knowledge as measured by several concept inventories; however, we observe very little gain in scientific reasoning as measured by Lawson's Classroom Test of Scientific Reasoning. Preliminarily, we see significantly larger gains on LCTSR questions after explicit intervention using materials that we are currently developing. It is our opinion that the primary focus of this type of course should be the development of reasoning patterns, which seems to require explicit intervention in an active-engagement environment. The LCTSR or an equivalent should become a standard assessment tool.

GB04: 2:10–2:20 p.m. Implementing Multiple Assessments for Student Placement in Introductory Physics

Bradley S. Moser, University of New England, Biddeford, ME 04005; bmoser@une.edu

James Vesenka, University of New England

The ability levels of life science students in general physics vary considerably. Institutional resources and staffing may prohibit service physics departments, with no major, to offer multiple levels of introductory physics to meet student needs. Instead, instruction is forced to follow the middle road, leading weaker students to failure and stronger students to boredom. Our department has recently switched to a small-classroom studio physics format, adopting the Modeling Instruction pioneered at Arizona State University. Now, with four instructors and 11 small classes, placing students into appropriate skill sections is not only possible, but imperative. This study investigates which assessments consistently predict student success in introductory physics for placement purposes. We are comparing the UNE-required math placement exam, Force Concept Inventory, Beichner's Test of Understanding Graphs in Kinematics and Lawson's Classroom Test of Scientific Reasoning. These pre-test scores are compared to post-test scores and final grades to help inform student placement.

GB05: 2:20–2:30 p.m. Assessing a Students' Understanding Using the Semantic Space

Nic Rady, University of North Texas, Huntsville, TX 77340; nrady@unt.edu

While there are ample resources to assess a students' conceptual understanding of physics, critics have claimed that these assessments may be so contextual based that the results may not be valid. For the last year, preliminary research has been conducted to create a tool that will allow one to create a multi-dimensional map of a students' semantic space to assess their knowledge without contextual underpinnings. Results from an initial study conducted in the summer of 2010 will be presented and future work will discussed.

GC: Research on the Effect of Anxiety, Frustration and Annoyance on Physics Learning

Location: City Terrace 7
Sponsor: Research in Physics Education Committee
Date: Wednesday, January 12
Time: 1–3 p.m.

Presider: Karen Cummings, SCSU

GC01: 1–1:30 p.m. Cognition, Affect, and Learning: The Role of Emotions in Learning*

Invited - Barry W. Kort, Visiting Scientist – Affective Computing Research Group – MIT Media Lab, Bedford, MA 01730-1200; bkort@media.mit.edu

Our species, Homo Sapiens, is the being who thinks. But we are also the beings who learn, and the beings who experience a rich spectrum of affective emotional states. This talk presents research and theoretical models relating emotions to learning and cognition. As we learn, we acquire units of knowledge, much like pieces of a gigantic jigsaw puzzle, and arduously weave them into a "fabric of knowledge" in which all the pieces fit neatly together and a "big picture" emerges. The "big picture" (which is hidden from view until we are nearly done) is called "insight." There is a dynamic process called "learning" that takes place as we build a knowledge base. The rate of learning is generally not steady. We learn in fits and starts and occasionally have to "unlearn" a misconception or two. That is, our "learning curve" does not gracefully ascend but has "wiggles" in it as the learning process advances and retreats. There are identifiable emotions that appear along the way. Among these we especially note: curiosity, fascination, confusion, anxiety, surprise, perplexity, frustration, chagrin, despair, hope, satisfaction, and elation. In this talk I will review a mathematical model of the interplay of emotions and learning and extend the model to encompass drama theory as well.

*This work was funded in part by the National Science Foundation.
Additional support for this presentation comes from the IEEE Education Society.

GC02: 1:30–2 p.m. Affect and Physics Learning: Recent Developments

Invited - Donald R. Franceschetti, The University of Memphis, Memphis, TN 38152; dfrncsch@memphis.edu*

Elizabeth Gire, Sidney D'Mello, Vasile Rus, Art Graesser, The University of Memphis

It is a truism that the student's emotional state plays an important role in determining the efficacy of instruction. Experienced teachers and tutors can often pick up from verbal and non-verbal (body language) clues, whether a student is engaged, bored, anxious, or preoccupied, and respond in an adaptive and effective way. For intelligent tutoring systems, this determination can be made to some extent based on measurements made while a student sits at the computer. In this presentation we will review some of the relevant literature on the connection between affect and learning, including some of the rich literature on "math anxiety" and discuss some measures of affect that seem promising to aid both human and machine teachers.

*Sponsored by Karen Cummings.

GC03: 2–2:10 p.m. The Coupling of Emotion, Epistemology, and Substance of Students' Reasoning in Physics

Luke D. Conlin, University of Maryland, College Park, MD 20742; luke.conlin@gmail.com

Ayush Gupta, Andrew Elby, University of Maryland

Recent work in cognitive science has strongly argued that cognitive processes influence and are influenced by emotions. Learning scientists and science educators have steadily paid greater attention to the role of effect in learning over the last few years. Despite these efforts, it has been challenging to connect emotions to students' personal epistemology and the conceptual substance of their reasoning at fine-timescales. We aim at such integration via fine-grained analysis of clinical interviews and classroom discussions, focusing on episodes where emotions seem to play a strong role. In this talk we will present episodes from a small-group discussion among students doing physics tutorials, arguing that students' in-the-moment beliefs toward knowledge and learning and their emotions mutually support one another leading to implication for how we design and implement reform curriculum in physics.

GC04: 2:10–2:20 p.m. The Impact of Self-efficacy on Student Performance

Lauren E. Kost-Smith, University of Colorado at Boulder, Boulder, CO 80305-0390; Lauren.Kost@colorado.edu

Steven J. Pollock, Noah D. Finkelstein, University of Colorado at Boulder

Our work on gender differences in introductory physics[1,2] has focused on student performance (exam scores, course grades, and conceptual surveys). In first-semester physics we find that males outperform females on the post-FMCE by about 12% on average over 13 semesters. In second-semester physics, a similar, but smaller, gender gap exists on the post-BEMA. Regression analysis suggests that background differences of males and females can account for a large fraction of the gender gap, but not all of it. Our more recent work has been to identify factors other than student background that impact performance. In this talk we focus on differences in males' and females' sense of physics self-efficacy (students' beliefs about their ability to complete the tasks necessary to be successful in physics) and how self-efficacy impacts students' performance in the course. We find that males have significantly higher self-efficacy and these differences are correlated with course performance.

1. L. E. Kost, S. J. Pollock, & N. D. Finkelstein, PRST-PER, 5, 010101.
2. L. E. Kost-Smith, S. J. Pollock & N. D. Finkelstein, PRST-PER, 6, 020112.

GD: Frontiers in Planetary Science

Location: Grand Ballroom 2
Sponsor: Space Science and Astronomy Committee
Date: Wednesday, January 12
Time: 1–2:30 p.m.

Presider: Janelle Bailey, University of Nevada - Las Vegas

This session will explore the frontiers of planetary science and take AAPT members where no one has gone before.

GD01: 1–1:30 p.m. NASA's Kepler Mission: Searching for Earth-size Planets in the HZ

invited - Pamela K. Harman, SETI Institute, Mountain View, CA 94043; pharman@seti.org*

Bill Borucki, David Koch, NASA Ames Research Center
Edna K. DeVore, SETI Institute
Alan Gould, Lawrence Hall of Science, UC Berkeley

There is now clear evidence for substantial numbers of three types of exoplanets: gas giants, hot-super-Earths in short period orbits, and ice giants. The Kepler Mission, launched in March 2009, is positioned to survey a portion of the Milky Way galaxy to discover dozens of Earth-size planets in or near the habitable zone and determine how many of the billions of stars in our galaxy have such planets. A spacecraft mounted telescope and photometer in heliocentric orbit collects photometric data from over 100,000 stars, detecting very small changes in brightness that indicate a transiting planet. Results from this mission will place our solar system within the continuum of planetary systems in the Galaxy. Kepler has announced the discovery of seven planets to date, published findings on the instrument's precision, and collected unprecedented stellar data. This talk will discuss the mission structure, science, recent findings and classroom applications.

*Sponsored by Janelle M. Bailey.

GD02: 1:30–2 p.m. Clouds of Mars

invited - David R. Klassen, Rowan University, Glassboro, NJ 08028; klassen@rowan.edu

In the mid-1990s NASA made a commitment to make the study of Mars a major focus of its science program. The plan, part of "better, faster, cheaper" was to send two probes every two years in order to study the geology, atmosphere, and possible biology of the red planet. On the whole, these missions have been very successful. One of the keys to understanding the past, and present, capability of Mars to support life is an understanding of water. These missions, as well as a host of ground-based telescopic projects, have endeavored to measure the total water inventory as well as model the water cycle(s) of Mars. In this talk I will focus on one, originally ignored, aspect of water on Mars: clouds. I will present a brief history of cloud observations, their importance to the water cycle and my own work in measuring the water content in Martian clouds.

GD03: 2–2:30 p.m. An Equation to Estimate the Habitability around a Star

Invited - Eduardo L. Martin, University of Central Florida,Orlando, FL 32816; ege@ physics.ucf.edu

More than 400 exoplanets have already been discovered, but none of them is likely to be habitable. A frontier of planetary sciences is the detection and characterization of habitable exoplanets. The likelihood that a given star could have a detectable habitable exoplanet can be estimated using a simple equation.

GE: PER Around the World - II

Location: Grand Ballroom 3
Sponsors: International Physics Education Committee, Research in Physics Education Committee
Date: Wednesday, January 12
Time: 1:15–2:15 p.m.

Presider: Andrew Crouse, Ithaca College

GE01: 1:15–1:45 p.m. Factors Affecting the Effectiveness of Undergraduate Physics Laboratory: The Case of Selected Higher Education Institutions

Invited - Kassahun D. Lewetegn, Arba Minch University, Arba Minch, 21 Ethiopia; kassa_l98@yahoo.com

The main purpose of this study was to identify the factors that affect the effectiveness of the undergraduate physics laboratory in three higher education institutions. The study included students from first year to third year, with 60 students selected from each higher education institution. Therefore the total number of student respondents was 180 out of 512, with 17 instructors and laboratory assistances. To conduct the study a descriptive survey method was employed. Simple random sampling for students was used and available sampling and purposive sampling was used for teachers and laboratory assistants. To gather data, the instrument of data collection were questioner, interview, document analysis, observation and achievement test. In analyzing the data percentage, mean and grand mean were used. The result of the study indicates that resources, curricula, students' assessment strategies, teaching effectiveness, and students' background were the major factors that affect the effectiveness of undergraduate physics laboratories. However, it was found out that the assessment in the laboratory does not involve more practical assessment, most of the resources found are very aged and few in number, teachers do not mostly attend the laboratory session, the curricula is poor to include the real laboratory experiences, and students have poor background of laboratory experience.

GE02: 1:45–1:55 p.m. Physics Education Research in Vietnam

Dong-Hai Nguyen, Kansas State University, Manhattan, KS 66506; donghai@phys.ksu.edu

Physics Education Research is a research field known by not more than a couple of physics and education researchers in Vietnam. In fact, there have been many researchers conducting research studies on the teaching and learning of physics, but not many of them are in the main stream of modern physics education research in the world. On the other hand, possessing good specialties in educational science, information technology, and team-work skills, Vietnamese researchers can potentially serve as effective research partners in many areas of Physics Education Research. Therefore, cooperation in Physics Education Research between researchers in Vietnam and those around the world is potentially mutually beneficial. Specifically, it is the purpose of this talk to introduce PER in Vietnam to the world and to seek for cooperation in training physicists with specialties in education research and in conducting research in physics education.

GE03: 1:55–2:05 p.m Brazilian Physics Teacher Certification: Beyond Traditional Versus Alternative Programs

Katemari D. Rosa, Columbia University/Teachers College, New York, NY 10027; katemari@gmail.com

Luzia M. Mota, Instituto Federal de Educacao, Ciencia e Tecnologia - IFBahia

Inspired by the debate between traditional versus alternative teacher certification programs in the United States, and by the new legislation for teacher certification in Brazil, this study discusses how Brazilian programs for physics teacher certification have been adapting to teacher education reforms in that country. We analyze the models existent in both countries in regards to student teaching, coursework structure, duration of courses, and legal requirements. In our analysis we consider the differences and similarities between both countries in general, and focus on the experiences of a large private traditional institution in the U.S., and also at a large, but public Brazilian institution that just recently started to offer physics teaching certifications. Our findings suggest that physics teacher education can benefit from diversifying certification initiatives instead of looking for a singular approach, and that looking to foreign experiences can only enrich the quality of our teacher force.

GE04: 2:05–2:15 p.m. Inquiring CLOE Labs on Electromagnetism and Reasoning of Pupils

Stefano Vercellati, Physics Department of University of Udine, UD 33047 Italy; stefano.vercellati@uniud.it*

Marisa Michelini, Lorenzo Santi, Alberto Stefanel, University of Udine

CLOE (Conceptual Laboratories of Operative Exploration) is a strategy developed and tested in the context of research on learning processes based on phenomena exploration in formal and informal contexts. CLOE labs are carried out by a researcher on a specific topic, based on a semi-structured interview protocol, which represents an open work plan through the proposal of everyday life scenarios. Everyday common situations are studied following narrative reasoning by means of simple hands-on apparatus. CLOE laboratories offer to students and teachers the possibility to explore different contexts. A research focused on construction of formal thinking through CLOE allows to identify students' spontaneous ideas and conceptual paths into the evolution of reasoning for a model of interpretation in the magnetic and electromagnetic phenomena. The empirical research done in the last five years will be presented with the main results collected.

*Sponsored by Marisa Michelini and Alberto Stefanel

GF: Laboratory Pedagogy - I

Location: City Terrace 9
Sponsors: Laboratories Committee, Physics in Undergraduate Education Committee
Date: Wednesday, January 12
Time: 1–3 p.m.

Presider: Nancy Beverly, Mercy College

What form have laboratories taken or could take to improve the physics curriculum across all levels? As we continue to re-evaluate what we want students to learn, how we will assess that learning progress, and how do we plan student activities accordingly.

GF01: 1–1:30 p.m. ISLE: Clear Epistemic Roles for Laboratory Experiments in Physics Instruction

Invited - David T. Brookes, Florida International University, Miami, FL 33199; dbrookes@fiu.edu

In physics, experiments inform theory as physicists try to account for unexpected experimental phenomena. Theory informs experimentation as physicists who propose new hypotheses, suggest ways in which their hypotheses might be experimentally tested. In a traditional introductory physics laboratory where students are expected to "verify" equations that were provided to them, this subtle connection between theory and experimentation is seldom emphasized. In the Investigative Science Learning Environment (ISLE), experimentation is divided into three distinct epistemological roles: observational, testing, and application. The goal of this is for students to see the true purpose of the experiments they conduct as they are engaged in a process of learning physics by doing physics. I will discuss our implementation of ISLE laboratories and integrated ISLE curriculum at Florida International University.

GF02: 1:30–2 p.m. Integrating Experiments and Computer Simulations to Promote Learning*

Invited - Fred Goldberg, San Diego State University, San Diego, CA 92120; fgoldberg@sciences.sdsu.edu

Physics and Everyday Thinking (PET) is a guided-inquiry laboratory/discussion course that focuses, in part, on helping students develop evidence-based ideas in physics. In its development, much attention was given to the sequencing of laboratory experiments and computer simulations to promote learning. In this talk I will draw on two examples from the PET curriculum to address the following questions: (1) How does a sequence of experiments guide development of ideas or models? (2) How can computer simulations help focus students' attention on critical features or different aspects of a situation? (3) How can experiments and computer simulations complement each other (and be sequenced) to promote learning? (4) Do students treat "evidence" from experiments and "model-based evidence" from computer simulations in similar or different ways when using them as tools to construct knowledge?

*This work was supported by NSF Grant 0096856. PET is published by It's About Time, Herff Jones Education Division

GF03: 2–2:30 p.m. Investigating Student Learning In a Laboratory Course on Analog Electronics*

Invited - MacKenzie R. Stetzer, University of Washington, Seattle, WA 98195-1560; stetzer@phys.washington.edu

The Physics Education Group at the University of Washington has recently begun an in-depth investigation of student understanding of analog electronics. As part of this investigation, we have been examining student learning in an upper-division laboratory course on this subject. In particular, we have administered written questions on fundamental electric circuits concepts (typically covered in introductory physics courses) and on canonical topics in analog electronics (e.g., filters, diodes, transistors, and operational amplifiers). Drawing on the results from such questions, we are investigating the impact of the analog electronics course on student conceptual understanding. Specific examples will be used to illustrate how the findings from this investigation have implications for instruction in both introductory and upper-division courses.

*This work has been supported in part by NSF Grant No. DUE-0618185.

GF04: 2:30–3 p.m. It's All About Attitude

Invited - Richard D. Dietz, University of Northern Colorado, Greeley, CO 80639; rdietz@unco.edu

Why do we continue to insist that our students participate in those time-consuming and resource-devouring rituals we call physics labs? The reasons often adduced for the existence of those labs imply some admirable goals, but labs are not the most appropriate or effective means to achieve some of those goals. Labs should instead focus on the most important goal of a physics laboratory experience which is the cultivation of attitude, by which I mean a state of mind conducive to effective problem solving. In this regard the current lab paradigm is clearly ineffective and may be counterproductive. Ways to instill the desired attitude will be described.

HA: Laboratory Pedagogy - II

Location: Grand Ballroom 1
Sponsors: Laboratories Committee, Physics in Undergraduate Education Committee
Date: Wednesday, January 12
Time: 3:15–4:25 p.m.

Presider: Jill Marshall, University of Texas at Austin

HA01: 3:15–3:25 p.m. Play Theory in the Development of a Sophomore Electronics Lab

Juan R. Burciaga, Denison University, Granville, OH 43023; burciagaj@denison.edu

Play theory provides a framework to inform, balance and interpret the competing demands of a laboratory environment. In order to optimize the laboratory learning experience, the elements of play pedagogy (play, continual assessment of the learning experience, establishing a rhythm to the learning experience) are being incorporated into the development of the sophomore electronics lab. But what are the play aspects of the electronics lab? How do we assess an experience that takes place outside the monitoring presence of the faculty? How do we establish a rhythm to the learning experience? The talk focuses on the process of designing a sophomore electronics lab under the paradigm of play theory.

HA02: 3:25–3:35 p.m. Our Current Second Semester Introductory Physics Laboratories

Mark F. Masters, IPFW, Fort Wayne, IN 46805; masters@ipfw.edu

The traditional second-semester introductory physics laboratory explores a hodge-podge of topics from circuits to capacitors to optics to physical optics. We have modified our second-semester laboratories such that they have a single concentration: circuits. These laboratories build a conceptual understanding of basic electricity and circuits through student investigation. The laboratories are arranged so that they build upon previous experiences requiring the students to retain what they have learned. The laboratories are so successful at teaching about circuits that we have been able to remove the topic from the lecture component of the class. The laboratories and measures of their success will be described.

HA03: 3:35–3:45 p.m. Enhancing Conceptual Learning: Lab Strategies for Algebra-based Introductory Physics

Deepika Menon, University of Missouri, Columbia, MO 65201; dm2qc@mail.mizzou.edu

Andrew Miskowiec, Haskell Taub, University of Missouri

To promote students' conceptual understanding in the first-semester algebra-based introductory physics course, we conducted a pilot instructional laboratory in winter semester 2010. The lab activities supported a conceptual and thematic approach used in lecture with three major themes: single particle motion; the conservation of energy; and the Second Law of Thermodynamics. We also sought to reduce the artificial barriers between lecture, lab, and recitation in our traditional course. New labs begin with an exploratory mini-lab based on a small toy e.g., a Slinky or a simple pendulum. Students' observations (e.g., standing wave patterns on a slinky) serve to introduce a smaller number of precise measurements on standing waves with the traditional apparatus. To unify the lab, lecture, and recitation parts of the course, we often end lab sessions with students working with their lab partner or a larger group on a related conceptual homework problem assigned for their recitation section.

HA04: 3:45–3:55 p.m. New Results in Astronomy Education Research

Kendra J. Sibbernsen, 287 Concord Circle, Papillion, NE 68046; ksibb@cox.net

Astronomy laboratory activities have been developed that intentionally scaffold a student from guided activities to open inquiry ones (Slater, S., Slater, T. F., & Shaner, 2008). This mixed-method quasi-experimental study was designed to determine how students in an undergraduate astronomy laboratory increase their understanding of inquiry working in relative isolation compared to working in small collaborative learning groups. The introductory astronomy laboratory students in the study generally increased their understanding of scientific inquiry over the course of the semester and this held true similarly for students working in groups and students working individually in the laboratories. This was determined by the examining the change in responses from the pre-test to the post-test administration of the Views of Scientific Inquiry (VOSI) survey, the increase in scores on laboratory exercises, and observations from the instructor.

HA05: 3:55–4:05 p.m. Recycling a Physics Lab: Electrostatic Potential Field Map +

Paul R. Simony, Jacksonville University, Jacksonville, FL 32211; psimony@ju.edu

The Overbeck electrostatic field mapping apparatus is standard in undergraduate physics labs and serves as a simple means of introducing scalar potential fields. With the addition of a few sheets of transparency film, spreadsheet, and vector field potting software, the traditional lab can be transformed, yielding the original equipotential field map, a 3-D surface plot as well as an explicit calculation of the average vector electric field. The final product of the traditional version (hand drawn equipotential curves and electric field lines, circa 1972) will be compared with the equipotential maps, 3-D surface maps, and vector field maps produced in the updated and extended version.

HA06: 4:05–4:15 p.m. Assessment of Modern Experiments in the Introductory Calculus-based Physics Labs

Brian Woodahl, Physics Department - IUPUI, Indianapolis, IN 46202; bwoodahl@iupui.edu

John Ross, Derek Scott, Jeremy Williams, Physics Department - IUPUI Sarah Lang, Center for Teaching and Learning - IUPUI

With the advent of newer microelectronic sensors it's now possible to modernize introductory physics labs with the latest technology and this may allow for enhanced student participation/learning in the experiments. For example, force plate sensors can digitize and record the force on an object, later it can be analyzed in detail (i.e, impulse from force vs. time). Small 3-axis accelerometers can record 3-dim, time-dependent acceleration of objects undergoing complex motions. These devices are small, fairly easy to use, and importantly, are likely to enhance student learning by "personalizing" data collection, i.e. making the student an active part of the measurement process and no longer a passive observer. To assess whether these new high-tech labs enhance student learning, we have implemented pre- and post-test sessions to measure the effectiveness of student learning. Four of our calculus-based lab sections were used: Two sections, the control group, using the previous "old technology" labs, the other two, the experimental group, using the new "modern technology" labs. Returns of assessment data offer some surprising insight.

HA07: 4:15–4:25 p.m. Introductory Physics Laboratory Teaching For HBCU College Students

Yan Zeng, Savannah State University, Savannah, GA 31404; zengy@savannahstate.edu

In an attempt to increase first-year college students' interest in learning physics, a curriculum that incorporates a sequence of laboratories was developed at Savannah State University, a four-year historical black college and universities (HBCU) college. Relevant science principles and laws are explored and studied in the context of hands-on experiments. Meanwhile, the learners are challenged to develop effective problem-solving and critical thinking skills. Based on the specialty of HBCU freshman students and lecture information, five experiments were designed for mechanics and six experiments were designed for waves & electricity. They are 1) Density measurement using a micrometer; 2) Acceleration measurement using Atwood machine; 3) Friction constant measurement using inclined plane; 4) Force table analyzing vector adding and subtraction; 5) Ballistic Pendulum study to confirm momentum and mechanic energy conservation; 6) Simple harmonic motion and Hooke's law; 7) Finding local gravitational acceleration from simple pendulum experiment; 8) Standing waves in a string; 9) Electric potential and electric field; 10) Measurement of resistance and Ohm's law; 11) DC circuits. Curriculum details, laboratory procedures, and typical results will be discussed in this paper.

HB: Post-Deadline Session - I

Location: Grand Ballroom 3
Date: Wednesday, January 12
Time: 3:15–4:25 p.m.

Presider: Elizabeth Chesick

HB01: 3:15–3:25 p.m. Physics: A History of Revolution and Change

Scott C. Beutlich, Crystal Lake South High School, Crystal Lake, Il 60014; sbeutlich@d155.org`

This talk will focus on our ever-changing field of physics. Starting with the Copernican Revolution, which began the Scientific Revolution and passing onto Newton, Faraday, Maxwell, Einstein, Fermi and many others, physics is always investigating, modifying and evolving to describe our complex world. Today's great technologies we enjoy stem from our previous revolutionary changes in the way we view our world. The history of physics is a history of new ideas and new technologies. What's the next revolution on the horizon?

HB02: 3:25–3:35 p.m. Water Balloons: Weapons of Mass Destruction?

Stan Jones, The University of Alabama, Tuscaloosa, AL 35487; stjones@bama.ua.edu

Can a water balloon cause serious injury? This was the question posed to me by a lawyer representing a young man. The answer...yes... is easily found on the Internet. Looking deeper into the question I found that a great deal of interesting physics can be applied to solving the motion and the impact of a water balloon launched at high velocity. I used this as an ongoing project in my introductory physics class, incorporating the range formula, methods of estimating impact force, the effects of air resistance, and computing trajectories numerically. The project ended with a balloon drop from the rooftop. The observed impact forces agreed well with our predictions.

HB03: 3:35–3:45 p.m. Development of a Fully Online Undergraduate Physics Laboratory Course

Ann M. Reagan, College of Southern Maryland, Lusby, MD 20657; areagan@csmd.edu

Feasibility of and approaches to fully online algebra-trig based undergraduate physics laboratory courses were investigated. The goal of the effort was to identify a set of experiments of appropriate subject content, technical rigour, and experimental accuracy that could be accomplished by students working semi-independently in a distance-learning format using inexpensive equipment, at a cost commensurate with that of a typical textbook. 325 U.S. colleges and universities offering undergraduate physics courses were surveyed to determine the extent to which online physics laboratory courses were already employed. A second survey identified approaches used for online labs. Candidate experiments meeting this effort's content and cost goals were identified, and several experiments were tested in a home environment. Results indicate a fully online undergraduate physics laboratory course of appropriate content, complexity, and cost is feasible to develop, deploy, and scale.

HB04: 3:45–3:55 p.m. Differential Thermal Analysis (DTA) Apparatus for Measuring Glass Transition

William Heffner, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

Adam Kohn, Tyler Schott, Lehigh University

Thermal analysis provides a useful tool for exploring thermal events in materials such as crystallization and the glass transition. Polymer and glass scientists typically utilize a commercial Differential Scanning Calorimeter (DSC) apparatus for this purpose. However, such specialized and expensive equipment is usually inaccessible to most college physics or chemistry students, let alone the high school classroom. On the other hand, Differential Thermal Analysis (DTA) is a much easier technique to implement and provides the inquisitive student access to this exciting phenomenology. We describe a DTA that the student can build from simple laboratory equipment to explore the glass transition in low melting glasses such as hard candy and PET, as well as crystallization in the later.

HB05: 3:55–4:05 p.m. Saturday Science Academy: Enhancing Scientific Knowledge of Elementary and Middle School Students via Inquiry

Bayram Akarsu, Erciyes University, School of Education, Kayseri, NA Turkey; bakarsu@erciyes.edu.tr

Saturday Science Academy, the first Turkish science academy, was designed to improve elementary and middle school students' interests and excitement in science and consists of several hands-on activities. The goal of this study is to reveal the findings during the school. The school was administered by Dr. Bayram Akarsu in Science Education department at Erciyes University (ERU) in Kayseri. The students gathered at the School of Education building on eight consecutive Saturday mornings for particular topics. This project enhanced students' research, experimentation and self development process, which was not utilized during regular school settings. Several types and different levels of courses at this program were taught by former science teachers and current graduate students at School of Education at ERU. Pre-service students, who are learning science to teach science, assisted them. The results of this study, which aimed at investigations completed during the school, revealed that Saturday Science Academy not only enhanced students' interests but also increased their knowledge of the nature of science.

HB06: 4:05–4:15 p.m. Combining JiTT with Wikis in Introductory Physics classrooms

Hashini E. Mohottala, University of Hartford, West Hartford, CT 06117; mohottala@hartford.edu

I report the combined use of Just in time teaching (JiTT) and Wiki Space (wikis) in an introductory level physics class. Wikis helps students, instructors and technology to interact with one another. A core element of JiTT is interactive lectures. Although these teaching tools have been used separately in physics classrooms over the years, the combination will be a new experience for both physics instructors and students. During this exercise, I carefully picked relevant physics problems and posted them on the Wikis in weekly basis, using it as a platform for students to meet online and discuss problem-solving strategies. The students were supposed to discuss and find the methods to solve the problems and not get the final answer in numerical forms. This activity helped students enhance their critical thinking abilities and as the Wiki page administrator, I was able to track all the write-ups, and allocate the necessary grades.

HB07: 4:15–4:25 p.m. Which String Breaks? Revisited

Christopher R. Frye, University of Central Florida, Lake Mary, FL 32746; christopher.frye@knights.ucf.edu*

Many have seen the common introductory physics demonstration in which a heavy ball hangs from a string, with another identical string hanging freely from the ball. When the instructor pulls the bottom string slowly, the top string breaks. However, when the instructor pulls the bottom string very rapidly, the bottom string breaks. This simple experiment is used to demonstrate inertia and Newton's laws. In *The Physics Teacher* of November 1996, there is an article in which the authors attempt to explain this phenomena quantitatively. However, their analysis gave strange results. Using their model, I will show that all major qualitative aspects of this demonstration can be predicted quantitatively using only simple calculations.

*Sponsored by Costas Efthimiou.

HC: Post-Deadline Session - II

Location: Grand Ballroom 2
Date: Wednesday, January 12
Time: 3:15–4:05 p.m.

Presider: Daniel Crowe

HC01: 3:15–3:25 p.m. Teaching Physics Though Modeling the Physics Research Community (Part 1)

Angela Little, University of California, Berkeley, CA 94703; little@berkeley.edu

Badr Albanna, University of California, Berkeley

In this talk, we will discuss The Compass Project, a program created at the University of California, Berkeley, five years ago to support physics students during the critical freshman transition into college. Drawing on physics education research, we had two major goals in creating a two-week summer program for incoming freshman: building community and helping students develop productive beliefs about what physics is and how to learn it. This presentation will focus on a newly developed semester-long course that follows the summer program. One focus of both the summer program and the course is developing the students' capacity to see the world through physics models; students also hone their ability to communicate and collaborate productively with their peers. We will discuss some of the successes and challenges of introducing college freshman to our model of a physics research community. The center of this talk will be on the students' interactions with physics models.

HC02: 3:25–3:35 p.m. Teaching Physics Though Modeling the Physics Research Community (Part 2)

Badr Albanna, University of California, Berkeley, CA 94703; badr_albanna@berkeley.edu

Angela Little, University of California, Berkeley

In this talk, we will discuss The Compass Project, a program created at the University of California, Berkeley, five years ago to support physics students during the critical freshman transition into college. Drawing on physics education research, we had two major goals in creating a two-week summer program for incoming freshman: building community and helping students develop productive beliefs about what physics is and how to learn it. This presentation will focus on a newly developed semester-long course that follows the summer program. One focus of both the summer program and the course is developing the students' capacity to see the world through physics models; students also hone their ability to communicate and collaborate productively with their peers. We will discuss some of the successes and challenges of introducing college freshman to our model of a physics research community. The center of this talk will be on the students' interactions with their peers.

HC03: 3:35–3:45 p.m. Integrating Concepts in Undergraduate Physics, Anatomy and Physiology

Bijaya Aryal, University of Minnesota-Rochester, Rochester, MN 55904; baryal@umn.edu

Robert L. Dunbar, Andrew Petzold, University of Minnesota-Rochester

Understanding the relationship between exercise, physiology and physics may not be trivial to the average undergraduate student. This project set out to generate and assess a learning environment that combines concepts from physics, anatomy and physiology in an effort to teach specific concepts and to encourage students to make the intellectual connection between material that they would normally see in distinct courses. Our fundamental questions included: 1) Can students link the concepts of levers, force, muscle fiber recruitment and EMG amplitude at the qualitative level? And 2) does introduction of physics concepts in the context of an anatomy and physiology course facilitate student understanding of those concepts? The activity included an introduction to levers and force, directed student design of experiments to explore the relationship between force and EMG amplitude; and an assessment of the students' ability to connect the concepts discussed.

HC04: 3:45–3:55 p.m. An Interactive Supplemental Physics Course based on the Assessment of Physics Experience

R. Wesley Foster, University of Memphis, Memphis, TN 38111-5707; rwfoster@memphis.edu

Wayne Mullins, Memphis University School

There are several factors that contribute to the low success rate of introductory trigonometry and calculus-based physics courses. One significant factor is prior experience. We will discuss a new survey instrument that measures a student's prior experience learning physics. A student is classified as either a novice learner, continuing learner, or experienced learner based on their responses to questions about prior coursework and confidence with specific physics topics. We administered this survey to 175 students in an attempt to identify novice physics learners in trigonometry and calculus-based introductory physics courses who might benefit from a low-cost, 7-week (14 total contact hours) supplemental course emphasizing fundamental skills and topics. We will discuss correlations between experience level and final course grade. We will also describe the supplemental course and its impact on novice physics learners' conceptual understanding (as measured by the FCI) and problem solving

HC05: 3:55–4:05 p.m. Teaching Physics Using YouTUBE*

Vasudeva R. Aravind, Clarion University, Clarion, PA 16214; varavind@clarion.edu

Teaching several concepts in physics, especially problem solving, needs constant reinforcement and practice. Video tutorials available on the Internet, 24X7 can serve as a wonderful tool for students trying to learn problem-solving concepts. I have uploaded my video tutorials on Youtube in my channel: www.youtube.com/varavind, as a tool complementing my lectures in a classroom. In this talk, I share my experience utilizing this tool, and discuss its impact on students' understanding of physics concepts in my freshman level introductory physics class.

*This project was financially supported by College or Arts and Sciences Faculty Professional Development Grant, Clarion University.

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Young, Hugh
Yuan, Allen
Yudovina, Elena
Zanton, Shirley
Zemaitis, Vincent
Zettlemoyer, Joseph
Zhu, John
Zimmermann, William
Zitto, Richard
Zitzewitz, Paul
Zook, Alma
Zwart, John
Zwicker, Earl
Anonymous (5)

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Index to Advertisers

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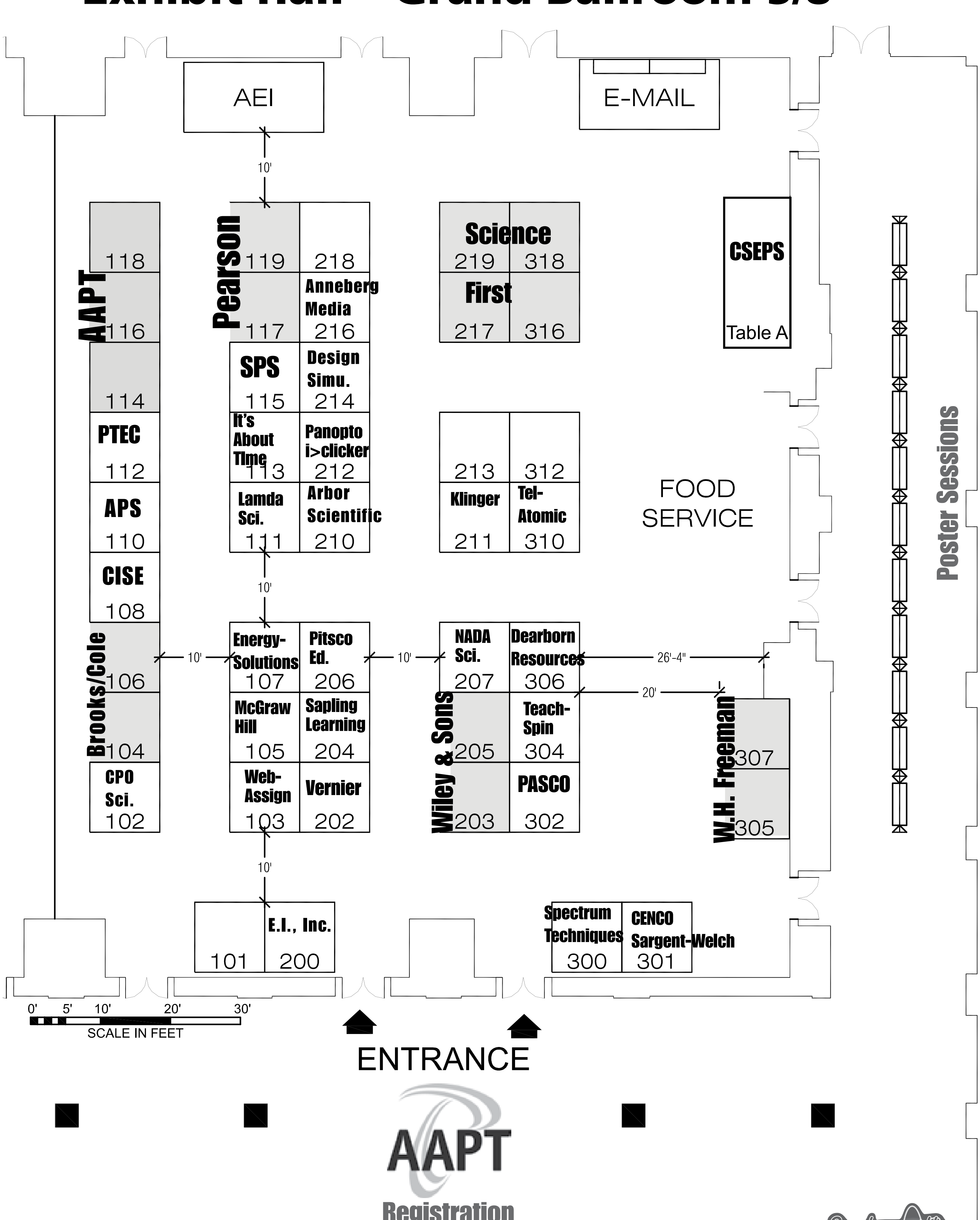

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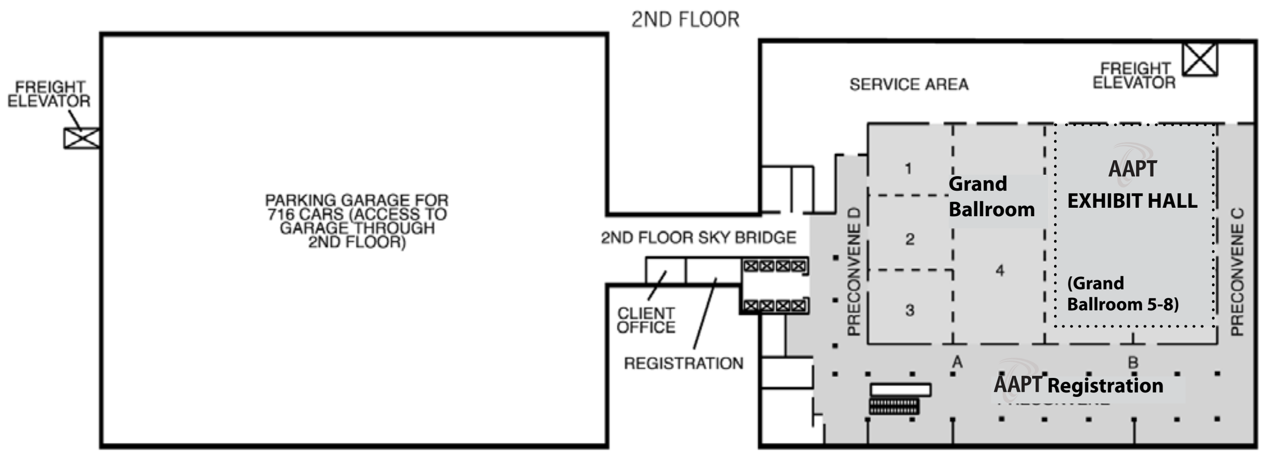

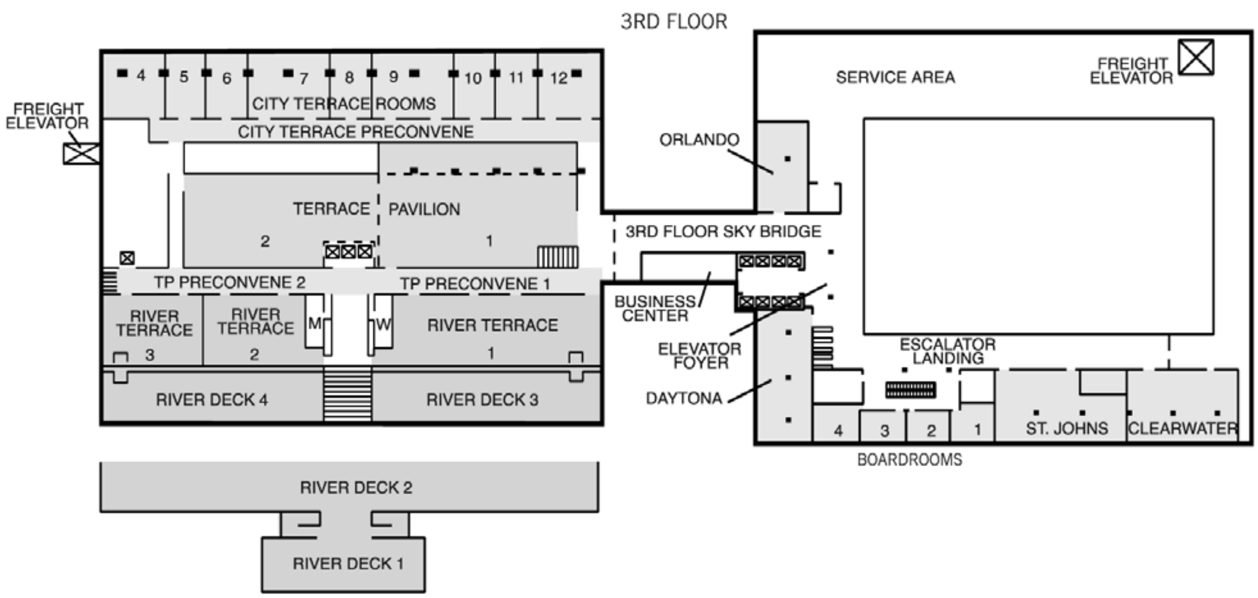

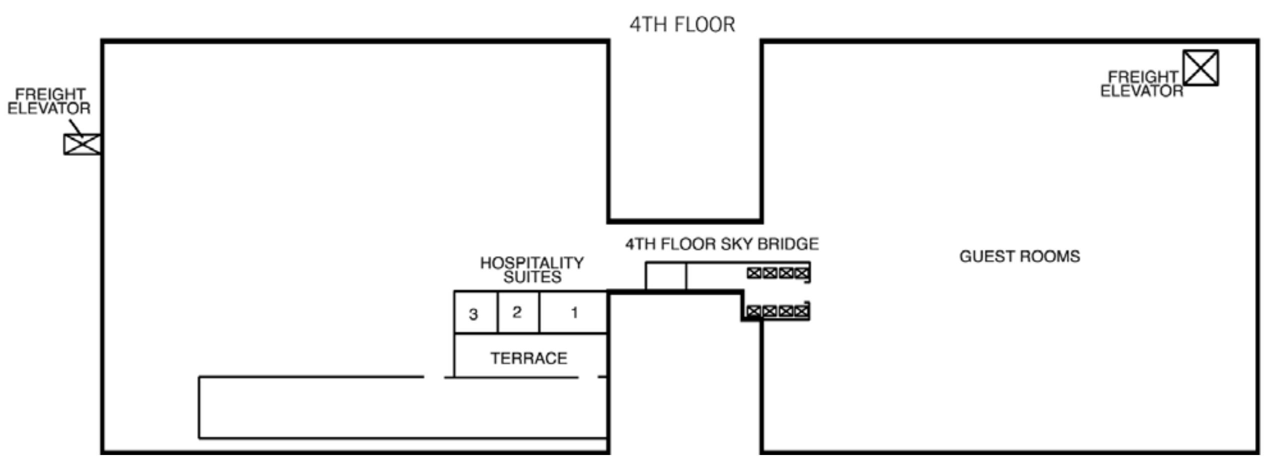

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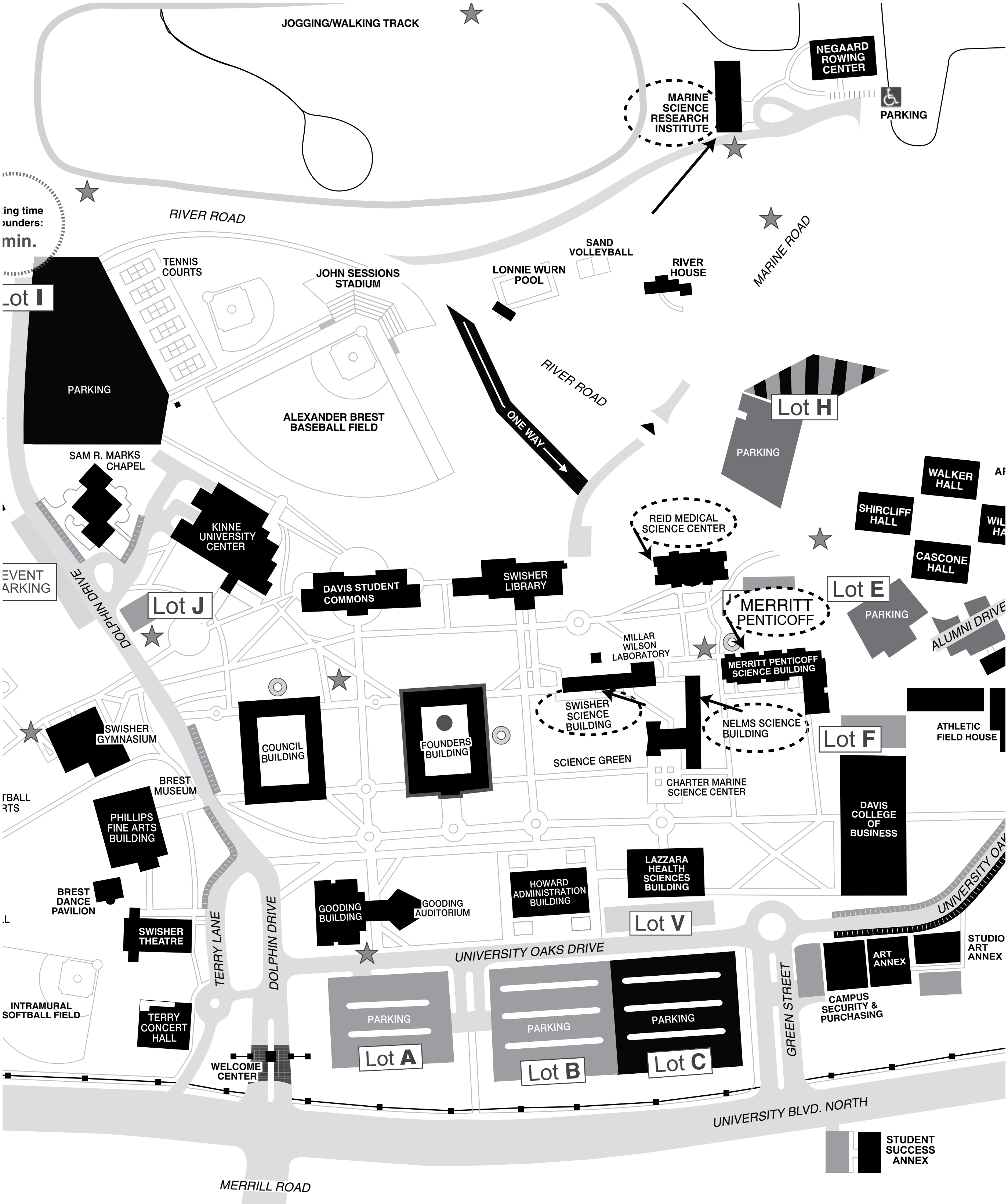

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