2012 AAPT Winter Meeting

Ontario, California
February 4–8, 2012

Ontario Convention Center
California State Polytechnic Univ., Pomona

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

Welcome to Ontario!

Our Winter 2012 AAPT meeting (WM12) is being held in Ontario, California (not the other CA!) at the Ontario Convention Center, 40 miles east of LA and adjacent to Ontario International Airport. The workshops will be held on the campus of Cal Poly University, Pomona. If you can come a day early, within an hour's drive you can find ocean beaches, three ski areas, Disneyland, Hollywood or the Temecula Valley Wine Country. San Diego, Palm Springs, and Joshua Tree National Park are day trips.

AAPT will once again host the 3rd Annual Fun Walk/Run, a fundraiser that supports our meetings and conferences. The Out-Laws of Physics, a five-person band emanating from the Physics Department at Cal Poly University, Pomona will play for us. Attendees will also have a chance to visit area shopping malls and wineries, as well as take a tour on Wednesday, targeted to high school faculty, but open to college faculty, is Science in the Stratosphere, a Field Trip To NASA's Stratospheric Observatory For Infrared Astronomy (SOFIA).

In this beautiful setting, WM12 has much offer. Our Meeting Theme is the Wave Nature of Light & Matter. Maxwell's equations were formalized 150 years ago, and this is the 75th anniversary of the Davisson-Germer Nobel Prize. California is known for its water waves, and fluid dynamics is an important area in the beautiful animated movies we have come to enjoy and associate with this region. Dr. Ron Henderson will present our first plenary talk. /at DreamWorks Animation, he is responsible for developing physical simulation and procedural modeling tools that have been used for key visual effects in films such as Kung Fu Panda and Monsters vs. Aliens. Prior to joining DreamWorks in 2002 he was a Senior Scientist at Caltech with a joint appointment to the Applied Math and Aeronautics departments where he worked on efficient techniques for the direct numerical simulation of fluid turbulence. He received a Ph.D. from Princeton University.

WM12 will also give us updates on PER and Public Policy, featuring Helen Quinn, theoretical physicist and SLAC Professor Emeritus who chaired the National Academy of Sciences committee that issued A Framework for K-12 Science Education about national standards; Howard Gobstein, Vice President, Research and Science Policy of the Association of Public and Land-Grant Universities and co-director of the Science & Mathematics Teacher Imperative, and Pat Heller, of the University of Minnesota.

We'll also have an opportunity to get involved in AAPT's efforts on Real World Problem Solving, the area of a recent grant to which AAPT is a partner with Project Kaleidoscope. In part, the FIPSE grant is to find ways to incorporate 21st century, real world problems into the physics curriculum. We will introduce this with a crackerbarrel and a plenary talk by Physics for Future Presidents author Richard Muller, well known author and professor of physics at the University of California, Berkeley. Other exciting plenary sessions feature our award winners. Richtmyer Memorial Lecture Award winner Brian Greene, well known author and professor of physics at Columbia University, is widely recognized for a number of groundbreaking discoveries in his field of superstring theory. Oersted Medal recipient Charles H. Holbrow, Charles A. Dana Professor of Physics, Emeritus, Colgate University, has served AAPT as President, Senior Staff Physicist, and Executive Officer. He has been editor of the New Problems section of the AJP and is Co-chair of the 2012 Gordon Research Conference—Physics Research and Education: "Astronomy's Discoveries and Physics Education." John David Jackson Excellence in Graduate Physics Education Awardee Kip Thorne, well known author and Caltech Feynman Professor of Theoretical Physics, Emeritus has made a tremendous impact on our understanding of gravitation and astrophysics. He and his research group have provided theoretical support for LIGO, including identifying gravitational wave sources that LIGO should target, and laying the foundations for data analysis techniques by which their waves are sought.

We'll hear talks on a wide variety of topics that will help us teach better at every level, face some of the changes coming with the new ESEA, consider how to evaluate the teachers we prepare, support undergraduate research at Two Year Colleges, increase diversity in our classrooms and better serve graduate students.

I very much look forward to seeing you in Ontario. It is going to be a great meeting, with a wealth of things to do and learn! Please feel free to share your feedback with me.

Gay Stewart, gstewart@uark.edu

2012 Program Chair

Special Thanks:

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

Paper Sorters: Janelle Bailey, University of Nevada - Las Vegas
Paul Williams, Austin Community College
John Griffith, Mesa Community College
David Sturm, University of Maine
Gary White, AIP
Our local organizer: – Mary Mogge, Cal Poly Pomona University Physics Dept.

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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 **#aaptwm12** 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!

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

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Contacts:

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programs@aapt.org, www.aapt.org

Shuttle Bus Schedule

Date: Saturday, February 4

Buses departing the Ontario Convention Center to Cal Poly Pomona:

- 7:20 a.m.
- 7:30 a.m.
- 12:20 p.m.

Buses departing Cal Poly Pomona, returning to Ontario Convention Center:

- 12:15 p.m.
- 1:00 p.m.
- 4:15 p.m.
- 5:15 p.m.
- 5:30 p.m.

Date: Sunday, February 5

Buses departing the Ontario Convention Center to Cal Poly Pomona:

- 7:20 a.m.
- 7:30 a.m.
- 12:20 p.m.

Buses departing Cal Poly Pomona, returning to Ontario Convention Center:

- 12:15 p.m.
- 1:00 p.m.
- 5:15 p.m.
- 5:30 p.m.

Pick-up Location/Convention Center:

Ontario Convention Center
2000 E. Convention Center Way
Ontario, CA 91764
South Lobby Entrance
(see map, p. 115 for location)

Workshop Location:

California State Polytechnic University, Pomona
3801 W. Temple Ave,.
Pomona, CA
Building 3, West End

Stop by to Visit Our Exhibitors

Exhibit Hall hours

Sunday: 7:30–9:30 p.m.
Monday: 10 a.m.–6 p.m.
Tuesday: 10 a.m.–4 p.m.

Exhibit Hall B

snack breaks: Mon. 10:00–10:30 a.m. & 4:30–5:00 p.m.
Tues., 10:40–11:10 a.m. & 3:15–3:45 p.m.

Booth #117

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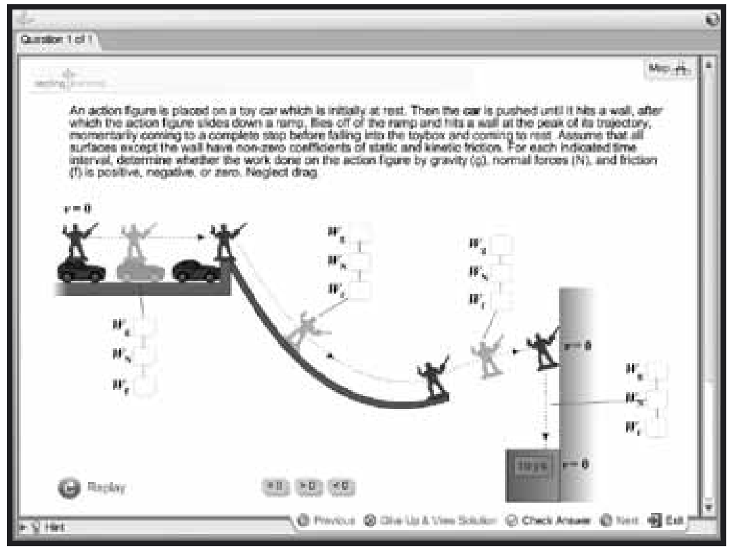

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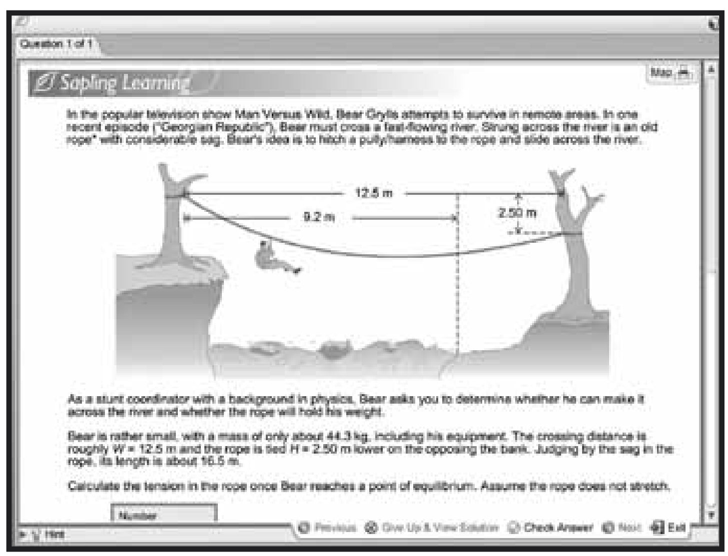

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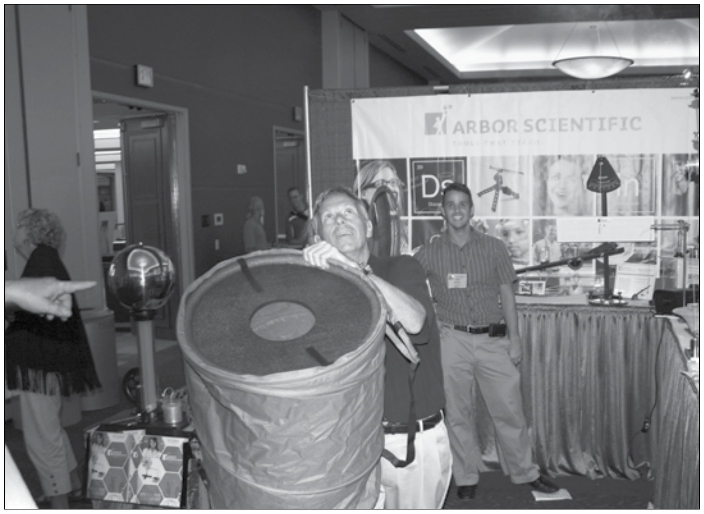
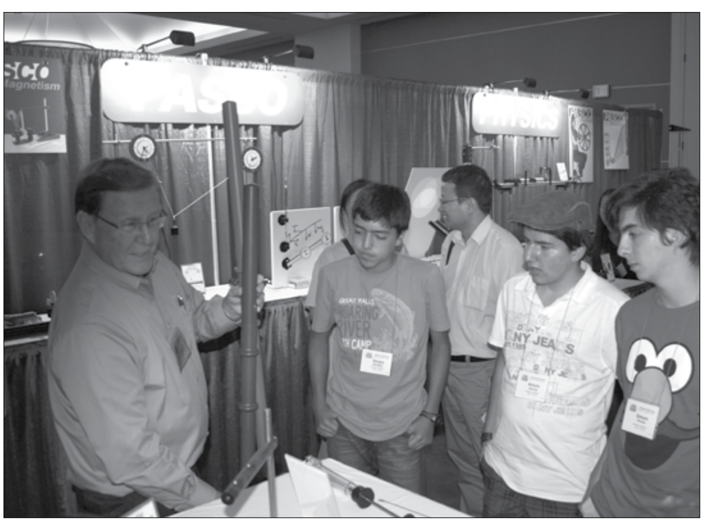
First time at an AAPT meeting?

Welcome to the 2012 AAPT Winter Meeting in Ontario! 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 the Exhibit Hall B. It is a wonderful way to learn more about the meeting and about AAPT. This is the first time it will be held in our Exhibit Hall!
- 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 in 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 Ontario

Situated 35 miles east of Los Angeles in San Bernardino County, Ontario is close to many of the best of Southern California's attractions, including ski resorts, lakes, Pacific Ocean, wineries, golf courses, Disneyland and Hollywood!

It was in 1881 when Ontario was conceived and built on a patch of the Cucamonga Desert. Canadian Brothers George and William Chaffey saw the land and bought up 6218 acres and water rights for their model city—which they called the "Ontario Colony" after their home city Ontario, Canada. They named the main road Euclid Avenue after the Greek mathematician. They established the Ontario Power Co. to bring up water from deep wells. Anyone buying land in the colony also got water piped to their land, which was not the norm in California.

Ontario was incorporated as a city in 1891, and North Ontario broke away in 1906, calling itself Upland. Ontario grew rapidly, increasing 10 times in the next half century.

Ontario's early economy was driven by a reputation as a health resort. Shortly thereafter, citrus farmers began taking advantage of Ontario's rocky soil to plant lemon and orange groves. Agricultural opportunities also attracted vintners and olive growers. The Graber Olive House, which continues to produce olives, is a historical landmark and one of the oldest institutions in Ontario. Dairy farming is also prevalent, as it continues to be in neighboring Chino.

A major pre-war industry was the city's General Electric plant which produced irons. During and after World War II, Ontario experienced a housing boom. The expansion of the Southern California defense industry attracted many settlers to the city. In 1923 Ontario became involved in aviation with the establishment of Latimer Field. Later during WWII the Ontario International Airport was used to train pilots for war.

Since WWII, Ontario has become a much more diversified community with a population of 163,924 today, with an industrial and manufacturing base.

Ontario has over two centuries of Hispanic residents—the first wave of Mexican settlers was in the 1880s brought as workers in the railroad industry and another wave from the Mexican Revolution of the 1910s.

Education

Ontario has 25 public elementary schools, six public middle schools, and five public high schools under the combined oversight of four school districts. There are also several private schools throughout the city as well as two private military schools. Ontario also has nine trade schools. Providence Christian College, a four-year Christian liberal arts college, opened in 2005. The University of La Verne College of Law and Chaffey College Ontario Campus are located in downtown Ontario. National University and Chapman University have a satellite campus near the Ontario Mills mall.

Things to do in Ontario:

➤ **Ontario Museum of History & Art:** "The Working White House" through Feb. 26, 2012. The stories of White House workers provide an intimate behind-the-scenes portrait of two centuries at the country's most famous household. Highlights include images, video, audio and historic artifacts. *Open Thursday–Sunday; 225 South Euclid Ave., Ontario, CA; 909-395-2510; http://www.ci.ontario.ca.us/index.cfm/1605*

➤ **Ontario Mills Mall:** The 1.7 million-square-foot Ontario Mills is Southern California's largest outlet shopping mall and entertainment center – and one of California's most popular tourist attractions. Whether you come for shopping, dining or to watch a blockbuster hit on one of its state-of-the-art IMAX theaters, you will find everything are you looking for and more at Ontario Mills. *Open daily; One Mills Circle, Ontario, CA; www.ontariomills.com*

➤ **Graber Olive House:** The historic Graber Olive House is nearby Ontario's Civic Center and just minutes from LA-Ontario International Airport (ONT). Still family-owned and operated, the Graber Olive House is a popular year-round tourist stop. Home of world famous Graber tree-ripened olives, Graber Olive House welcomes visitors daily to discover a bit of Early California and to view the long and careful tradition of grading, curing, canning and packaging. *315 E. Fourth Street • Ontario, CA; www.graberolives.com*

➤ **Wine Country:** Nestled in greater Ontario's own Cucamonga Valley, the local wineries and tasting rooms are a living testament to the California wine industry. Local wine production, widely recognized as the oldest in the state, began here in the late 1850s. Sample wine at: Joseph Filippi Winery, Galleano Winery,San Antonio Winery, Grape Harvest Festival and more. *http://www.ci.ontario.ca.us/index.cfm/2567/3862*

➤ **Cucamonga-Guasti Regional Park:** Cucamonga-Guasti Regional Park isn't your typical city park. It has more than 150 acres of land where visitors can swim, fish, picnic, boat and even ride waterslides. It costs $7 per vehicle. *800 N Archibald Ave, Ontario, CA*

➤ **Horseshoe Resort Skiing:** Take off down 22 of Ontario's best downhill ski runs, 14 of which are night-lit. Or strap on your snowboard. Resort has a spa and dining. *http://horseshoeresort.com*

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 at the Ontario Convention Center, unless otherwise noted. Workshops on Saturday and Sunday will be at ***Cal Poly Pomona.***

FRIDAY, Feb. 3

6–8 p.m.		Pre-registration Pickup	**North Lobby**

SATURDAY, Feb. 4

7 a.m.–4 p.m.		**REGISTRATION**	**North Lobby**
8 a.m.–12 p.m.	W06	Supernova Physics: Individualized Investigations Using DS9, Chandra's Public Archives	Bldg. 3–2004
8 a.m.–12 p.m.	W07	In-Class Polling for All Learners (iPAL) Project	3–2016
8 a.m.–12 p.m.	W09	Teaching & Learning Electromagnetism in Intro Physics	8–210
8 a.m.–12 p.m.	W11	Make and Take Your Own Photogate/Lasergate	3–2011
8 a.m.–5 p.m.	W01	Cal Poly's Physics Lecture Demonstrations	8-241
8 a.m.–5 p.m.	W02	Graphing Analysis of Student Data With AP B Examples	3–2618
8 a.m.–5 p.m.	W05	Physics by Design	3–2628
9 a.m.–4:45 p.m.		Two-Year College Tandem Meeting	offsite
10 a.m.–5:30 p.m.		Wine Country Tour in Temecula	offsite
1–4 p.m.	T02	Teaching Statistical and Thermal Physics	3–2011
1–5 p.m.	W12	Teaching About Radioactivity	8–210
1–5 p.m.	W13	Hands On Activities for Teaching About Light	3–2016
1–5 p.m.	W14	Photons and Phonons in the Advanced Lab	8–211
1–5 p.m.	W16	Using NASCAR to Teach Physics	offsite
3:30–5:30 p.m.		New Area Chairs Orientation	100B
4:30–5:30 p.m.		New Board Members Orientation	101
5:30–7:30 p.m.		E. Leonard Jossem Dinner	Ballroom A
7:30–10 p.m.		AAPT Executive Board I	101

SUNDAY, Feb. 5

7 a.m.–4 p.m.		**REGISTRATION**	**North Lobby**
7:30–10 a.m.		Publications Committee	107A
8 a.m.–12 p.m.	W21	Energy and the Environment Hands-On Activities	Bldg. 3–2615
8 a.m.–12 p.m.	W22	Approaching Quantum Mechanics by Playing with Polarization	3–2628
8 a.m.–12 p.m.	W23	CASTLE	3–2004
8 a.m.–12 p.m.	W25	NTIPERs: Research-based Reasoning Tasks for Intro Mechanics	3–2623
8 a.m.–12 p.m.	W28	Modeling Amusement Park Physics with EJS Simulations & Tracker Video Analysis	3–2019
8 a.m.–12 p.m.	W29	Affordable High-Speed Video Analysis	3–2016
8 a.m.–5 p.m.	W18	Arduino Microcontrollers in the Physics Lab	3–2618
8 a.m.–5 p.m.	W19	Reformed Teacher Observation Protocol (RTOP)	8–210
8 a.m.–5 p.m.	W20	Research-based Alternatives to Traditional Problem-Solving Exercises	8–241
8–9:45 a.m.		Meetings Committee	107C
10–11 a.m.		Nominating Committee	107B
10 a.m.–5 p.m.		Executive Board II	101
11:30 a.m.–2:30 p.m.		Resource Letters Committee	107C
1–5 p.m.	W30	Astronomy Is a Verb: Engaging Science Students in Scaffolded Astro. Research	3–2019
1–5 p.m.	W32	Writing Apps for the IPhone and the IPad	3–2004
1–5 p.m.	W34	Learner-Centered Environment for Algebra-based Physics (LEAP)	3–2628
1–5 p.m.	W36	Potpourri of Physics Simulations	3–2011
1–5 p.m.	W37	Reaching, Teaching, and Keeping Underrepresented Groups	8–246
1–5 p.m.	W38	Sweet Labs in Physics and Optics With Candy Glass	3–2016
1–5 p.m.	W39	Video Resource for Learning Assistant Development	3–2615
5–6 p.m.		Section Officers Exchange	204
5–6 p.m.		Programs Committee I	200AB
5:30–7:30 p.m.		High School Share-a-Thon	200C
5:30–7:30 p.m.		**REGISTRATION**	**North Lobby**
6–7:30 p.m.		Section Representatives	204
6–7:30 p.m.		Committee on Physics in Two-Year Colleges	100B

6–7:30 p.m.		Committee on the History & Philosophy of Physics	107A
6–7:30 p.m.		Committee on Apparatus	107B
6–7:30 p.m.		Committee on Women in Physics	107C
6–7:30 p.m.		Committee on SI Units and Metric Education	104A
7:30–9:30 p.m.		**Exhibit Hall Opens / Welcome Reception**	Exhbit Hall B
7:30–9:30 p.m.		SPS Undergraduate Research and Outreach Poster Reception	Exhibit Hall Foyer

MONDAY, Feb. 6

7 a.m.–5 p.m.		**Registration**	**North Loby**
7–8 a.m.		First Timers' Gathering	Exhibit Hall B
7–8 a.m.		Retired Physicists' Breakfast (ticket required)	104A
7–8 a.m.		TYC Breakfast (ticket required)	100B
8–9 a.m.		Poster Session I Setup	Ballroom A
8–10 a.m.	AA	Heliophysics	106
8–9:30 a.m.	AB	Task Force on Teacher Preparation in Physics	103
8–10 a.m.	AC	Integrating Math & Science to Prepare Pre-College Teachers	204
9–9:50 a.m.	AD	PER: Investigating Classroom Strategies	104B
8–10 a.m.	AE	Animation Physics in Hollywood	203C
8–8:30 a.m.	AF	DIY Technology for the Physics Classroom	203AB
8–9:20 a.m.	AG	Wave Nature of Matter	200C
8–9:20 a.m.	AH	Overview of High School Physics in the U.S.	200AB
9–9:50 a.m.	AI	Pre High School	202AB
10–10:15 a.m.		Raffle for One Night Anywhere in the Continental U.S. at Hilton Hotel	**Exhibit Hall B**
10–11 a.m.	**CW05**	Free Commercial Workshop: **Pearson** author Paul Hewitt	200AB
10 a.m.–2 p.m.		Spouse/Guest Event - Victoria Gardens Shopping Trip	offsite
10 a.m.–6 p.m.		**Exhibit Hall Open (coffee break, 10–10:30 a.m.)**	**Exhibit Hall B**
10:30–11:30 a.m.	**Plenary**	**"Waves in Animation" Ron Henderson**	**Ballroom C**
11:30 a.m.–12:30 p.m.	**CW06**	Free Commercial Workshop: **Pearson** author Randy Knight	200AB
11:45 a.m.–12:45 p.m.		Young Physicists' Meet and Greet	100B
11:45 a.m.–12:45 p.m.	Ckrbrl-01	Crackerbarrel for Physics Education Researchers	104B
11:45 a.m.–12:45 p.m.	Ckrbrl-02	Crackerbarrel: Planning the Next Two-Year College Tandem Meeting	106
11:45 a.m.–12:45 p.m.	Ckrbrl-03	Crackerbarrel: Physics and Society	203C
11:45 a.m.–12:45 p.m.	**CW01**	Free Commercial Workshop: **Expert TA**	201AB
11:45 a.m.–12:45 p.m.	**CW03**	Free Commercial Workshop: **Oceanside Photo and Telescope I**	103
11:45 a.m.–1 p.m.		Membership and Benefits Committee	101
11:45 a.m.–1:15 p.m.		Committee on Science Education for the Public	107C
11:45 a.m.–1:15 p.m.		Committee on Educational Technologies	107B
11:45 a.m.–1:15 p.m.		Committee on Teacher Preparation	105
11:45 a.m.–1:15 p.m.		Committee on Minorities in Physics	107A
11:45 a.m.–1:15 p.m.		Committee on International Physics Education	205
12:30 p.m.–12:45 p.m.		**Monday Kindle Drawing**	Exhibit Hall B
12:45–2:35 p.m.	BA	Astronomy Research at the Small Observatory	203AB
12:45–2:15 p.m.	BB	Physics Education Research Around the World	203C
12:45–2:15 p.m.	BC	Best Practices for Outreach to Elementary or Middle School Teachers	103
12:45–2:25 p.m.	BD	Online Physics Courses: Technology, Assessment, Experiences	106
12:45–2:15 p.m.	BE	Physics First	200C
12:45–1:55 p.m.	BF	Physics by the #s: Mobile Communications in the Classroom (Including Diversity)	204
12:45–2:35 p.m.	BG	How I Use Popular Media In Teaching Physics	200AB
12:45–2:05 p.m.	BH	Methods of Teacher Evaluation	104B
12:45–2:15 p.m.	BI	SPS Undergraduate Research and Outreach	202AB
3–4:30 p.m.		**Awards Ceremony: Oersted Medal, DSCs, SPS Chapter**	**Ballroom C**
4:30–6 p.m.		Awards Committee	101
4:30–6 p.m.		Committee on Laboratories	107A
4:30–6 p.m.		Committee on Professional Concerns	107B
4:30–6 p.m.		Committee on Physics in Undergraduate Education	107C
4:30–6 p.m.		Committee on Physics in High Schools	205
4:30–5 p.m.		**Afternoon Break in Exhibit Hall**	Exhibit Hall B
4::30–5:30 p.m.		PER Town Hall Meeting	104B
6–7 p.m.	CA	Frontiers in Space Exploration	202AB
6–7:10 p.m.	CB	Teaching Physics Around the World	200C

6–7 p.m.	CC	AP Physics B	106
6–7:30 p.m.	CE	Best Practices in the Use of Educational Technologies	204
6–7:10 p.m.	CF	Physics and Society Education	200AB
6–7:30 p.m.	CG	Undergraduate Research and Two-Year Colleges	103
6–7:30 p.m.	CH	Teaching Methods for Physics Teacher Preparation	203AB
6–7 p.m.	CI	Teaching Across the Science Curricula: Engaging Students in Physics Curricula	104B
7–8 p.m.		SPS Undergraduate Awards Reception	201AB
7:30–9 p.m.		Poster Session I	Ballroom A
8:15–9:30 p.m.		AAPT Council Meeting	Ballroom B

TUESDAY, Feb. 7

6:15–7:45 a.m.		Semi-annual AAPT Fun Run/Walk	DoubleTree Lobby
7–8 a.m.		Physics Bowl Advisory Committee	205
7–8 a.m.		PTRA Advisory Committee	101
7–8 a.m.		PERLOC	107A
7–8 a.m.		Review Board I	107C
7 a.m.–4:30 p.m.		**Registration**	**North Lobby**
8–9 a.m.		Poster Session II Setup	Ballroom A
8–9:20 a.m.	DA	Using the Riches of Astronomy to Teach Physics	103
8–9:20 a.m.	DB	Professional Exchanges for Physics Teachers at the College and Pre-college Levels	106
8–9 a.m.	DC	PER: Topical Understanding and Attitudes	104B
8–9:10 a.m.	DD	Wave Nature of Matter Part II	200C
8–9:30 a.m.	DE	Physics on Parade	202AB
8–9:10 a.m.	DF	Teaching Science Writing/Writing in Science	203C
8–9:30 a.m.	DG	Supporting Emergency Professional Development	203AB
8–9:30 a.m.	DI	*Panel:* What Is the Point of the Instructional Lab?	204
9:40-10:40 a.m.	**Awards**	**Richtmyer Memorial Lecture Award: *Brian Greene***	**Ballroom C**
10 a.m.–4 p.m.		**Exhibit Hall Open (coffee break 10:40–11:10 a.m.)**	**Exhibit Hall B**
11 a.m.–12 p.m.		**Book Signing by Brian Greene,** *Hidden Reality*	AAPT Booth
11:10 a.m.–12:10 p.m.	**Awards**	**J.D. Jackson Excellence in Graduate Physics Education: *Kip Thorne***	**Ballroom C**
12:15–1:15 p.m.	Crkrbrl-04	Crackerbarrel for PER Graduate Students	106
12:15–1:15 p.m.	Crkrbrl-05	Crackerbarrel: Future Directions of the Committee on Physics in Two-Year Colleges	204
12:15–1:15 p.m.	Crkrbrl-06	Crackerbarrel on The Physics Educator	203C
12:15–1:15 p.m.		Multicultural Luncheon (ticket required)	100B
12:15–1:15 p.m.	**CW02**	Free Commercial Workshop: Engaging Students through Online Interactive Learning	201AB
12:15–1:15 p.m.	**CW04**	Free Commercial Workshop: **Oceanside Photo and Telescope II**	103
12:15–1:15 p.m.		New Faculty Reunion	101
12:15–1:15 p.m.		Audit Committee	205
12:15–1:15 p.m.		Bauder Endowment Committee	107A
12:30–1:30 p.m.		**Book Signing by Kip Thorne,** *Black Holes* and *Future of Spacetime*	AAPT Booth
12:45 p.m.–1 p.m.		**Tuesday Kindle Drawing**	Exhibit Hall B
1:15–3:15 p.m.	EA	PER Graduate Student Curriculum Beyond the Core Courses	104B
1:15–2:45 p.m.	EB	Teaching with Technology	203C
1:15–2:55 p.m.	EC	Best Practices for Increasing the Numbers of Women in Physics	200C
1:15–3:05 p.m.	ED	Student Understanding of Concepts that Underlie Astronomical Data and Models	204
1:15–2:45 p.m.	EE	SPIN-UP Ten Years Later	106
1:15–2:55 p.m.	EF	Teacher Preparation Around the World	103
1:15–2:55 p.m.	EG	PER: Student Reasoning	200AB
1:15–1:45 p.m.	EH	Physics of Games, Animations and Game Interfaces	202AB
1:15–2:45 p.m.	EI	Effective Practices in the Instructional Laboratory	203AB
2–2:40 p.m.	EJ	Mentoring: Stories and Strategies	202AB
3:15–3:45 p.m.		**Exhibit Hall: Afternoon Coffee Break**	Exhibit Hall B
3:45–5:20 p.m.		**AAPT Symposium on Physics Education Research and Public Policy**	Ballroom C
5:30–7 p.m.		Committee on Research in Physics Education	105
5:30–7 p.m.		Committee on Physics in Pre-High School Education	107A
5:30–7 p.m.		Committee on Graduate Education in Physics	107B
5:30–7 p.m.		Committee on Space Science and Astronomy	104A
5:30–7 p.m.		Committee on the Interests of Senior Physicists	205
5:30–7 p.m.		PIRA	107C
6–7 p.m.		**Out-Laws of Physics** performance	Ballroom B
7:30–9 p.m.		Poster Session II	Ballroom A

WEDNESDAY, Feb. 8

7–8 a.m.		Yoga Class	104A
7–8:20 a.m.		Programs Committee II	100B
7–8:20 a.m.		Lotze Scholarship Committee	205
8 a.m.–3 p.m.		**REGISTRATION**	**North Lobby**
8 a.m.–5 p.m.		SOFIA Tour (NASA's Stratospheric Observatory for Infrared Astronomy)	offsite
8–9 a.m.	FA	New Results in Astronomy Education Research	106
8–9:40 a.m.	FB	Implementing Matter and Interactions and Six Ideas that Shaped Physics	103
8–9 a.m.	FC	Computational and Online Tools for Teaching Physics	200C
8:30–10 a.m.	FD	Introductory Physics Courses	202AB
8–9:20 a.m.	FE	Upper Division Physics	104B
8–9:50 a.m.	FF	Pseudoscience	204
9–10 a.m.	FG	Interactive Lecture Demonstrations: Physics Suite Materials	203AB
8–10 a.m.	FH	*Panel:* Two-Year College Guidelines	203C
8–10 a.m.	FI	Reforming the Introductory Physics Course for Life Science Majors VI	200AB
9 a.m. –12 p.m.		SEES Program–for elementary school children	Ballroom A
10–10:30 a.m.		Summer Meeting 2012 – Philadelphia Kick-off	Registration area
10:30–11:30 a.m.	**Plenary**	***Richard Muller* – Real World Problems: Physics for Presidents**	Ballroom C
11:30 a.m.–12:30 p.m.	Crkbrl-07	Crackerbarrel: Teaching Physics with "Real World" Problems	204
11:30 a.m–12:30 p.m.		ALPhA Meeting	101
11:30 a.m.–12:30 p.m.		Governance Structure Committee (COGS)	107C
11:30 a.m.–12:30 p.m.		Nominating Committee II	205
12:30–1 p.m.		AAPT Ceremonial Session	Ballroom C
1–1:50 p.m.	GA	Unusual Uses of Video Analysis in the Classroom	106
1–2:30 p.m.	GB	Learning From Research in Museums, Media, and Other Informal Environments	200C
1–2 p.m.	GC	The Search for Dark Matter	103
1–2:20 p.m.	GD	Teaching Methods for Physics Teacher Preparation II	203C
1–2:30 p.m.	GE	Physics of Everyday Devices	200AB
1–2:30 p.m.	GF	PER: Student Reasoning and Problem Solving	202AB
1–1:30 p.m.	GG	Post Deadline	203AB
1–3 p.m.	GH	*Panel:* Report on IUPAP International Conference on Women in Physics	104B
3–3:30 p.m.		Great Book Giveaway	Registration area
3–4 p.m.		Venture Fund Review Committee	205

Special Events at AAPT Winter Meeting

Saturday, Feb. 4

Wine Country Tour

10 a.m to 5:30 p.m. $95

This wine country tour in Temecula offers an insider's view of Southern California Wine Country. Enjoy this very carefree and relaxing day on an all inclusive tour of four wineries, behind the scenes tour of a winery and lunch. Must be 21 to attend. (meet at Convention Center)

E. Leonard Jossem Dinner

5:30 to 7:30 p.m. $150
Room: Ballroom A

Pre-registration was required.

Join us for an elegant reception and dinner in h. of the life and legacy of Len Jossem, one of the prime international leaders in physics education. The net proceeds from this event will benefit the E. Leonard (Len) Jossem International Education Fund.

TYC Tandem Meeting

9 a.m. to 4:45 p.m. $25

This meeting will be held at Mount San Antonio College. Transportation will be provided

Sunday, Feb. 5

Exhibit Show/ Welcome Reception

7:30 to 9:30 p.m. No Fee
Exhibit Hall B

Browse the Exhibit Hall and see what's new in the physics teaching world. Purchase a raffle ticket for a Kindle (at the AAPT Registration Desk). There will be two drawings, one Monday and one Tuesday.

Hall is also open Monday and Tuesday, beginning at 10 a.m.

Monday, Feb. 6

1st Timers' Gathering

7:00 to 8:00 a.m. No Fee
Room: Exhibit Hall B

Are you new to an AAPT National Meeting? If so, this is the best time to learn about AAPT and the Winter Meeting, as well as meet fellow attendees. See all the Exhibits, as well as learn about ways to get more involved with AAPT.

TYC Breakfast

7:00 to 8:00 a.m. $25
Room: 100B

Two Year College staff begin their day by breaking bread and sharing ideas.

Retired Physicists' Breakfast

7:00 to 8:00 a.m. $25
Room: 104A

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

Spouse/ Guest Event

10 a.m. to 2 p.m. $7
Offsite

This is a special shopping trip for spouses/guests of attendees only. Visit Victoria Gardens, a pedestrian oriented, open-air shopping mall in Rancho Cucamonga, CA. The bus will leave from the Double Tree hotel and lunch is on your own.

Young Physicists' Meet & Greet

11:45 a.m. to 12:45 p.m. No Fee
Room: 100B

Mix and mingle with other young physicists.

Kindle raffle drawing

Exhibit Hall at 12:30 p.m.

Hilton Hotel raffle drawing

Exhibit Hall at 10 a.m.

Tuesday, Feb. 7

AAPT Fun Run/Walk

6:15 to 7:45 a.m. $20

Semi Annual AAPT Fun Run—Meet in the lobby of the Double-Tree Hotel at 6:15 a.m. Water will be provided. The $20 donation will benefit AAPT's programs. Participants will receive a t-shirt.

Kindle raffle drawing

Exhibit Hall at 12:45 p.m.

Multicultural Luncheon

12:15 to 1:15 p.m. $35
Room: 100B

Increase awareness and understanding while sharing and celebrating unique perspectives.

Out-Laws of Physics Show

6 to 7 p.m. $20
Room: Ballroom B

AAPT fundraiser will feature a lively five-person band formed in November 2003 by members of the Physics Department at Cal Poly Pomona. (Jolene Houser, John Mallinckrodt, John Jewett, Harvey Leff and John Hadden)

Wednesday, Feb. 8

SOFIA Tour

8 a.m. to 3 p.m. $30

Pre-registration was required.

Science in the Stratosphere: Tour of NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA). NASA's SOFIA is an airborne observatory built into a 747 that carries a 100" telescope to the stratosphere to perform infrared astronomy.

Yoga Class

7 to 8 a.m. $20
Room: 104A

Committee Meetings

All interested attendees are invited and encouraged to attend the Committee meetings with asterisks (*).

Saturday, Feb. 4

New Area Chairs Orientation	3:30–5:30 p.m.	100B
New Board Members Orientation	4:30–5:30 p.m.	101
Executive Board I	7:30–10 p.m.	101

Sunday, Feb. 5

Publications Committee	7:30–10 a.m.	107A
Meetings Committee	8–9:45 a.m.	107C
Nominating Committee	10–11 a.m.	107B
Executive Board II	10 a.m.–5 p.m.	101
Resource Letters Committee	11:30 a.m.–2:30 p.m.	107C
Programs Committee I	5–6 p.m.	200AB
Section Officers Exchange	5-6 pm	204
Committee on Physics in Two-Year Colleges*	6–7:30 p.m.	100B
Committee on the History & Philosophy of Physics*	6–7:30 p.m.	107A
Committee on Apparatus*	6–7:30 p.m.	107B
Section Officers	6-7:30 p.m	204
Committee on Women in Physics*	6–7:30 p.m.	107C
Committee on SI Units and Metric Education*	6–7:30 p.m.	104A

Monday, Feb. 6

Membership and Benefits Committee	11:45 a.m.–1 p.m.	101
Committee on Science Education for the Public*	11:45 a.m.–1:15 p.m.	107C
Committee on Educational Technologies*	11:45 a.m.–1:15 p.m.	107B
Committee on Teacher Preparation*	11:45 a.m.–1:15 p.m.	105
Committee on Minorities in Physics*	11:45 a.m.–1:15 p.m.	107A
Committee on International Physics Education*	11:45 a.m.–1:15 p.m.	205
Awards Committee	4:30–6 p.m.	101
Committee on Laboratories*	4:30–6 p.m.	107A
Committee on Professional Concerns*	4:30–6 p.m.	107B
Committee on Physics in Undergraduate Education*	4:30–6 p.m.	107C
Committee on Physics in High Schools*	4:30–6 p.m.	205
AAPT Council Meeting*	8:15–9:30 p.m.	Ballroom B

Tuesday, Feb. 7

Review Board	7–8 a.m.	107C
Physics Bowl Advisory Committee	7–8 a.m.	205
PTRA Advisory Committee	7–8 a.m.	101
PERLOC	7–8 a.m.	107A
Audit Committee	12:15–1:15 p.m.	205
Bauder Endowment Committee	12:15–1:15 p.m.	107A
Committee on Research in Physics Education*	5:30–7 p.m.	105
Committee on Physics in Pre-High School Education*	5:30–7 p.m.	107A
Committee on Graduate Education in Physics*	5:30–7 p.m.	107B
Committee on Space Science and Astronomy*	5:30–7 p.m.	104A
Committee on the Interests of Senior Physicists*	5:30–7 p.m.	205
PIRA*	5:30–7 p.m.	107C

Wednesday, Feb. 8

Programs Committee II	7–8:20 a.m.	100B
Lotze Scholarship Committee	7–8:20 a.m.	205
ALPhA Meeting*	11:30 a.m–12:30 p.m.	101
Governance Structure Committee (COGS)	11:30 a.m.–12:30 p.m.	107C
Nominating Committee II	11:30 a.m.–12:30 p.m.	205
Venture Fund Review Committee	3–4 p.m.	205

Brian Greene
Columbia University
Mathematics & Physics
Department
New York City

Tuesday, Feb. 7
9:40 a.m.
Ballroom C

Cosmology, Dark Energy and String Theory

Brian Greene will be available for signing his book, The Hidden Reality, *following the lecture.*
11 a.m.–12 noon
at the AAPT Booth
in the Exhibit Hall

Richtmyer Memorial Lecture Award

The Richtmyer Memorial Lecture Award for 2012 is presented to **Brian Greene** for his outstanding contributions to physics and his abilities to communicate those contributions effectively to audiences of all types and at all levels. His first book, *The Elegant Universe*, was a finalist for the Pulitzer Prize in General Nonfiction, sold more than a million copies worldwide, and served as the basis for a NOVA special that was nominated for three Emmy Awards and that won the Peabody Award and the French prix Jules Verne Award. His next book, *The Fabric of the Cosmos*, remained on the New York Times bestseller list for six months and was the subject of a four-part Nova TV series aired in the fall of 2011. His latest book, *The Hidden Reality*, explores the science of parallel universes and is also a New York Times bestseller. Dr. Greene is the co-founder of The World Science Festival, the nation's premier science celebration for the general public, which draws hundreds of thousands in live audiences and has been hailed by the New York Times as a "new cultural institution." He has several times been a guest on programs ranging from David Letterman to Charlie Rose, and his children's story, *Icarus at the Edge of Time*, has been adapted for live symphonic presentation, with orchestral score by Philip Glass, and premiered at Lincoln Center. Beth Cunningham, AAPT Executive Officer, said that Dr. Greene "is a perfect fit for the Richtmyer Award. He is an outstanding physicist who is also an accomplished writer and communicator with the ability to explain his work and engage the public."

Dr. Greene graduated from Harvard University where he majored in physics before attending Oxford University as a Rhodes Scholar. After completing his doctorate in 1990, he joined the Cornell University physics faculty. In 1996 he became a professor of physics and mathematics at Columbia University. Widely recognized for his ground-breaking discoveries in the field of superstring theory, Greene is co-founder and director of Columbia's Institute for Strings, Cosmology, and Astroparticle Physics. In accepting the award, Dr. Greene stated, "I am thrilled to receive the Richtmyer Award, an h. that spans my two passions—pushing the boundaries of fundamental science and helping to spark the public's enthusiasm for science."

Established in 1941 and named in memory of Floyd K. Richtmyer, distinguished physicist, teacher, and administrator, one of the founders of AAPT, and an early AAPT president, the Richtmyer Memorial Lecture Award is presented annually to a person who has made outstanding contributions to physics and effectively communicated those contributions to physics educators.

Kip Thorne
California Institute of
Technology
Pasadena, CA

Tuesday, Feb. 7
11:10 a.m.
Ballroom C

Black-Hole Research: A New Golden Age

Kip Thorne will be available for signing his books, Black Holes & Time Warps *and* Future of Spacetime, *following the lecture.*
12:30–1:30 p.m.
at the AAPT Booth
in the Exhibit Hall

The John David Jackson Award for Excellence in Graduate Physics Education

The 2012 John David Jackson Award for Excellence in Graduate Physics Education is presented to **Kip Thorne** in recognition of his career-long concern for and attention to quality education at the graduate level. With John A. Wheeler and Charles W. Misner, Dr. Thorne co-authored the textbook *Gravitation* (1973), from which most of the present generation of scientists have learned general relativity. He is also a co-author of *Gravitation Theory and Gravitational Collapse* (1965) and *Black Holes: The Membrane Paradigm* (1986), and the sole author of *Black Holes and Time Warps: Einstein's Outrageous Legacy* (1994). He is currently putting the finishing touches on a new textbook, co-authored with Roger Blandford, covering all the areas of classical physics that PhD students are often not exposed to, but should be: statistical physics, optics, elasticity, fluid dynamics, plasma physics, and general relativity.

Dr. Thorne has been mentor and thesis advisor for more than 50 PhD physicists who have become world leaders in their chosen fields of research and teaching. His students are unanimous in their appreciation of his attention to encouraging them, to teaching them to present their work to best effect in written and oral forms, and to teaching them to respect and make best use of collaborators and competitors. In 2004 his work was recognized with the Caltech Graduate Student Council Mentoring Award. In their group letter of nomination, his former students said, "We know of no one who has worked harder on his teaching and his textbooks, and with greater resulting effect, than our beloved teacher, Kip Thorne."

Dr. Thorne received his BS degree from Caltech and his PhD from Princeton University. After two years of postdoctoral study, he returned to Caltech in 1967, was promoted to Professor of Theoretical Physics in 1970, and became The William R. Kenan, Jr., Professor in 1981 and The Feynman Professor of Theoretical Physics in 1991. His research has focused on gravitation and astrophysics, with emphasis on relativistic stars, black holes, and gravitational waves. He is a co-founder (with Rainer Weiss and Ronald Drever) of the Laser Interferometer Gravitational-Wave Observatory Project (LIGO), and his research group has provided theoretical support for LIGO by identifying promising gravitational wave sources, laying foundations for techniques for combing data in search of gravitational waves, designing baffles to control scattered light in the LIGO beam tubes, and, in collaboration with Vladimir Braginsky's (Moscow, Russia) research group, inventing quantum-nondemolition designs for advanced gravity-wave detectors. In June 2009, he retired from teaching in order to ramp up a new career in writing, movies, and continued scientific research. He is widely recognized as one of the handful of people who have had the greatest influence on the field of General Relativity over the past four decades.

Named in honor of outstanding physicist and teacher, John David Jackson, this award recognizes physicists and physics educators who, like John David Jackson, have made outstanding contributions to curriculum development, mentorship, or classroom teaching in graduate physics education.

Oersted Medal

The Oersted Medal for 2012 is presented to **Charles H. Holbrow** who, during a career spanning more than forty years, has made numerous innovative contributions to physics education and physics research. Among his more significant efforts on behalf of physics teaching, he and his Colgate colleagues, James Lloyd and Joseph Amato and, more recently, Enrique Galvez, and Beth Parks, have worked to revitalize the introductory physics curriculum by replacing the time-h.ed chronological approach with an approach emphasizing atoms, non-Newtonian topics, and twentieth-century physics. First published in 1999, the second edition of their textbook, *Modern Introductory Physics*, appeared in 2010.

Beyond his teaching and mentoring of students, Dr. Holbrow's interests in physics pedagogy, physics research, and history of physics have resulted in many talks at AAPT and other meetings and many articles in *Physics Today*, *American Journal of Physics*, *Physical Review Letters*, *Physical Review*, and other journals. He has served as a member of the Steering Committee of "The Research Physicist in Undergraduate Curriculum Development: A Joint Program of the APS and the AAPT." He has been a member of the APS Forum on the History of Physics, the APS Committee on Education, the Board of Directors of AIP, the AIP Liaison and Advisory Committee on Public Policy, and the *Physics Today* advisory committee. In 2009, he received an AAPT Distinguished Service Citation in recognition of his contributions as a physics teacher, textbook author, nuclear physics researcher, and physics historian as well as his service as Associate Editor of *Physics Today*, AAPT President, AAPT Senior Staff Physicist, and AAPT Executive Officer. He is currently a member of AAPT's Finance Committee and Co-chair of the 2012 Gordon Research Conference–Physics Research and Education: "Astronomy's Discoveries and Physics Education."

Dr. Holbrow earned his BA in history at the University of Wisconsin–Madison in 1955. Following the receipt of an AM in History and a Certificate of the Russian Institute from Columbia University, he earned his MS (1960) and PhD (1963) in physics from the University of Wisconsin. He began his teaching career at Haverford in 1962, moved to a research position at the University of Pennsylvania in 1965, and became Associate Editor of *Physics Today* in 1966. In 1967, he joined the Department of Physics and Astronomy at Colgate University, becoming Charles A. Dana Professor of Physics by the time of his retirement in 2003. Along the way, he served Colgate as Associate Director (1968) and Director (1972) of the Computer Center, Chairman of the Department of Physics and Astronomy (1970–72; 1977–80; 1982–84), Director of Institutional Research (1972), and Director of the Division of Mathematics and Natural Sciences (1985–1988). During his career, he has held short-term teaching and/or research appointments at Stanford, CalTech, the University of Wisconsin, Cornell, Brookhaven National Laboratory, SUNY–Stony Brook, MIT, Harvard (in history), Gesellschaft für Schwerionenforschung, and the University of Vienna. Since his retirement, he has held visiting positions at MIT and Harvard.

Established in 1936, the Oersted Medal h.ing the Danish physicist Hans Christian Oersted (1777-1851) is presented annually to a person who has had outstanding, widespread, and lasting impact on the teaching of physics.

Charles H. Holbrow
Massachusetts Institute of Technology
Dept. of Physics
Cambridge, MA

Monday, Feb. 6
3 p.m.
Ballroom C

Making Physics Make Sense – Narratives, Content, Witz

SPS Chapter Advisor Award

The SPS Chapter Advisor Award for 2010-2011 is Dr. Brent Hoffmeister, associate professor and department chair of physics, Rhodes College, Memphis, TN. He received his PhD in physics from Washington University in St. Louis in 1995. He joined Rhodes College in 1996 and quickly revived their dormant SPS chapter. He has served as SPS advisor ever since. His chapter has been named an Outstanding Chapter for the last 13 years, in part for its creative outreach efforts to the Memphis community. Student leadership in the Rhodes Chapter includes an Outreach Officer who coordinates many of their activities. In addition, the Physics Department at Rhodes offers a course called "Memphysics" where students can earn academic credit for their community outreach activities. His chapter has received multiple awards including the Blake Lilly Prize, the Marsh White Award and several SPS Leadership Scholarships. One of the many students who wrote letters nominating him for this award wrote, "During my second week as a freshman at Rhodes…I walk[ed] into the office to see Brent [Hoffmeister], who turns and greets me, then says, 'I'm looking for a team of students to do another microgravity experiment and I think you would be perfect for the job. Would you like to join?'…I would not be where I am today without Brent."

Brent Hoffmeister
Rhodes College
Physics Department
Memphis, TN

Awards nominations are accepted online at http://www.aapt.org/Programs/awards/

Monday, Feb. 6, 3–4:30 p.m. • Ballroom C

Elizabeth Chesick

Elizabeth Chesick

A member of AAPT since 1959, **Elizabeth Chesick** is presented with a 2012 Distinguished Service Citation in recognition of her service as Section Representative, Vice President, and President of the Southeastern Pennsylvania Section of AAPT, as a member over the years of ten different AAPT Area and Advisory Committees and as chair of two of those Area Committees, as a Physics Teacher Resource Agent (PTRA) at the inception of the program, as an official AAPT delegate to the 1986 International Conference on Physics Education in Tokyo and to the US/Japan/China Conferences on Physics Education in 1989, 1991, and 1993, and as a co-author of the AAPT publication titled "The Role, Education, Qualifications, and Professional Development of Secondary School Physics Teachers." In 2008 she was elected as the High School Member-at-Large of the AAPT Executive Board, serving until the end of her three-year term in 2011.

Ms. Chesick earned her BA in physics at Wellesley College and her MS in physics at Tufts University, specializing in high energy and particle physics, before taking a position as Physics and Geometry Teacher at Day Prospect Hill School in New Haven, CT. In 1963 she moved to The Baldwin School in Bryn Mawr, where she taught Physics and Physical Science and ended her professional career as Chair of the Science Department. Her expertise as a teacher has been recognized with the Presidential Award for Excellence in Science and Math Teaching for Pennsylvania (1988) and the Rosamond Cross Chair for Excellence in Teaching (The Baldwin School, 1997).

Peter Hopkinson

Peter Hopkinson

A member of AAPT since 1982, Peter Hopkinson is presented with a 2012 Distinguished Service Citation in recognition of his many years of service as Board Member and officer of and Section Representative for the British Columbia Section of AAPT and his role on the AAPT Nominating Committee. Since the 1980s, he has presented numerous talks and demo shows, outreach events, and crackerbarrel contributions in British Columbia and Alberta, throughout the United States, and at national AAPT meetings. He is a long-time strong supporter of and contributor to AAPT and BCAPT, an exceptional physics teacher, an ambassador for physics and science outreach, and a mentor and role model for hundreds of middle school, high school and university/college physics teachers and students across North America. Mr. Hopkinson grew up in England and, in 1972, received a Teaching Certificate with majors in physics and drama from The College of the Venerable Bede (a teacher training school) at the University of Durham. After teaching for a few years at International schools in Istanbul, Algiers, Santo Domingo, and other places, he moved to Canada where he received BEd and MSc degrees from Simon Fraser University in Burnaby, British Columbia. He received the 2002-03 Award for Teaching Excellence from the Association of Canadian Community Colleges. The bulk of his career was spent teaching at Vancouver Community College in British Columbia, from which he retired in 2008.

Jan Tobochnik

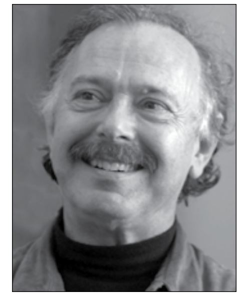
Jan Tobochnik

A member of AAPT since 1987, **Jan Tobochnik** is presented with a 2012 Distinguished Service Citation in recognition of his outstanding decade-long service to AAPT as editor of the *American Journal of Physics* (*AJP*). Besides maintaining the high quality of AJP, he has worked to bring it into the electronic age with a totally electronic submission and reviewing process and has implemented a number of enhancements, including color online figures without author charges, online animations, color figures on the cover, and incorporation of the PER section. During his time as editor of *AJP*, he served *ex officio* on the AAPT Executive Board and as a member both of the AAPT Publications Committee and the AIP Committee on Publishing. Just before assuming the editorship of *AJP*, he and Harvey Gould co-organized and co-chaired the first Gordon Research Conference on "Physics Research and Education (Focus on Thermal and Statistical Physics)," which took place in June 2000.

Dr. Tobochnik holds a BA degree in physics from Amherst College and a PhD in theoretical condensed matter physics from Cornell University. He was a post-doc at Rutgers University, and held visiting scientist positions at IBM-Yorktown Heights, at the Center for Polymer Studies at Boston University, at the Center for Fundamental Materials Research at Michigan State University, and at McGill University. He has held faculty positions at Worcester Polytechnic Institute and Clark University. Since 1985 he has been at Kalamazoo College in Kalamazoo, Michigan, where he is currently Professor of Physics and Computer Science and the Dow Distinguished Professor of Natural Science.

Established in 1953, Distinguished Service Citations are presented to AAPT members in recognition of their exceptional contributions to AAPT at the national, sectional, or local level.

Physics for Future Presidents: Inspiring the non-science student by emphasizing issues of international importance


Richard A. Muller

Wednesday, Feb. 8, 10:30–11:30 a.m. • Ballroom C

Richard A. Muller received his AB degree from Columbia University, and his PhD at Berkeley working under Luis Alvarez. He has been on the faculty at University of California Berkeley since 1978. He is a fellow of the APS and of the AAAS, and his awards include the Texas Instruments Founders Prize, the NSF Alan T. Waterman Award, and a MacArthur Foundation Prize Fellowship.

DreamWorks Studios "Waves in Animation"


Ron Henderson

Monday, Feb. 6, 10:30–11:30 a.m. • Ballroom C

Ron Henderson manages the FX Tools group at DreamWorks Animation, where he is responsible for developing physical simulation and procedural modeling tools. These systems have been used for key visual effects in recent films such as "Puss in Boots", "Megamind", and "How To Train Your Dragon." Prior to joining DreamWorks in 2002, he was a Senior Scientist at Caltech with a joint appointment to the Applied Math and Aeronautics departments where he worked on efficient techniques for the direct numerical simulation of fluid turbulence. He has a PhD in Mechanical and Aerospace Engineering from Princeton University, and a BS in Aeronautical and Astronautical Engineering from Purdue University.

Physics Education Research and Public Policy

SYMPOSIUM on Physics Education

Tuesday, Feb. 7, 3:45–5:20 p.m. • Ballroom C • Noah Finkelstein, moderator

>> Howard J. Gobstein, Executive Vice President, Research, Innovation and STEM Education, Association of Public and Land-grant Universities (APLU)


Howard Gobstein

Howard Gobstein initiated and co-directs the "Science and Mathematics Teacher Imperative," which strives to stimulate 125 member universities to prepare more, better and more diverse science and math teachers. He is the PI on several NSF and foundation grants under the auspices of the Teacher Imperative, totaling over $2.5 million. The most recent NSF grant, awarded in late 2011, is to improve math teacher preparation programs. Gobstein and his staff also are responsible for the APLU Council on Research Policy and Graduate Education and the APLU Commission on Innovation, Competitiveness and Economic Prosperity. Gobstein has been Associate VP, Michigan State University; Senior Policy Analyst, White House Office of Science and Technology Policy; VP, Association of American Universities (AAU); Director of Federal Relations for Research, University of Michigan and Sr. Science Policy Analyst with the U.S. GAO. His master's degree is in Science, Technology and Public Policy, George Washington University and a BS in Interdisciplinary Engineering from Purdue University. He is a Fellow of the American Association for the Advancement of Science (AAAS) and selected as outstanding alumni of Purdue's School of Engineering Education in 2010.

>> Helen R. Quinn, Stanford University


Helen R. Quinn

Helen Quinn is Professor Emerita of the Department of Particle Physics and Astrophysics at the SLAC National Accelerator Laboratory, and Co-chair of Stanford University's K12 Initiative. Dr. Quinn is a theoretical physicist who was inducted into the National Academy of Sciences (NAS) in 2003and holds numerous h.s, including the prestigious Dirac and Klein medals, for her research contributions. She has had a long term engagement in education issues and has worked at the local, state, and national level on them. Her interests range from science curriculum and standards to the preparation and continuing education of science teachers. She was an active contributor to the California State Science Standards development. Dr. Quinn served as a member on the National Research Council (NRC)'s Committee on Physics of the Universe and on the High Energy Physics 2010 panel, and was a member of the Particle Astrophysics group for the Astrophysics 2010 Panel. She is a member and former President of the American Physical Society. She received her PhD in physics from Stanford University in 1967. She currently chairs the Board on Science Education of the National Research Council and has served on a number of its studies, including "Taking Science to School" and a panel that reviewed NASA's K12 activities which she chaired. She also chaired of the NRC study committee that developed "A Framework for K-12 Science Education."

Pat Heller

>> Pat Heller, Associate Professor of Curriculum and Instruction at the University of Minnesota and a founding member of the Physics Education Research (PER) Group

Pat Heller has been at the forefront of Physics Education Research for most of her career, taking on problems and issues that later bloom into entire research areas. One example of this is her work with instructor beliefs. She recognized that no instructional change will happen unless the individual instructor believes in the value of the change. This means we need to know what instructors believe and how those beliefs can change. Her work on cooperative group problem solving has also been of great importance and has not only established a firm research base on the topic in university-level physics education, but she and her research group have created (and freely disseminated) materials that are widely used and have influenced many instructors to bring more group problem solving into their classrooms.

Building on her research, Heller has worked tirelessly to improve physics education at all levels. From a background that includes K-12 and university teaching, she took her experiences and her understanding of the education system to create curricula for elementary-school teachers, middle school students, college students, teaching assistants, and even college professors. She knows that change is slow and must come in steps, and has pushed the system to step slowly but surely towards improvement. She has also helped with K-12 reform by being a part of the group that created the science teaching licensure standards for Minnesota's Board of Teaching. In addition, Heller was a consultant to the American Association for the Advancement of Science national science standards, Benchmarks for Science Literacy (1985-1995), and a committee member for the College Board Science standards for College Success™ (2007-2008).

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Women in Physics: W19, W37, EJ, GH, EC

Free Commercial Workshops

CW01: Expert TA

Location: Room 201AB
Date: Monday, Feb. 6
Time: 11:45 a.m.–12:45 p.m.
Sponsor: Expert TA

Leader: Jeremy Morton

Expert TA is a commercial online homework and tutorial system for introductory-level physics courses. It was designed to grade problems the way instructors do; considering more than just a student's final answer. Solving physics problems involves numerous steps such as applying equations, drawing free-body diagrams, etc; to solve for numeric answers. Expert TA's problems are all multi-step and involve these aspects of problem solving. With a sophisticated math engine, Expert TA is able to grade student equations in detail, in a manner similar to how you or your TA would. It identifies detailed mistakes within equations, deducts points, and provides specific feedback. In Homework Mode, students are provided with a detailed grade report after the assignment due date. In Tutorial mode, students can access hints, and feedback is provided instantaneously. Expert TA has partnered with talented professors, leaders in physics education, to develop a rich library of original problems. Users of Expert TA have discovered the power of detailed/sophisticated grading over simple right vs. wrong grading. Instructors are provided with a much more accurate assessment of students' work and students are provided with the feedback required to help them master concepts. Join us and learn how Expert TA can help you and your students.

CW02: Engaging Your Physics Students through Online Interactive Learning!

Location: 201AB
Date: Tuesday, Feb. 7
Time: 12:15–1:15 p.m.
Sponsor: Perfection Learning

Leader: Ken Filbin

See the new comprehensive physics digital textbooks from Kinetic Books designed from the ground up to take maximum advantage of current technology. Through interactive activities, digital simulations, self assessment, and step-by-step problem solving support, Kinetic Books allow instructors and students to realize the promise of a digital learning environment today! Kinetic Books contain hundreds of interactive activities that bring concepts to life, digital simulations with step-by-step narrated instructions, and interactive problems throughout each chapter that provide real-time feedback.

CW03: OSIRIS-REx

Location: 103
Date: Monday, Feb. 6
Time: 11:45 a.m.–12:45 p.m.
Sponsor: Oceanside Photo and Telescope

Leader: Ralph Emerson

The OSIRIS-REx spacecraft will orbit and explore asteroid 1999 RQ36 for more than a year before closing in and collecting a sample of pristine organic material that may have seeded Earth with the building blocks that led to life. NASA has selected the University of Arizona to lead the sample-return mission. OPT is an official member of the University of Arizona OSIRIS-REx E/PO Team and is tasked specifically with administering an associated NASA Citizen Science project. The project's assignment is to gather data that will be used by the team for target analysis and selection. Please come to the workshop to learn how your school and students can participate in this exciting NASA mission.

CW04: Astronomy in Education

Location: 103
Date: Tuesday, Feb. 7
Time: 12:15–1:15 p.m.
Sponsor: Oceanside Photo and Telescope

Leader: Ralph Emerson

Amateur astronomy is one of the most exciting ways to stimulate interest in physics, math, and engineering. Colleges and K-12 schools are increasingly turning to astronomy in their pursuit of STEM goals. OPT has worked to support schools for over 30 years in this endeavor. Industry leading companies such as Meade Instruments have responded by providing EDU pricing support. Come to the workshop for Case Study presentations given by educators who are making it happen!

CW05: Pearson Workshop with Paul Hewitt

Location: 200AB
Date: Monday, Feb. 6
Time: 10–11 a.m.
Sponsor: Pearson

Leader: Paul Hewitt

Please join us for a discussion with Pearson author Paul Hewitt regarding his textbooks in conceptual physics, physical science and integrated science as well as MasteringPhysics.

CW06: Pearson Workshop with Randy Knight

Location: 200AB
Date: Monday, Feb. 6
Time: 11:30 a.m.–12:30 p.m.
Sponsor: Pearson

Leader: Randy Knight

Please join us for a discussion with Pearson author Randy Knight regarding his textbooks *Physics for Scientists and Engineers* Third Edition, and Knight, Jones, *Field College Physics Second Edition Technology Update* as well as MasteringPhysics.

AAPT Exhibitor Information

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- *Strange New Worlds,* Jayawardhana
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- *Statistical Mechanics in a Nutshell*, Peliti
- *Mathematical Modeling of Earth's Dynamical Systems*, Slingerland/Kump
- *Elementary Particle Physics in a Nutshell*, Tull

Doubleday:

- *Design in Nature: How the Constructual Law Governs Evolution in Biology, Physics, Technology and Social Organization*, Adrian Bejan/J. Peder Zane

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AAPT PHYSICS EDUCATION

Monday, Feb. 6, 2012– Session Schedule

Rooms are in Ontario Convention Center – Poster Session I is in Ballroom A, 7:30 to 9:00 p.m.

	Room 106	Room 103	Room 204	Room 104B	Room 203C	Room 203AB	Room 200C	Room 200AB	Room 202AB	Ballrrom C
8:00 a.m.	**AA** Heliophysics	**AB** Task Force on Teacher Preparation in Physics	**AC** Integrating Math & Science to Prepare Pre-College Teachers		**AE** Animation Physics in Hollywood	**AF** DIY Technology for the Physics Classroom	**AG** Wave Nature of Matter	**AH** Overview of High School Physics in the U.S.		
8:45 a.m.										
9:00 a.m.				**AD** PER: Investigating Classroom Strategies					**AI** Pre High School	
9:30 a.m.										
10:00 a.m.										
10:30 a.m.										**Plenary:** Ron Henderson
11:00 a.m.										
11:45 a.m.	**Crkrbrl 2** Planning The Next Two-Year College Tandem Meeting			**Crkrbrl 1** Crackerbarrel: Physics Education Researchers	**Crkrbrl 3** Physics and Society					
12:15 p.m.										
12:30 p.m.										
12:45 p.m.	**BD** Online Physics Courses: Technology, Assessment, Experiences	**BC** Outreach to Elementary or Middle School Teachers	**BF** Mobile Communications in the Classroom	**BH** Methods of Teacher Evaluation	**BB** Physics Education Research Around the World	**BA** Astronomy Research at the Small Observatory	**BE** Physics First	**BG** How I Use Popular Media In Teaching Physics	**BI** SPS Undergraduate Research and Outreach	
1:15 p.m.										
2:00 p.m.										
2:25 p.m.										
2:35 p.m.										
2:45 p.m.										
3:00 p.m.										**Awards:** –Oersted Medal –DSCs –SPS Chapter
3:30 p.m.										
4:30 p.m.										
6:00 p.m.	**CC** AP Physics B	**CG** Undergraduate Research and Two-Year Colleges	**CE** Best Practices in the Use of Educational Technologies	**CI** Teaching Across the Science Curricula		**CH** Teaching methods for physics teacher preparation	**CB** Teaching Physics Around the World	**CF** Physics and Society Education	**CA** Frontiers in Space Exploration	
6:30 p.m.										
7:00 p.m.										
7:30 p.m.										

Tuesday, Feb. 7, 2012– Session Schedule

Rooms are in Ontario Convention Center – Poster Session II is in Ballroom A, 7:30 to 9:00 p.m.

	Room 106	Room 103	Room 204	Room 104B	Room 203C	Room 203AB	Room 200C	Room 200AB	Room 202AB	Ballroom C
8:00 a.m.	**DB** Professional Exchanges for Physics Teachers	**DA** Using the Riches of Astronomy to Teach Physics	**DI** *Panel:* What Is the Point of the Instructional Lab?	**DC** PER: Topical Understanding and Attitudes	**DF** Teaching Science Writing	**DG** Supporting Emergency Professional Development	**DD** Wave Nature of Matter Part II		**DE** Physics on Parade	
8:45 a.m.										
9:00 a.m.										
9:30 a.m.										**Richtmyer Award:** Brian Greene
10:00 a.m.										
10:30 a.m.										
11:10 a.m.										**J.D. Jackson Award:** Kip Thorne
11:45 a.m.										
12:15 p.m.	**Crkrbrl 4** Crackerbarrel for PER Graduate Students		**Crkrbrl 5** Future Directions of the Committee on Physics in Two-Year Colleges		**Crkrbrl 6** The Physics Educator					
12:30 p.m.										
12:45 p.m.										
1:15 p.m.	**EE** SPIN-UP Ten Years Later	**EF** Teacher Preparation Around the World	**ED** Student Understanding of Concepts that Underlie the Interpretation of Astronomical Data and Models	**EA** *Panel:* PER Graduate Student Curriculum Beyond the Core Courses	**EB** Teaching with Technology	**EI** Effective Practices in the Instructional Laboratory	**EC** Best Practices for Increasing the Numbers of Women in Physics	**EG** PER: Student Reasoning	**EH** Physics of Games	
2:00 p.m.									**EJ** Mentoring: Stories and Strategies	
2:30 p.m.										
2:45 p.m.										
3:05 p.m.										
3:15 p.m.										
3:45 p.m.										**AAPT Symposium on Physics Education Policy**
4:30 p.m.										
5:00 p.m.										
5:20 p.m.										
6:00 p.m.										
6:30 p.m.										

Wednesday, Feb. 8, 2012– Session Schedule

Rooms are in Ontario Convention Center

	Room 106	Room 103	Room 204	Room 104B	Room 203C	Room 203AB	Room 200C	Room 200AB	Room 202AB	Ballroom C
8:00 a.m.	**FA** Astronomy Education Research	**FB** Implementing Matter and Interactions and Six Ideas that Shaped Physics	**FF** Pseudoscience	**FE** Upper Division Physics	**FH** *Panel:* Two-Year College Guidelines		**FC** Computational & Online Tools for Teaching Physics	**FI** Reforming the Introductory Physics Course for Life Science Majors VI		
8:30 a.m.									**FD** Introductory Physics Courses	
9:00 a.m.						**FG** Interactive Lecture Demonstrations				
9:40 a.m.										
10:00 a.m.										
10:30 a.m.										**Plenary:** Richard Muller
11:15 a.m.										
11:30 a.m.			**Crkrbrl 7** Teaching Physics with "Real World" Problems							
12:00 p.m.										
12:15 p.m.										
12:30 p.m.										
1:00 p.m.	**GA** Unusual Uses of Video Analysis in the Classroom	**GC** The Search for Dark Matter		**GH** *Panel:* Report on IUPAP International Conference on Women in Physics	**GD** Teaching Methods for Physics Teacher Preparation II	**GG** Post Deadline	**GB** Learning From Research in Museums, Media, & Other Environments	**GE** Physics of Everyday Devices	**GF** PER: Student Reasoning and Problem Solving	
1:30 p.m.										
2:00 p.m.										
2:30 p.m.										
3:00 p.m.										
3:15 p.m.										
3:45 p.m.										
4:30 p.m.										
5:00 p.m.										
5:20 p.m.										
6:00 p.m.										
6:30 p.m.										

Workshops – Saturday, Feb. 4

All workshops are held at California State Polytechnic University, Pomona. Shuttle buses will be available from the Convention Center —see page 6.

W06: Supernova Physics: Individualized Investigations Using DS9 and Chandra's Public Archives

Sponsor: Committee on Space Science and Astronomy
Time: 8 a.m.–12 p.m. Saturday
Member Price: $70 Non-Member Price: $95
Location: Bldg. 3–Room 2004

Donna Young, donna.young@tufts.edu

Doug Lombardi, Pamela Perry, Terry Matilsky

The Chandra X-ray mission has developed a set of investigations that utilize the ds9 image analysis software. Each one of the investigations introduces a unique ds9 analysis tool, including light curves and energy spectra, to study the physical processes of stellar evolution products such as supernova remnants, black holes and white dwarfs, and the interactions of colliding galaxies. More analysis tools can be learned through the Chandra Ed site through a set of guided activities and tutorials. The investigations are an application of several basic physics equations. This workshop expands from the introductory investigations and analysis tools to the next step of having students design their own research projects. Participants will learn how to access the Chandra archives and find objects to study with ds9 analysis tools. The software accepts any FITS file, so optical and other wavelength images can be imported into ds9 to compare with the X-ray data.

W07: IPAL In-Class Polling for All Learners

Sponsor: Committee on Educational Technologies
Co-sponsor: Committee on Apparatus
Time: 8 a.m.–12 p.m. Saturday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2016

William F. Junkin III, Eckerd College, St. Petersburg, FL 33711; junkinwf@eckerd.edu

Anne J. Cox

This workshop provides a hands-on experience to learn to use a new, free, open source in-class polling program. Through funding by the Bill Gates Foundation, a small stipend is available for those who try the program at their home institution. Participants must bring a laptop. The IPAL project allows students to use a mixture of clickers and web-enabled devices (laptops, iPads, cell phones) to respond to in-class polling through a Moodle module or a website for non-Moodle users. Only a browser is needed on instructors' and students' devices. IPAL provides peer-reviewed polling questions, including hundreds of ConcepTests used for Mazur's Peer Instruction. A searchable database at ComPADRE provides these questions, appropriate for the Introductory (or AP) Physics course. Instructors can create their own questions for any course. The workshop will also explore the pedagogy that this program enables, the greater student involvement and the feedback to instructors.

W09: Teaching & Learning Electromagnetism in Intro Phys

Sponsor: Committee on Research in Physics Education
Co-sponsor: Committee on International Physics Education
Time: 8 a.m.–12 p.m. Saturday
Member Price: $95 **Non-Member Price:** $120
Location: Bldg. 8–Room 210

Jenaro Guisasola, Escuela Universitaria Politecnica, San Sebastian, 20018 Spain; jenaro.guisasola@ehu.es

In this workshop we will discuss the impact of physics education research on electromagnetism in the educational designing and practice of physics teaching at the university level. Two of the presentations will be studies about students' difficulties in learning topics of electromagnetism such as electromotive force, electromagnetic induction or Faraday's law. It will present a study about the problems of teaching Maxwell equations in relation to cognitive theories. Finally, a study on developing students' mathematics' techniques involving the meaning of the physics concepts will be discussed.

W11: Make and Take Your Own Photogate/Lasergate

Sponsor: Committee on Laboratories
Co-sponsor: Committee on Physics in High Schools
Time: 8 a.m.–12 p.m. Saturday
Member Price: $130 **Non-Member Price:** $155
Location: Bldg. 3–Room 2011

Barbara Hoeling, California State Polytechnic Univ - Pomona; bmhoeling@csupomona.edu

Peter Siegel, Nina Abramzon and the Cal Poly Pomona Physics Department

This workshop is appropriate for high school teachers and college faculty who teach introductory physics laboratories. You will make your own laser gate and test it in different experiments, such as the Atwood machine, rotational dynamics, velocity measurements, and pendulum timing. The gate has an accuracy of 2 microseconds, is easy to build, and interfaces via USB to a computer. Each participant will take home the system he/she builds (an approximate value of $40). You may bring your own laptop (PC) for interfacing, or use one supplied by us.

W01: Cal Poly's Physics Lecture Demonstrations

Sponsor: Committee on Apparatus
Time: 8 a.m.–5 p.m. Saturday
Member Price: $165 **Non-Member Price:** $190
Location: Bldg. 8-Room 241

Doug Johnson, 5701 Anchorage Ave. Madison, WI 53705; djohnson44@ameritech.net

Annie Atiyeh, Jeff Cady, Gueorgui Gueorguiev, Anatol Hoemke, Angella Johnsonn, Hector Maciel, Martin Simon, Maria Vaughn

Cal Poly Pomona has over 600 physics lecture demonstrations to choose from for this workshop. We will show some of the most popular demos used on the university level. Unlike other workshops, we will have invited guests from the surrounding colleges and universities showing us some of their latest and greatest demonstrations as well. For those of you that are unable to make the summer lecture demonstration workshops, this will be something you will not want to miss!

W02: Graphing Analysis of Student Data With AP B Examples

Sponsor: Committee on Science Education for the Public
Co-sponsor: Committee on Apparatus
Time: 8 a.m.–5 p.m. Saturday
Member Price: $115 **Non-Member Price:** $140
Location: Bldg. 3-Room 2618

Jim Nelson, nelsonjh@ix.netcom.com

Dorrie Bright

The theme of this AAPT/PTRA workshop is a Generic 4-Step procedure for students to use for analyzing experimental data. During the workshop you will do several laboratory activities. For each activity you will measure, graph, and analyze the data. Graphing calculators will be provided; however, you are encouraged to bring your own calculator or computer with graphing software. The goal for each activity is to arrive at a general equation that summarizes the relationship between variables measured. The analysis will start simple and gradually build up to more complex analysis. A CD with notes and masters of each activity will be provided. Sample laboratory activities include: Speed of a Toy Car, Weight versus Mass, Hinged Mirrors, Density of a Solid, Planck's Constant, Wave Equation, Resonance of Sound, Free Fall Motion, Elastic Spring Energy, Frequency versus Period, and Thin Lens Equation. These activities are representative of typical laboratory activities done in introductory classes, but the generic 4-step analysis is appropriate for many laboratory activities.

W05: Physics by Design

Sponsor: Committee on Physics in Pre-High School Physics
Time: 8 a.m.–5 p.m. Saturday
Member Price: $125 **Non-Member Price:** $150
Location: Bldg. 3–Room 2628

Julia Olsen, University of Arizona, Tucson, AZ 85718 ; jkolsen@u.arizona.edu

What is understanding? What is the relationship between knowledge and understanding? What does "teaching for understanding" look like? Why is deeper understanding important in the current educational climate which emphasizes standardized assessments? These and other important questions will be explored as participants design, develop, and refine a cohesive unit plan based on the principles found in Understanding by Design (UbD). In the UbD classroom, there are high expectations and incentives for all students while exploration of big ideas and essential questions is differentiated, so students who are able delve more deeply into the subject matter than others. This workshop is appropriate for instructors from pre-high school through college levels. Participants will receive a copy of UbD, 2nd Ed. *Note:* Participants are strongly encouraged to bring their own laptops to the workshop, but a limited number of computers may be available. Please contact the organizer (jkolsen@u.arizona.edu) if you will need one.

T02: Teaching Statistical and Thermal Physics

Sponsor: Committee on Physics in Undergraduate Education
Co-sponsor: Committee on Apparatus
Time: 1–4 p.m. Saturday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2011

Jan Tobochnik, Kalamazoo College, Kalamazoo, MI 49006-3295; jant@kzoo.edu

Harvey Gould

This workshop will provide suggestions for the improvement of the teaching of statistical and thermal physics including the use of computer simulations, the treatment in detail of concepts from probability theory and thermodynamics, and the inclusion of approaches from current research. The workshop will use examples from the presenters' recent newly published text. Participants are encouraged to bring their own computers.

W12: Teaching About Radioactivity

Sponsor: Committee on Science Education for the Public
Time: 1–5 p.m. Saturday
Member Price: $80 **Non-Member Price:** $105
Location: Bldg. 8–Room 210

Alice Flarend, Bellwood-Antis H.S., 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.

W13: Hands On Activities for Teaching About Light

Sponsor: Committee on Science Education for the Public
Time: 1–5 p.m. Saturday
Member Price: $92 **Non-Member Price:** $117
Location: Bldg. 3–Room 2016

Pati Sievert, Northern Illinois University, DeKalb, IL 60115; psievert@niu.edu

Explore light activities designed to help students wrap their minds around the concepts. Topics covered include color mixing, ray tracing, relative energy levels of various colored light, diffraction, inverse square law, refraction, and reflection. The items are used in informal physics education, but are also suitable for the classroom, from elementary through high school. All the apparatus used in the workshop can be constructed inexpensively with readily available materials. Instructions and resources for all activities will be provided and a few will be constructed by participants to take back to the classroom.

W14: Photons and Phonons in the Advanced Lab

Sponsor: Committee on Laboratories
Co-sponsor: Committee on Apparatus
Time: 1–5 p.m. Saturday
Member Price: $90 **Non-Member Price:** $115
Location: Bldg. 8–Room 211

Barbara Hoeling, California State Polytechnic Univ - Pomona; bmhoeling@csupomona.edu

Nina Abramzon

Cal Poly Pomona Physics Department

This workshop is appropriate for college and university faculty who teach labs beyond the first year. We will demonstrate five of our upper-division experiments at Cal Poly Pomona: inquiry-based He spectrum, investigation of entangled photon properties, measurements of phonon energies in a tunnel diode, phase shifts upon total reflection at dielectric interfaces, and experiments in Fourier optics and spatial filtering. Attendees will spend about one hour at each station to discuss instrumentation, lab procedures, and pedagogy. Documentation will be provided for each experiment, with sample data, equipment lists, and construction or purchase information.

W16: Teaching Physics Using NASCAR

Sponsor: Committee on Physics in High Schools
Time: 1–5 p.m. Saturday
Member Price: $75 **Non-Member Price:** $100
Location: Offsite

Don Franklin, 39 W Main St., Hampton, GA 30228; dgfrank1@aol.com

Want to take physics out of the textbook and into real life? This reality workshop will allow you to travel to a NASCAR track, dialog with an engineer, ride around the track in a van, and sit in the pits while the cars are making laps around the track. For an additional fee, you can also ride in the passenger seat for four laps or drive the car on the track yourself for 10 laps. Help the motor heads in your school see Physics in Action. Have them coming to class asking what part physics played in how the cars finish. Now you can teach for the moment! Transportation is included in the cost of this workshop, as well as a copy of textbook: *Fast Car Physics*. The van(s) will depart from the Ontario Convention Center.

Workshops – Sunday, Feb. 5

All workshops held at Cal Poly Pomona. Shuttle buses will be available—see page 6.

W21: Energy and the Environment Hands-On Activities

Sponsor: Committee on Science Education for the Public
Time: 8 a.m.–12 p.m. Sunday
Member Price: $74 **Non-Member Price:** $99
Location: Bldg. 3–Room 2615

John Welch, Cabrillo College, Aptos, CA 95003; jowelch@cabrillo.edu

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 afterwards 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.

W22: Approaching Quantum Mechanics by Playing with Polaroids

Sponsor: Committee on Research in Physics Education
Co-sponsor: Committee on International Physics Education
Time: 8 a.m.–12 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2628

Marisa Michelini, University of Udine (Italy); marisa.michelini@uniud.it

Lorenzo Santi, David Sokoloff, Alberto Stefanel

A research-based inquiry method for learning quantum mechanics (QM) was tested in more than 20 secondary school classes. The approach involves the development of the quantum way of thinking in rigorous terms by analyzing the simple phenomenon of light polarization. The method focuses on the essential aspects of the concepts of the quantum state, the superposition principle, the wave-particle duality, the uncertainty principle, the specific meaning of measurement. In the workshop, after a presentation of the method and its comparison with other approaches, the participants will work in groups by means of tutorials analyzing one/two steps of the method. In a plenary discussion, we will bring together all the steps of the method as a coherent whole.

W23: CASTLE

Sponsor: Committee on Physics in High Schools
Time: 8 a.m.–12 p.m. Sunday
Member Price: $95 **Non-Member Price:** $120
Location: Bldg. 3–Room 2004

Dick Feren, New Hampshire Comm. Tech. College, Manchester, NH 03102-8518; rbferen@comcast.net

Participants will explore complex concepts using simple equipment in straightforward experiments designed to promote image-based understanding of electromagnetic field concepts that are usually developed mathematically. These include using a portable radio to detect an electric field radiated by accelerating charge when a current is turned on or off; using shaped-wire circuits to show that magnetic fields of turned-on current contain energy that radiation carries to the radio; using a transformer with a variable iron core as a dimmer and brightener for a bulb at the output. The current detected in the coil with the moving magnet, and the changing output of the transformer with the variable core are both predicted by Faraday's law.

W25: NTIPERs: Research-based Reasoning Tasks for Intro Mechanics

Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Physics in Two-Year Colleges
Time: 8 a.m.–12 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2623

Stephen Kanim, New Mexico State University, Las Cruces, NM 88003-8001; skanim@nmsu.edu

Curtis Hieggelke, David Maloney

Students often rely on formulas and algorithms to solve problems without really understanding underlying physics concepts. TIPERs (Tasks Inspired by Physics Education Research) are exercises for students in alternate formats that encourage a focus on physics concepts. In this workshop we will introduce these alternative task formats that support active learning approaches, that can be incrementally incorporated into instruction, and that can be employed in all areas of physics. Many of the tasks are adapted directly from physics education research tasks, or have been designed to address difficulties described in the PER literature. Participants will work in groups to develop a set of TIPERs. These will be shared with and discussed by the group. Participants will receive published collections of TIPERs.

W28: Modeling Amusement Park Physics with EJS Simulations and Tracker Video Analysis

Sponsor: Committee on Educational Technologies
Sponsor: Committee on Physics in High Schools
Time: 8 a.m.–12 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2019

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

Mario Belloni, Anne Cox

How do physical laws affect amusement park ride design? Rides must be designed with physics and engineering tolerances in mind, but they also need to be exciting but not dangerous to the rider. Amusement park rides are rich in physics content and are an exciting context for learning physics and this workshop will use EJS computer models and Tracker video modeling to study physics. These simulations can be used for computer demonstrations or as virtual laboratories in high school and undergraduate courses, or serve as programming examples and tasks for computational physics with higher level students. Participants of the workshop will receive a CD with these EJS simulations and Tracker video models; and these models are also in the OSP ComPADRE Collection at: www.compadre.org/osp/. Partial funding for this workshop was obtained through NSF grant DUE-0442581.

W29: Affordable High-Speed Video Analysis

Sponsor: Committee on Physics in Two-Year Colleges
Co-Sponsor: Committee on Educational Technologies
Time: 8 a.m.–12 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2016

Dwain Desbian, Estrella Mountain Community College, Avondale, AZ 85392; dwain.desbien@emcmail.maricopa.edu

David Weaver

In this workshop participants will learn about consumer level high-speed cameras (up to 1000 FPS) and use them to perform video analysis of motion. Limitations of the cameras and quality examples will be discussed. Participants don't need their own camera to attend this workshop.

W18: Arduino Microcontrollers in the Physics Lab

Sponsor: Committee on Educational Technologies
Co-sponsor: Committee on Apparatus
Time: 8 a.m.–5 p.m. Sunday
Member Price: $170 **Non-Member Price:** $195
Location: Bldg. 3–Room 2618

Eric Ayars, California State University - Chico; ayars@mailaps.org

The Arduino is an open-source microcontroller system that is relatively easy to use in a broad range of situations. In this workshop we will be building and programming an Arduino for a variety of purposes including experiment control and data logging. Participants will gain their own Arduino and the software needed to customize and extend its capabilities, as well as all schematics, sources, software, and a basic skill-set for getting started with using Arduino microcontrollers as lab tools. Participants must bring a laptop. Prior experience in soldering and/or c programming will be helpful, but is not required.

W19: Reformed Teacher Observation Protocol (RTOP)

Sponsor: Committee on Women in Physics
Co-Sponsor: Committee on Teacher Preparation
Time: 8 a.m.–5 p.m. Sunday
Member Price: $93 **Non-Member Price:** $118
Location: Bldg. 8–Room 210

Kathleen Falconer, Buffalo State College, Buffalo, NY 14222; falconka@buffalostate.edu

The Reformed Teaching Observation Protocol (RTOP) is a 25-item rubric that provides a percentile measure of the degree and type of student-centered, constructivist, inquiry-based engagement in an instructional situation. RTOP scores correlate very highly with student conceptual gains. In this workshop, we will score video vignettes of teaching to learn how to use RTOP for guiding personal reflection and improvement and change of our own teaching; for mentoring peers, novice teachers, and student teachers; and to establish a vocabulary for discussing reformed teaching practices. If you wish, you may bring a DVD of your own teaching to score.

W20: 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: $95 **Non-Member Price:** $120
Location: Bldg. 8–Room 241

Kathy Harper, The Ohio State University, Columbus, OH 43210; harper.217@osu.edu

Thomas M. Foster, David P. Maloney

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.

W30: Astronomy Is a Verb: Engaging Novice Science Students in Scaffolded Astronomical Research

Sponsor: Committee on Space Science and Astronomy
Time: 1–5 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2019

Timothy F. Slater, University of Wyoming, Laramie, WY 82071; timslaterwyo@gmail.com

Stephanie J. Slater

How do I help my students to engage in scientific research and participate in scientific discourse—in short, to do science themselves rather than just learn about it? Modern cognitive science demonstrates that in order for novice science students to effectively design, conduct, report, and defend science observations and experiments, learners must be purposefully supported in each step of the scientific process before they are able to successfully pursue scientific questions of their own design. This participatory workshop for teachers and professors provides strategies for bringing these two ideas together. It is an introduction to scaffolding strategies that teach students to fruitfully engage in scientific thinking and design astronomy investigations by mining online astronomy databases such as GalaxyZoo and JPL's Solar System Simulator. All participants and will receive copies of classroom-ready inquiry teaching materials for guiding student inquiry in astronomy and are encouraged to bring laptops.

W32: Writing Apps for the IPhone and the IPad

Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Physics in Two-Year Colleges
Time: 1–5 p.m. Sunday
Member Price: $75 **Non-Member Price:** $100
Location: Bldg. 3–Room 2004

Andrew Duffy, Boston University, Boston, MA 02215; aduffy@bu.edu

This workshop is a basic introduction to creating apps for the iPhone, the iPod Touch, and the iPad. No prior knowledge is assumed. We will cover the basics of drawing and animating; learn a little Objective-C; become familiar with the XCode environment in which apps are created on the Mac; and get an introduction to Interface Builder, where we lay out various buttons and sliders, etc. Workshop attendees should bring their own Mac computers, with Apple's latest version of XCode already downloaded and installed. Xcode is available for $4.99 at the Mac App Store.

W34: Learner-Centered Environment for Algebra-based Physics (LEAP)

Sponsor: Committee on Research in Physics Education
Time: 1–5 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2628

Paula Engelhardt, Tennessee Tech University, Cookeville, TN 38505-0001; engelhar@tntech.edu

Steve 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, and will examine and work through a sample of the types of activities students do. We hope to be able to view video from the college LEAP classroom.

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

W36: Potpourri of Physics Simulations

Sponsor: Committee on Physics in Two-Year Colleges
Co-Sponsor: Committee on Educational Technologies
Time: 1–5 p.m. Sunday
Member Price: $75 **Non-Member Price:** $100
Location: Bldg. 3–Room 2011

Paul Williams, Austin Community College, Austin, TX 78751; pwill@austincc.edu

Tom O'Kuma

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.

W37: Reaching, Teaching, and Keeping Underrepresented Groups

Sponsor: Committee on Minorities in Physics
Co-Sponsor: Committee on Women in Physics
Time: 1–5 p.m. Sunday
Member Price: $78 **Non-Member Price:** $103
Location: Bldg. 8–Room 246

Juan Burciaga, Mount Holyoke College, South Hadley, MA 01075-1424; jburciag@mtholyoke.edu

The purpose of the workshop is to increase the effectiveness of teachers (K-12) and college faculty in constructing inclusive learning environments in their classrooms and beyond. Workshop participants, using guided discussion and collaborative exercises, will explore pedagogical philosophies, outreach paradigms, and assessment strategies that can be adapted for their own use. Participants will also investigate the factors that can help (or hinder) widespread, permanent change. Though focused particularly on under-represented groups, the workshop is actually geared toward making the learning of physics more effective for all students. The pedagogical exercises are built on physics at the senior high school or introductory college level but most teachers in the K-20 educational enterprise may find the workshop useful.

W38: Sweet Labs in Physics and Optics With Candy Glass

Sponsor: Committee on Apparatus
Time: 1–5 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2016

William R. Heffner, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

Glass is seldom discussed in our study of matter, yet it is one of the most ubiquitous materials in our everyday life and provides numerous applications in optics, devices, and materials. In this workshop we provide an introduction to glass science for the teacher through a series of low-cost experiments with candy glass, a.k.a. hard candy. Experiments will include the making of candy glass, preparing optical fibers, measuring refractive index, exploring polarization and crystallization—all with commonly available materials and minimal cost. The experiments can be tailored for use in the classroom demonstration or student labs from middle school through high school or even college labs. Additional material will be available on our website at www.lehigh.edu/imi/libraryglassedu.html.

W39: Video Resource for Learning Assistant Development

Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Apparatus
Time: 1–5 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: Bldg. 3–Room 2615

Rachel Scherr, Seattle Pacific University, Seattle, WA 98119-1997; rescherr@gmail.com

Renee Michelle Goertzen

The Video Resource for Learning Assistant Development is a package of thematic case-based "video workshops" created to complement and enhance the LA pedagogy course developed by the University of Colorado–Boulder. The video episodes for this project showcase a variety of exemplary LA-relevant instructional formats including Tutorials in Introductory Physics, Modeling Instruction, Investigative Science Learning Environment, and Open Source Tutorials. The Video Resource for LA Development provides LAs (or any instructor) with opportunities to observe, discuss, and reflect on teaching situations similar to the ones they themselves face, developing their pedagogical content knowledge and supporting their emerging identity as teaching professionals. Participants will be provided with the Resource materials.

Sunday, Feb. 5 Highlights

Workshops at Cal Poly Pomona

REGISTRATION	7 a.m.–4 p.m.	North Lobby
Publications Committee	7:30–10 a.m.	107A
Meetings Committee	8–9:45 a.m.	107C
Nominating Committee	10–11 a.m.	107B
Resource Letters Com.	11:30 a.m.–2:30 p.m.	107C
Section Officers Exchange	5–6 p.m.	204
Programs Committee I	5–6 p.m.	200AB
High School Share-a-Thon	5:30–7:30 p.m.	200C
REGISTRATION	5:30–7:30 p.m.	North Lobby
Section Representatives	6–7:30 p.m.	204

COMMITTEE MEETINGS, 6–7:30 p.m.

– Physics in Two-Year Colleges	100B
– History & Philosophy of Physics	107A
– Apparatus Committee	107B
– Women in Physics	107C
– SI Units and Metric Education	104A

Exhibit Hall Opens/Welcome Reception

7:30–9:30 p.m.

SPS Undergraduate Research and Outreach Poster

Reception 7:30–9:30 p.m. Exhibit Hall Foyer

Session SPS: SPS Undergraduate Research and Outreach (Posters)

Location: Exhibit Hall Prefunction Area
Sponsor: Physics in Undergraduate Education Committee
Date: Sunday, Feb. 5
Time: 7:30–9:30 p.m.

Presider: Gary White

SPS01: 7:30-9:30 p.m. Analysis of Student Understanding of Statics Principles

Poster – Brittany D. Johnson, Robert Noyce REU in PER, Fayetteville, AR 72701; bdjohns@uark.edu

Peter S. Shaffer, Paula R. Heron, Lillian C. McDermott, University of Washington

An analysis of introductory physics students' understanding of statics principles was conducted. The prior development and use of Tutorials in Introductory Physics[1] has addressed student difficulties concerning introductory physics concepts, including fundamental statics principles; yet, conceptual difficulties persist, particularly when the complexity of an assessment question increases. To assess the extent to which the introductory physics curriculum prepared students for an engineering statics course, students completed multiple-choice questions taken from the "Statics Concept Inventory."[2] Responses illuminated remaining areas of difficulty for students, as well as trends in student understanding. Interestingly, students commonly made the same errors as those reported in the analysis of the "Statics Concept Inventory," especially with regard to applying a limit on the friction force in order to maintain static equilibrium. Further exploration of student difficulties with statics concepts is needed so curricula can be adapted for extensive instruction.

1 L. C. McDermott, P. S. Shaffer, and P.E.G. U. Wash., Tutorials in Introductory Physics, New York: Learning Solutions, 2010.

2 P. S. Steif and J. A. Dantzler, "A Statics Concept Inventory: Development and Psychometric Analysis," *Journal of Engineering Education*, 2005, p. 363.

SPS02: 7:30–9:30 p.m. Angelo State SPS Public Engagement-Road Tour 2011

Poster – Blake McCracken, Angelo State University, TX 76909; bmccracken@angelo.edu

Toni Sauncy, Angelo State University

The Angelo State Society of Physics Students Peer Pressure Team has traveled throughout Texas for a week following the spring semester for the past seven years. The goals of this activity are two-fold. First, the group seeks to engage undergraduate presenters in public service; the second goal is to enhance attitudes about science and encourage students in K-12 public schools to study science. For the 2011 outreach, a record of more than 1300 students, teachers, and school administrators were presented to. Demonstrations focused on several aspects of physics. The tradition of a custom laser light show for each school was continued and new demonstrations were added. At each visit, surveys were collected to gauge the program's effectiveness. Student responses indicate a strong desire to study more science in their regular school curriculum. In addition, results are used to determine which demonstrations leave the most lasting impression on the audience participants.

SPS03: 7:30–9:30 p.m. Assessing Changes to Instructional Format in Introductory Astronomy

Poster – Gabriela Serna, California State University Fullerton, Fullerton, CA 92834; gabster562@csu.fullerton.edu*

Michael Loverude, Josh Smith, Cal State University Fullerton

Physics 120, introductory astronomy, has been taught as a traditional large lecture course at California State University Fullerton. The course has no pre-requisites, therefore many students take it to fulfill general education requirements. In the fall of 2011, we introduced into this course a reformed instructional format including using of Peer Instruction and Lecture Tutorials in Introductory Astronomy. Our main focus is to increase student conceptual knowledge. In order to assess the effectiveness of the changes to the course, we will be testing student understanding of the subject at the beginning and end of the semester. In this presentation we will describe the changes to the course and assessments of student understanding. Supported in part by the Louis Stokes Alliance for Minority Participation (LSAMP) program.

*Sponsor: M. E. Loverude

SPS04: 7:30–9:30 p.m. Automated Data Acquisition Interface for Electrical Characterization for Undergraduate Lab

Poster – Ethan Gully, Angelo State University, Angelo, TX 76909; egully2@angelo.edu

Toni Sauncy, Angelo State University

The goal of this work was to develop a multipurpose lab setting for use by undergraduates (advanced lab) and undergraduate research projects. We have interfaced a suite of electrical measurement tools using the graphical platform of LabVIEW. The array of instruments includes a nano-voltmeter, pico-ammeter, digital multimeter, capacitance meter and two source meters. In addition, the system is outfitted with a multichannel switch and is capable of low-level measurements for highly resistive materials. These meters are interfaced to a four-point probe and a Hall-Effect probe situated in a 1 T electromagnet. The four- point probe interface includes a software routine for performing Van der Pauw style measurements for surface resistance on odd shaped samples. Both techniques require using the switching mainframe to control the current direction. In addition to the software, the Hall Effect measuring device was designed and constructed by undergraduate students to perform these automated with an easy to adjust sample mounting system.

SPS05: 7:30–9:30 p.m. Changing the Way We Teach: Integrating Online with Face-to-Face Instruction in a College Physics Course

Poster – Josh A. Zeeman, California State Polytechnic University, Pomona, CA 91768; jazeeman@csupomona.edu

Barbra Hoeling, California State Polytechnic University, Pomona

We present our studies on the design of an algebra-based, freshman-level physics course in hybrid-online format covering waves, optics, and heat. Students are beginning to favor classes that have more material available online because of the convenience, the ability to repeat the material anytime, and the fact that it is easier to view complicated or very small physical systems with an online animation than in a textbook. Through the integration of online modules, some developed here at Cal Poly Pomona and others found at other universities, we aim at improving student interest and retention of the subject matter. We will present results of student learning with our own online optics modules and describe the structure of the new hybrid-online course. The results of the effectiveness in teaching a course that integrates a significant amount of online material could potentially change how introductory physics courses will be taught to accommodate the changing attitudes of today's college students.

SPS06: 7:30–9:30 p.m. Comparing Engineering Students' Kinds of Mental Representations Across Contexts*

Poster – Bashirah Ibrahim, Kansas State University, Manhattan, KS 66502-2601; bibrahim@phys.ksu.edu

N. Sanjay Rebello Kansas State University

We compare the categories of mental representations that 19 engineering students construct when completing 10 non-directed tasks requesting qualitative or quantitative solutions. The tasks were posed in graphical, symbolic, and linguistic forms. The Johnson-Laird (1983) cognitive framework was applied to classify the participants' mental representations. The framework proposes three types of internal constructs namely propositional representations, mental models, and mental images. The students' external manifestations (written solutions and individual interview responses) were related to the cognitive framework. Most (11 in 19) students consistently constructed propositional representation across the two topics. The remaining eight students shifted from using a mental image for tasks on kinematics to either propositional or mental model for tasks on work. This outcome indicates that most students have a poor understanding of the various concepts presented by the different tasks. Moreover, students' strategies tend to change with topic and representation.

*Supported in part by NSF grant 0816207.

SPS07: 7:30–9:30 p.m. In Search of the Spectrum of the Down Converted Photons

Poster – Gina M. Labriola, Cal Poly Pomona, Pomona, CA 91768; gmlabriola@csupomona.edu*

Hector Saldivar, Clint Hawkins, Jonathan Hooker, Eric Sosa Cal, Poly Pomona

Spontaneous parametric down conversion is an important process in quantum optics, in which blue photons of a high-intensity laser beam are converted into pairs of lower energy infrared photons inside a non-linear optical crystal. Our goal is to measure the wavelength spectrum of these photons using a single photon counting module and a high-resolution optical emission spectrometer. A preliminary step towards merging these two systems is to find out the minimum photon flux required to achieve an adequate signal-to-noise ratio with the spectrometer. Additionally, we need to determine how much signal is lost in the proposed connector between the two setups. We will present our findings from the characterization of the spectrometer, as well as dark counts from the single photon detector and measurements of the polarization properties of the down-converted photons. We will discuss how we plan to determine the wavelength spectrum of the down-converted photons.

*Sponsor: Nina Abramzon

SPS08: 7:30–9:30 p.m. Mechanisms of Ultrasonic Attenuation in Porous Bone

Poster – Stephanie M. Milazzo, Rhodes College, Memphis, TN 38112; milsm1@rhodes.edu

Brent K. Hoffmeister, Rhodes College

Ultrasound is a well established method for measuring the density of porous bone. Ultrasonic backscatter is one application of this technology. Backscattered power has been found to decrease with bone density. We hypothesized that increased attenuation causes a decrease in the backscattered power. There are two mechanisms of attenuation in porous bone: absorption and scattering of acoustic energy away from the forward direction. To determine the dominant mechanism for attenuation, we measured eight specimens of human and bovine bone ranging in density from 0.142-0.259 g/cc. Measurements were first performed with the specimens in water (with water filling the porous regions) and then in ethanol. By altering the saturating fluid, we altered the scattering properties of the bone, but not the absorption properties. We observed differences in the backscattered signals between water and ethanol measurement trials, but not between attenuation signals. This suggests that the dominant mechanism of attenuation is absorption.

SPS09: 7:30–9:30 p.m. Modeling the Motion of a Magnet in the Presence of a Conductor

Poster – Benjamin J. Irvine, Loyola University, Chicago, IL 60660; birvine@luc.edu*

Matthew R. Kemnetz, Asim Gangopadhyaya, Loyola University Chicago

We plan to develop an analytical model of magnetic damping. Magnetic damping occurs when a magnet moves in proximity to a conductor. The changing magnetic field produces an electric field, which generates currents in the conductor. These eddy currents then produce a magnetic field that opposes the motion of the magnet. This phenomenon is utilized in the braking systems of hybrid cars, some trains, and roller coasters. The major benefit of magnetic braking is that an object can be slowed down without losing energy to friction. The kinetic energy of an object is converted directly into electrical energy. For this reason, magnetic damping is fundamental to the development of future technology in regenerative braking. Magnetic braking is extensively used in industry where computational methods are employed to accurately model magnetic braking. Our improved analytical model will provide an excellent benchmark for any computational models.

*Sponsor: Asim Gangopadhyaya

SPS10: 7:30–9:30 p.m. Optical Tweezers for Advanced Undergraduate Lab

Poster – David To, Angelo State University, San Angelo, TX 76909; dto@angelo.edu

Toni Sauncy, David Bixler Angelo State University

We have constructed an optical tweezers apparatus using off-the-shelf, fairly inexpensive components. These include a 20-mw HeNe laser, a standard student lab optical microscope, and an inexpensive CCD firewire camera. The trap is designed to work with polystyrene spheres of various diameters, but to be robust enough for more advanced research. The goal of the work is to use the device for undergraduate research projects but also for use in the advanced labs at Angelo State. Trapping is achieved in the device by focusing the collimated laser beam using a 100x oil immersion objective on the microscope. At the position of the beam waist, the light produces gradient forces that trap the micron-sized spheres. Images are collected and processed using LabVIEW(TM) software. Measurement of particle size is accomplished through software tools for use with unknown-sized samples in the future.

SPS11: 7:30–9:30 p.m. The California-Arizona Minority Partnership for Astronomy Research and Education (CAMPARE)

Poster – Courtney Lemon, California State Polytechnic University, Pomona, CA 91768; courtneylemon@gmail.com

Don McCarthy, University of Arizona

Alexander Rudolph, California State Polytechnic University, Pomona

The California-Arizona Minority Partnership for Astronomy Research and Education (CAMPARE) is an NSF-funded partnership between the Astronomy Program at Cal Poly Pomona (CPP) and the University of Arizona Steward Observatory designed to promote participation of underrepresented minorities (including women) in astronomy research and education. As part of the education component of the program, CPP undergraduate physics majors and minors are eligible to work as a counselor at the University of Arizona's Astronomy Camp, one of the premier astronomy outreach opportunities in the world. CAMPARE students have the opportunity to work in this learn-by-doing environment with a wide range of students to gain first hand experience of teaching astronomy to students of a wide variety of ages in highly structured educational setting. Cal Poly Pomona students who are interested in education, both formal and informal, work in a variety of camps, from Girl Scout camps to camps for advanced high school students, to further their understanding of what it means to be a professional in the field of education. The CAMPARE student who participated in this program during summer 2010 had the opportunity to work under Dr. Don McCarthy, camp director of University of Arizona's Astronomy Camps for 20 years, and observe the interpersonal relations between campers and staff that is so vital to the learning the students receive. Through these observations, the CAMPARE student was able to learn to gauge students' interest in the material, and experience real life teaching and learning scenarios in the informal education realm.

SPS12 : 7:30–9:30 p.m. Wigner Distributions of the Biharmonic Oscillator and Asymmetric Linear Potential

Poster – Leah J. Ruckle, Davidson College, Davidson, NC 28035;leruckle@davidson.edu*

Mario Belloni, Davidson College

The very nature of quantum physics puts limitations on what can be precisely known at any given time. As a result, probability is used as a way to most effectively describe many of a particle's fundamental properties. Wigner quasi-probability distributions are useful for determining the relationship of the probabilities of the position and momentum of a particle in a potential well. In this project, we studied the Wigner distributions of the biharmonic oscillator and the asymmetric linear well potential wells. Since the particle is more likely to be found on the side of "weaker" potential energy, the behavior of the particle is different from a particle in a symmetric well. While this research is theoretical, the results provide a base for future research and help to shine light on real-life asymmetric potential wells.

*Sponsor: Mario Belloni

SPS13: 7:30–9:30 p.m. Infinitely Sharp Boundaries in the Path Integral Formalism

Poster – Phillip Dluhy, Loyola University, Chicago, IL 60626; pdluhy@luc.edu

Asim Gangopadhyaya, Loyola University Chicago

We revisit the analysis of sharp infinite potentials within the path integral formalism using the image method (Goodman). We show that using a complete set of energy eigenstates that satisfy the boundary conditions of an infinite wall precisely generates the propagator Goodman proposed. We then further add to the validity of the image method by using supersymmetric quantum mechanics to relate a potential without a sharp boundary to the infinite square well and derive its propagator with an infinite number of image charges. Finally, we show that by using the image method we can readily generate the propagator for the half-harmonic oscillator, a potential that has a sharp infinite boundary at the origin and a quadratic potential in the allowed region, and that it leads to its well-known eigenvalues and eigenfunctions.

M. Goodman, *Am. J. Phys.* **49**, 843 (1981).

*Sponsor: Asim Gangopadhyaya

Session AA: Heliophysics

Location: Room 106
Sponsor: Committee on Space Science and Astronomy
Date: Monday, Feb. 6
Time: 8–10 a.m.

Presider: Mary Kadooka

AA01: 8-8:30 a.m. Electromagnetic and Particle Radiation from the Sun: Myths and Reality

Invited – Ilia I. Roussev, Institute for Astronomy, Honolulu, HI 96822; iroussev@ifa.hawaii.edu

This talk discusses the two types of radiation coming from the Sun and its variation over the 11-year solar cycle. We talk about the great radiation hazard posed by solar flares and coronal mass ejections, and what could be done to predict those "solar radiation storms."

AA02: 8:30–9 a.m. Studying the Sun with the Solar Dynamics Observatory

Invited – Monica G. Bobra, Stanford University HEPL Solar Physics, Physics & Astrophysics, Stanford, CA 94035-4085; mbobra@stanford.edu

In February 2010, NASA launched its most ambitious endeavor to study the Sun—a spacecraft called the Solar Dynamics Observatory (SDO), designed to simultaneously image the Sun (at a resolution eight times higher than HDTV) from its surface to upper atmosphere in more than 10 different optical and ultraviolet wavelengths. SDO's scientific mission is to understand the origins of spaceweather—a continuous, but chaotic and thus far unpredictable plasma streaming off the Sun and buffeting the entire solar system. Extreme examples of spaceweather include solar flares, eruptions that cause aurorae and potentially disrupt space-based technology. To understand and ultimately predict spaceweather, scientists use SDO data to study (1) the solar magnetic field, and (2) how processes like solar flares rapidly convert magnetic energy into kinetic energy. This talk will introduce these topics of study and give an overview of what scientists have learned using SDO data.

AA03: 9-9:30 a.m. Solar Tsunamis: Observations and Models of Large-Scale Coronal Waves

Invited – Cooper Downs, Institute for Astronomy, University of Hawaii, Honolulu, HI 96817; cdowns@ifa.hawaii.edu*

Ilia I Roussev, Noé Lugaz Institute for Astronomy, University of Hawaii

In this talk I will detail our research effort focused on understanding large-scale waves observed in the solar corona, the Sun's outermost atmosphere. Of magnetic origin and related to solar eruptions know as Coronal Mass Ejections (CMEs), these coronal waves exhibit coherent fronts traveling hundreds of kilometers per second and are capable of reaching halfway across the Sun in under an hour. I will document our efforts to combine advanced 3D simulations with the latest data products from space satellites in order to directly explore and test various theories on the nature of these coronal waves. Furthermore, with the 2010 launch of the Solar Dynamics Observatory, cutting-edge imaging observations of the corona are freely available for interactive analysis online, making many of the fundamental concepts of the corona and solar eruptions both tangible and accessible to a broader audience.

*Sponsor: Mary Kadooka

AA04: 9:30-10 a.m. Determining the Position of Hot Spots

Invited – Travis Le, 98-640 Moanalua Loop Apt.#2028 Aiea, HI 96701; prostrykerz@gmail.com*

Ilia I, Roussev Institute for Astronomy

Studying solar flares and Coronal Mass Ejections (CMEs) are essential because of the massive threat they pose to our current lifestyles. Caused by magnetic reconnection, these phenomena are essentially explosions in the

Monday, Feb. 6 Highlights

REGISTRATION	7 a.m.–5 p.m.	North Lobby
First Timers' Gathering	7–8 a.m.	Exhibit Hall B
Spouse/Guest Shopping	10 a.m–2 p.m.	offsite
Young Physicists' Meet & Greet	11:45 a.m.	100B

PLENARY 10:30–11:30 a.m. Ballroom C

Ron Henderson, "Waves in Animation"

COMMERCIAL WORKSHOPS

- –Expert TA, 11:45 a.m.–12: 45 p.m. 201AB
- –Oceanside Photo, 11:45 a.m.–12: 45 p.m. 103
- –Pearson: Paul Hewitt, 10-11 a.m. 200AB
- –Pearson: Randy Knight, 11:30 a.m.–12:30 p.m. 200AB

COMMITTEE MEETINGS, 11:45 a.m.–1:15 p.m.

- –Membership and Benefits 101
- –Science Education for the Public 107C
- –Educational Technologies 107B
- –Teacher Preparation 105
- –Minorities in Physics 107A
- –International Physics Education 205

AWARDS CEREMONY 3–4:30 p.m. Ballroom C

–Oersted Medal, Distinguished Service, SPS

COMMITTEE MEETINGS, 4:30–6 p.m.

- –Laboratories 107A
- –Professional Concerns 107B
- –Physics in Undergrad Education 107C
- –Physics in High Schools 205
- –Awards 101

PER Town Hall Meeting	4:30–5 p.m.	104B
Afternoon Break	4:30–5 p.m.	Exhibit Hall B
AAPT Council Meeting	8:15–9:30 p.m.	Ballroom B
Poster Session I	7:30–9 p.m.	Ballroom A

Sun's atmosphere. This research aimed to determine and track the positions of "hot spots," where CMEs are more likely to occur. Historical solar flare and CME data were used from the CDAW Data Center. After data preprocessing, extensive programs created in Fortran 95 correlated solar flares' and CMEs' occurrences, under certain time intervals. The time intervals varied from 10 to 40 minutes with increments of five minutes. Binning the data, five "hot spots" were determined. Their locations respective to initial Carrington Coordinates in longitude_latitude form are 190_10, 230_-15, 305_-15, 340_20, and 355_-5. Prediction dates were then created for the upcoming solar maximum with an error of 1-2 days, and the activity levels of the "hot spots" are currently being tested. Knowing when these regions could release a possible CME can help large corporations, the military, and space agencies save money and time.

*Sponsor: Mary Kadooka

Session AB: Task Force on Teacher Preparation in Physics

Location: Room 103
Sponsor: Committee on Teacher Preparation
Date: Monday, Feb. 6
Time: 8–9:30 a.m.

Presider: Stamatis Vokos

AB01: 8–8:30 a.m. Physics Teacher Education in Perspective: A Century of Constrained Evolution

Invited – David E. Meltzer, Arizona State University, Mary Lou Fulton Teachers College, Mesa, AZ 85212; david.meltzer@asu.edu

The National Task Force on Teacher Education in Physics has carried out the most extensive investigation ever reported on the education of U.S. physics teachers. Nonetheless, the challenges related to physics teacher education have been matters of concern to the U.S. physics community for over a century. There have been dozens of relevant reports, research papers, and policy statements, generated by various committees, professional organizations, and university-based researchers. The various findings and recommendations are striking in their consistency and reproducibility; they reveal a constrained evolutionary process with distinct invariant properties. I will outline the history of research and reporting on physics teacher education, and show how our Task Force recommendations are consistent not only with the specific findings of our own extensive investigation, but with the vast body of research and analysis generated by others who have examined these same problems during the past 130 years.

AB02: 8:30–9 a.m. The Recommendations of the Task Force on Teacher Education in Physics as Part of a National Agenda

Invited – Mary Ann Rankin, National Math & Science Initiative, Dallas, TX 75201; 214-665-2512

John R. Thompson, Donald B. Mountcastle University of Maine

The National Task Force on Teacher Education in Physics (T-TEP) concluded its two-year investigation of the professional preparation of teachers of physics in the U.S. T-TEP, formed by APS, AAPT, and AIP, was charged with (a) identifying generalizable, yet flexible, strategies that institutions, and in particular physics departments and schools or colleges of education, can employ to increase the number of qualified physics teachers, (b) identifying effective strategies in recruitment, models of professional preparation, and higher education systems of support during the first three years of teaching, and (c) articulating research, policy, and funding implications. In this talk, the work of T-TEP will be placed in the context of other major initiatives, such as the National Math and Science Initiative, UTeach replication, the Science and Mathematics Teacher Imperative, and large-scale math and science education reform efforts.

AB03: 9-9:30 a.m. Implementing the Recommendations of the Task Force

Invited – Monica Plisch, Washington, DC 20002; plisch@aps.org

The Task Force on Teacher Education in Physics* put forward a national proposal for regional centers in physics education. These centers will prepare new physics teachers, provide professional development for in-service teachers, and engage in scholarly research in the teaching and learning of physics. How can these centers be realized? What are the funding implications? What should their relationship be with the majority of physics teacher education programs that graduate fewer than two students per year? What changes, if any, are needed in academic institutions or government agencies? We will consider these questions and others, and invite discussion.

*The Task Force on Teacher Education in Physics is jointly sponsored by APS, AAPT and AIP with funding from the Physics Teacher Education Coalition (PhysTEC) project, supported by the NSF and the APS Campaign for the 21st Century.

Session AC: Integrating Math & Science to Prepare Pre-College Teachers

Location: Room 204
Sponsor: Committee on Physics in Pre-High School Education
Co-Sponsor: Committee on Teacher Preparation
Date: Monday, Feb. 6
Time: 8–10 a.m.

Presider: Kathleen Falconer

AC01: 8–8:30 a.m. Physics & Geometry Activities for Pre-Service Middle School Teachers

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

Panagos Papageorgiu, Wright College

Heather Patay, Wayne Landerholm, Northeastern Illinois University

Where's the Geometry in Physics? What happens when both are taught together? The MSTQE Program at NEIU is an integrated Math-Science program for preparing middle school math and science teachers. The program is especially aimed at the urban environment (Chicago Public Schools) and for inclusion of underrepresented groups. The program is a collaboration between NEIU and two of the City Colleges of Chicago (Wright & Truman Colleges). Graduates receive an endorsement in Middle School Math and Science. Physics and Geometry are taught together; physics uses traditional and nontraditional labs and activities. Each core content course consists of a linked course-pair, the science taken concurrently with a pertinent math course, emphasizing the math-science and interdisciplinary connections, and using inquiry activities. This talk will focus on this link, from the point of view of a physicist; the companion talk will focus on this link from the point of view of a mathematician.

AC02: 8:30–9 a.m. Geometry & Physics Activities for Pre-Service Middle School Teachers

Invited – Panagos Papageorgiu, Wright College, Chicago, IL 60634; panagospap@comcast.net*

Paul J. Dolan, Jr., Heather Patay, Wayne Landerholm, Northeastern Illinois University

Where's the Physics in Geometry? What happens when both are constructed together? The MSTQE Program at NEIU is an integrated math-science program for preparing middle school math and science teachers. The program is especially aimed at the urban environment (Chicago Public Schools) and for inclusion of under-represented groups. The program is a collaboration between NEIU and two of the City Colleges of Chicago (Wright & Truman Colleges). Graduates receive an endorsement in middle

school math and science. Geometry and physics are taught together; geometry is taught using classical Euclidean constructions. Each core content course consists of a linked course-pair; the math taken concurrently with a pertinent science course, emphasizing the math-science and interdisciplinary connections, and using inquiry activities. This talk will focus on this link, from the point of view of a mathematician; the companion talk will focus on this link from the point of view of a physicist.
*Sponsor: Paul Dolan

AC03: 9-9:30 a.m. Aiding Pre-Service Teachers in Determining What Math and Science Content is Appropriate for their Future Students*

Invited – Mel S. Sabella, Chicago State University, Department of Chemistry and Physics, Chicago, IL 60628; msabella@csu.edu

*Andrea Gay Van Duzor,** Chicago State University*

Mathematics comprises part of the language of the physical sciences. To effectively teach science, pre-service secondary science teachers should reflect on how they will integrate mathematics teaching in the classroom. At Chicago State University students in our National Science Foundation-Noyce Program and our American Physical Society-PhysTEC Program are encouraged to reflect on teaching theory and practice through courses that emphasize reading the science education literature and engaging in early teaching experiences. In this talk we will explore how our pre-service physical science teachers in these programs reflect on the integration of mathematics in the science curriculum. Considerations include incorporating explicit mathematics, such as the use of equations, and implicit mathematics, such as proportional reasoning. In addition, we discuss how pre-service teachers view the role of mathematics in teaching the underlying physical science concepts. We will then discuss how coursework in our secondary education program may be used to encourage pre-service teacher reflection.
*Supported by the NSF Noyce Program (DUE # 0833251) and a PhysTEC Grant from the American Physical Society.
*Sponsor: Mel Sabella.

AC04: 9:30-10 a.m. A Sustainability Themed Middle School STEM MNS Program

Invited – Colleen Megowan-Romanowicz, Arizona State University, Tempe, AZ 85282; megowan@asu.edu

Extensive literature documents the detrimental effects of middle school instruction on students' mathematical and scientific achievement. Moreover, middle school students' interest in science and mathematics and their intent to continue to pursue STEM-related careers declines markedly during the transition from elementary to departmentalized middle schools. Traditional avenues for the preparation of middle school STEM-specialists are inadequate to meet the immediate or long-term need. In conversations with school districts, we identified a potential market for STEM content in already-certified in-service elementary teachers. These teachers have a general pedagogical background and expertise already in hand and have made a commitment to teaching as a profession. The Middle School STEM MNS program, which utilizes Energy and Sustainability as the theme for an integrated content core, prepares them to become highly qualified middle school science and mathematics teachers.

Session AD: PER: Investigating Classroom Strategies

Location: Room 104B
Sponsor: Committee on Research in Physics Education
Date: Monday, Feb. 6
Time: 9–9:50 a.m.

Presider: Julia Olsen

AD01: 9-9:10 a.m. Getting the Word Out: Effective Communication of PER Study Results

Contributed – Stephanie V. Chasteen, sciencegeekgirl enterprises and University of Colorado,Boulder, CO 80301; stephanie@sciencegeekgirl.com*

I will make the case that we often stick to a flawed model of communication when we disseminate the results of physics education research (PER) to teachers. We have a similar problem to those who study climate change or tobacco epidemiology; we have data that we think should effect behavior change (i.e., instruction). Why doesn't it? While many instructors are aware of the instructional techniques that PER has demonstrated to be effective, research is showing that many instructors may miss the point of these methods, or quit using them after just one semester. Just as climate scientists have needed to become versed in public communication, so do we need to become versed in communication with our audience (physicists). I will outline some of the lessons we can learn from the research and practice of public science communication, and discuss the power and limits of communication in effecting behavior change.
*Dr. Chasteen is a PER researcher and former AAAS Mass Media Fellow at NPR; her work can be seen at http://sciencegeekgirl.com

AD02: 9:10-9:20 a.m. The Challenges of Assessing Teaching Effectiveness: Strategies for PER to Influence Practice*

Contributed – Charles R. Henderson, Western Michigan University, Kalamazoo, MI 49008-5252 charles.henderson@wmich.edu

Melissa H. Dancy, University of Colorado Boulder

Chandra Turpen, University of Maryland

An ongoing concern within the PER community is how to promote the use of PER-based instructional strategies by non-PER college faculty. Three current trends suggest that PER has an opportunity to influence teaching practice by focusing more attention on assessment: 1) our research and that of others has found that neither faculty nor their institutions are satisfied with the way teaching is assessed; 2) the lack of ability to assess teaching effectiveness has been cited as a barrier to faculty use of research-based instructional strategies; and 3) current trends in higher education are encouraging institutions to pay more attention to assessing student learning outcomes. This talk will describe what PER currently knows about the assessment of student learning, some assessment trends outside of PER, and potentially productive ways for PER to influence the discussion about assessment.
*Supported, in part, by NSF#0715698.

AD03: 9:20-9:30 a.m. Variance and Variables: The Analysis of Pre-test Results from Thousands of Students

Contributed – Paula R. Heron, University of Washington, Seattle, WA 98195-1560 pheron@uw.edu

The Physics Education Group at the University of Washington often reports the results of pre-tests given in many sections of the same course, with the total number of student responses numbering in the hundreds or even thousands. Many variables associated with pre-test administration and prior instruction could, in principle, affect student performance. With results available from a large number of sections, it is possible to characterize the typical variation quantitatively, and to identify variables that may be important.

AD04: 9:30-9:40 a.m. Designing Research-based Instruction in a Large Lecture Course without Recitations

Contributed – Warren M. Christensen, North Dakota State University, Fargo, ND 58102; Warren.Christensen@ndsu.edu

As post-secondary education budgets grow ever tighter, universities are often adopting undesirable measures to cope with a lack of funds. At North Dakota State University, our introductory physics courses have been without the benefit of recitation sessions due to a lack of appropriated funds. The calculus-based sequence is composed solely of four 50-minute lectures per week. This fits a traditional model of lecture-based physics instruction to the letter, but presents numerous limitations for an instructor who recognizes the benefits of creating interactive environments within a course. I will present a number of methods being employed in the first-semester course--including the adaptation of research-validated tutorials for the lecture environment--and student data on several summative assessments that demonstrate the level of success to date.

AD05: 9:40-9:50 a.m. Learning Integration in Physics Using Debate Problems and Multimodal Communication

Contributed – Joshua S. Von Korff, Kansas State University, Manhattan, KS 66506-2601; vonkorff@phys.ksu.edu

Dehui Hu, N. Sanjay Rebello, Kansas State University

Research has highlighted students' difficulties with integration in physics problems. We present a teaching experiment with six lessons about integration in an introductory mechanics context using a reformed instructional approach. During these lessons, the instructor guided discussion, but did not lecture. Students considered "debate problems," in which they read a discussion between fictitious students and attempted to draw conclusions about the merits of the students' claims. Participants communicated with one another in multiple ways. They discussed physics while writing on whiteboards at their tables of four, then each table made a presentation to the other table using their whiteboard, and finally they recorded individual written and audio presentations using a smartpen. This "pencast" presentation was later reviewed and critiqued by other students as well as by the student who created it. We qualitatively analyze the pencasts, and consider the students, learning progress.

Session AE: Animation Physics in Hollywood

Location: Room 203C
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Science Education for the Public
Date: Monday, Feb. 6
Time: 8–10 a.m.

Presider: Wolfgang Christian

Physics has an impact on motion sensing capability and motion processing technology for personal video game systems. Physics also impacts how programmers use motion sensing data to develop games with compelling realism.

AE01: 8-8:30 a.m. Teaching Physics to Animation Artists

Invited – Alejandro Garcia, San Jose State University, Dept. of Physics and Astronomy, San Jose, CA 95192; algarcia@algarcia.org

Animation is enormously popular in feature films, television, and video games. Art departments and film schools at universities as well as animation programs at high schools have expanded to meet the growing demands for animation artists. While animators identify the technological facet as the most rapidly advancing component of their industry, at present there is little overlap between art and science in the typical high school or college curriculum. San Jose State University is located in Silicon Valley near many of the leading animation studios and video game companies, such as DreamWorks, Pixar, and Electronic Arts, and has over 400 Animation/Illustration majors. In spring 2008 we received a National Science Foundation "Course Curriculum and Laboratory Improvement" grant to develop physics curricular materials for art students studying animation. This talk will describe this project and the creation of an upper-division General Elective course, entitled "Physics of Animation," at San Jose State.

AE02: 8:30-9 a.m. Animation Physics in Hollywood

Invited – Bill Kroyer, Dodge College of Film, Chapman University, Orange, CA 92866; kroyer@chapman.edu

Following the principle that "reality is the basis of all caricature," the motion in both animated and visual effects scenes in Hollywood movies is usually stylized in a manner that reflects the stylization of the physical design of characters, props, and environments. Understanding the fundamental principles of real physics is the starting point in the education of every animator. The representation of weight, balance, force, intertia, overlap, and preservation of volume have been benchmarks since the advent of hand-drawn cartoons, and are equally important in modern computer graphics animation. What an audience feels as opposed to what they actually see in stylized animated movement is one of the great illogical sources of fascination in that medium. Animation Director Bill Kroyer will present examples of how real physics is studied, exploited and shamelessly distorted in the pursuit of entertainment.

AE03: 9-9:30 a.m. Inventing Magic

Invited – Rasmus Tamstorf, Walt Disney Animation Studios, 2100 Riverside Drive, Burbank, CA 91506; ccantrel@aapt.org

Creating the Disney magic is a highly collaborative process involving both art and science. In this talk I will present some of the (computer graphics) research inspired by the movie "Tangled" and argue that research is as much of a creative process as story telling or drawing. The examples will center around cloth simulation and hair rendering for CG animation. At a technical level the former requires simulation of thin shell dynamics and contact mechanics while the latter considers light transport and user interface design. In the end, however, it is not enough to simply simulate reality. To create magic we must be able to go further, and this talk will illustrate some of the challenges in doing so.

AE04: 9:30-10 a.m. The Design Universe

Invited – Dave Walvoord, DreamWorks Animation, 28239 Timothy Drive, Saugus, CA 91350; dave.walvoord@dreamworks.com*

Our universe is described by physics. In our universe, if a car is going 60 mph it cannot stop instantly by braking. If it suddenly does so in a movie, then immediately the entire audience will question the validity of what they are watching. However, the world of animation opens the possibility of creating an alternate universe with "cartoon physics." But again, we can only go so far before we start to question or lose attachment to everything we see. So what is too far? I propose that good design for animation creates a universe with a consistent set of laws that govern it. These laws can be completely different from our own, but they must be internally consistent to our alternate universe. We will examine how physics is applied in computer graphics and then how computer animation can manipulate the laws of physics in pursuit of strong design.

*Sponsor: Alej Garcia

Session AF: DIY Technology for the Physics Classroom

Location: Room 203AB
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, Feb. 6
Time: 8–8:30 a.m.

Presider: Vern Lindberg

When off-the-shelf technologies are not quite right to address your needs, what do you do? This session on do-it-yourself technologies seeks to answer that question.

AF01: 8-8:10 a.m. IPAL – In-class Polling for All Learners

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

Anne Cox, Eckerd College

We have developed a polling program that can receive responses from students using various web-enabled devices (laptops, smart phones, iPads, etc.) as well as some models of clickers. The instructor only needs to use a computer. The program is free, open-course, and is a module in Moodle or through a stand-alone module for non-Moodle schools. We provide ready-to-use questions (from Eric Mazur's ConcepTest questions) for Intro physics and teachers can also write their own. Come, bring your smart phone or laptop, and find out for yourself if this technology might improve student learning through greater interaction in your classroom.

AF02: 8:10–8:20 a.m. Using Your Classroom Projector to Demonstrate Some Properties of Light

Contributed – Michael B. Ottinger, Missouri Western State University 4525 Downs Drive Saint Joseph, MO 64507 ottinger@missouriwestern.edu

Brian Bucklein Missouri Western State University

LCD and LCoS Projectors, which are commonly used in most modern classrooms, project a tri-color RGB image on the screen using polarized light. The properties of these projectors can be exploited to aid students' understanding of the basic properties of light. In this presentation, we explain how the different projectors create their color images. We will demonstrate how students, wearing inexpensive ($0.25-$0.40) spectral glasses, can see how different combinations of the RGB colors mix to produce the colors of the visible spectrum. In addition, we will demonstrate how to use the polarized projector light and a simple polarizer sheet to help students understand polarization.

AF03: 8:20–8:30 a.m. Building a Better Electric Field Demonstrator

Contributed – James J. Lincoln, Tarbut V' Torah HS, Irvine, CA 92660; James@PhysicsForEveryone.com

In this talk I instruct on the creation of an extremely inexpensive, highly effective Electric Field Demonstrator. I also advise on how to get the best results from the device once it is constructed. Further, I compare the ones available from science suppliers to the home-made version.

Session AG: Wave Nature of Matter

Location: Room 200C
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Apparatus
Date: Monday, Feb. 6
Time: 8–9:20 a.m.

Presider: Jon C. Levin

To celebrate the 75th Anniversary of the Davisson-Germer Nobel Prize, this special session aims to highlight instructional labs that might reasonably be construed as helping students to think about the wave nature of matter.

AG01: 8-8:30 a.m. Using Nanostrucutres to Teach the Wave Nature of Light

Invited – Joyce P. Allen, Georgia Institute of Technology, Atlanta, GA 30436; joyce.palmer@mirc.gatech.edu

Nanosize particles of a given substance often exhibit different properties and behavior than macro or micro size particles of the same material. As a material gets smaller and transitions through the nano, molecular, and atomic sizes, the importance of the wavelike character increases. The wavelength becomes more significant relative to the size of the object and the wave character becomes more important. Quantum mechanics is then needed to explain its behavior. The wave-particle nature of light is often studied in secondary science classes with the use of flame tests, polarized filters, diffraction gratings, glass prisms, lenses, mirrors and other lab devices. We will offer lessons that show that the use of nanostrucutures such as quantum dots, thin films and structures found in the Morpho butterfly can also be used to help students develop an understanding of the wave nature of matter.

AG02: 8:30-9 a.m. Acoustic Experiments Modeling the Wave Nature of Matter

Invited – Rene Matzdorf, University of Kassel Heinrich-Plett-Str. 40 Kassel, D-34132, Germany; matzdorf@physik.uni-kassel.de

Jonathan F Reichert, Teach Spin, Inc.

Quantum Mechanics is one of the most difficult concepts for students to master. Understanding the wave nature of electrons and all its consequences for atoms, molecules, and solids is crucial for students. We present acoustic experiments modeling quantum phenomena with sound waves "Quantum Analogs." The eigen function solutions to the Schroedinger equation for a radially symmetric potential have a direct mapping to the solutions to the Helmholtz differential equation for sound propagating in a spherical boundary, which allows us to model some aspects of the hydrogen atom. Other resonator shapes can be used to model a hydrogen molecule and a one-dimensional solid with its band structure. These hands-on experiments provide students with a tool to study many phenomena around the wave nature of matter by "playing" with different resonator geometries.

AG03: 9-9:10 a.m. Teaching of Matter Waves in General Physics Class

Contributed – Roman Ya. Kezerashvili, New York City College of Technology, Brooklyn, NY 11201; rkezerashvili@citytech.cuny.edu

Follow the same strategy as presented in Ref. 1, we discuss physics laboratory curricula and suggest physics laboratory exercises where the wave properties of matter (electrons) and electromagnetic wave (light) are studied in parallel. It is shown that one of the important educational advantages of an experimental study of the diffraction of electrons in a polycrystalline lattice, as an example of matter waves diffraction, simultaneously with the diffraction of light, as an example of electromagnetic waves, are, on one hand, visualization of the properties of matter waves and measurement the electron's de Broglie wavelength, and on the other hand, provide evidence of the similarity in the pattern produced by the monochromatic light that is an electromagnetic wave.

1. R.Ya. Kezerashvili, "Light and Electromagnetic Waves Teaching in Engineering Education," *International Jour. of Electrical Engineering Education,* **46**, 343-353, 2009.

AG04: 9:10-9:20 a.m. Reproducible Quantized Conductance: A Lab Experiment on the Wave Nature of Matter

Contributed – Robert Tolley, Miami University, Oxford, OH 45056; tolleyrd@muohio.edu

Antony Silvidi, Chris Burnett, Khalid F. Eid, Miami University

We demonstrate clear quantized conductance steps in mechanical break junctions (MBJ) based on a gold wire, a springy-steel bending beam, a micrometer, a 1.5V battery, and a Teflon disc that we rotate manually. As the wire is stretched (in steps of less than 1 Angstrom) to the point when it is about to break at a weak point, its resistance increases gradually and eventually follows a stair-case-like shape, which is a hallmark of quantized conductance. The resistance steps are observed at values of 25.8 k?/2n, where n is an integer. The resistance steps are clearer and more distinct for smaller n, in agreement with the Correspondence Principle. The quantization occurs when the wire is thin enough that its diameter is comparable to the de Broglie wave length of the current-carrying electrons and is a direct consequence of confinement. This experiment is designed for sophomore/junior level undergraduate labs on contemporary physics.

Session AH: Overview of High School Physics in the U.S.

Location: Room 200AB
Sponsor: Committee on Physics in High Schools
Date: Monday, Feb. 6
Time: 8–9:20 a.m.

Presider: Lawrence Escalada

The American Institute of Physics has conducted Nationwide Surveys of High School Physics Teachers and the Horizon Research is conducting a 2012 National Survey of Science and Mathematics Education. These surveys are valuable in providing insights on the status of high school physics on a national scale.

AH01: 8-8:30 a.m. Physics in U.S. High Schools: Facts, Not Fiction

Invited – Susan White, American Institute of Physics, College Park, MD 20740; swhite@aip.org

Is physics offered every year in every high school in the U.S.? How many students take physics in U.S. high schools? Who teaches them? Are the teachers well prepared? How many teachers are teaching physics at a typical school? What kind of courses do the students take? Do girls take high school physics at the same rate as boys? Is there a racial gap in physics taking? We'll tackle these questions and more using data from our quadrennial Nationwide Survey of High School Physics Teachers.

AH02: 8:30-9 a.m. High School Physics in Iowa

Invited – Jeffrey T. Morgan, University of Northern Iowa, Cedar Falls, IA 50614-0150; jeff.morgan@uni.edu

Trevor Kittleson, Perry High School, Perry, IA

Half a decade ago, state leaders in Iowa made dire predictions of an approaching shortage of physics teachers.[1] Because the University of Northern Iowa is a state leader in physics teacher preparation and professional development, we were interested in ascertaining the current state of physics teachers and teaching in our state. Although the American Institute of Physics has done invaluable work in documenting national and regional trends in physics education,[2] this data does not provide state-by-state analysis. We created an electronic survey[3] and sent it to all known Iowa high school physics teachers; 40% responded. We present demographic information about current high school physics teachers, report on the content they're teaching, share teacher views on effective physics instruction, and discuss resources available to and needed by physics instructors.

1. Campbell, Lynn, "Iowa foresees shortage of physics teachers," *Des Moines Register*, Oct. 30, 2005.
2. http://www.aip.org/statistics/
3. The full survey and accompanying report are available online at http://www.physics.uni.edu/outreach.shtml.

AH03: 9-9:10 a.m. High School Physics: Chief STEM Pathway & Science-Math Literacy

Contributed – Jane Jackson, Arizona State University, Tempe, AZ 85287-1504; jane.jackson@asu.edu

High school physics is the chief pathway to college STEM majors. Reform physics, such as Modeling Instruction, strengthens that pathway and also produces world-class scientific and mathematical literacy. University-based reform professional development (PD) for high school physics teachers is thus essential for the STEM workforce and a literate citizenry. Yet federal funding for such PD is sparse and is threatened to end in the ESEA reauthorization. Resources and proposed actions are at http://modeling.asu.edu/modeling/ConvincingDocuments.html

AH04: 9:10-9:20 a.m. U.S. Physics Standards: A Nationwide Comparison

Contributed – Kathryn Beck, Bolsa Grande High School, Costa Mesa, CA 92626; kbboogie@yahoo.com

Laura Henriques, California State University, Long Beach

As we stand at this pivotal moment, looking ahead to new national science standards, it is only appropriate to step back and evaluate where we are now as a nation in terms of physics education. Some of the questions we need to ask ourselves are: "How do the physics standards across each state compare? Are they comparable?" and "Are all areas of physics represented equally?" To shed light on these questions, we present a nationwide overview and comparison of the current physics standards. We'll share data on how states compare to each other and also how the the current draft of the national science standards fits into the picture.

Session AI: Pre High School

Location: Room 202AB
Sponsor: Committee on Physics in Pre-High School Education
Date: Monday, Feb. 6
Time: 9–9:50 a.m.

Presider: Kathleen Falconer

AI01: 9-9:10 a.m. Developing Extension Activities for APS PhysicsQuest: Inquiry-based Learning at Home

Contributed – Moriel Schottlender, Society of Physics Students/American Institute of Physics, New York, NY 11377; moriel@gmail.com

PhysicsQuest is a program aimed at middle-school students with the goal of transforming physical concepts into easily-understandable, interactive experiments that can be delivered by teachers regardless of their level of physics knowledge. The kit includes a comic book, instruction manual, and all the material necessary for students to complete four activities. By performing these activities the students help Spectra, the teenage superhero, battle her enemies, and can also participate in a national competition by submitting their results online. In addition, there are extension activities available online for classrooms who want to delve into specific topics. This summer I developed the extension activities, producing 12 experiments that can be done with materials found at home. The talk will discuss the process of creating inquiry-based experiments: finding the right experiments, testing them and writing the manuals.

APS PhysicsQuest Website: http://www.physicscentral.com/experiment/physicsquest/

AI02: 9:10-9:20 a.m. Students Using XO Laptops to Create, Discover, and Share Ideas

Contributed – Anne E. Emerson, University of California, Santa Barbara, CA 93106: aemerson@education.ucsb.edu*

Danielle B. Harlow, Alyssa Dyar University of California, Santa Barbara

Children in primary schools today will need not only the skills to use technology, but the ability to create with technology. Through a year-long qualitative study of 20 third grade students, we investigated how ideas were shared, propagated, and changed as children used a geometric drawing program (TurtleArt) on laptops designed for children. When the children used the laptops, they shared ideas, some of which moved or evolved through the classroom. Our research explores which of these communicated ideas children found valuable enough to replicate or change, in what ways this process occurred, and what classroom norms and expectations supported or constrained the communication, replication, and alteration of these ideas. Understanding how students take up and use different types of ideas as they interact with new technology has implications for the types of opportunities for learning with technology we provide students.

*Sponsor: Danielle Harlow

AI03: 9:20-9:30 a.m. Developing STEAM Instruction for Talented/Gifted Students

Contributed – Hyeon-Suk Choi, Korea National University of Education; eovnddl@hotmail.com

Jung Bog Kim, Korea National University of Education

The main purpose of this study is to outline developing STEAM instruction for seventh-grade gifted students in Korea. STEAM is STEM with the addition of fine and liberal art. We will show how STEAM instruction could be implemented in the class for the gifted/talented setting to prepare physics teachers to implement STEAM curriculum in their classrooms.

AI04: 9:30-9:40 a.m. Force and Motion Through Inquiry in Second Grade

Contributed – Jennette L. Aranda, Cortez Math and Science Magnet, Rancho Cucamonga, CA 91730, ladyjenbugg@gmail.com*

Young children have a natural curiosity for how our world works. This natural curiosity combined with guided inquiry can serve as a foundation for building understanding in science. In collaboration with faculty from Cal Poly Pomona, a force and motion unit was developed for second-grade students at Cortez Math and Science Magnet. In this presentation we will be sharing how students were able to build their understanding of basic physics concepts through the use of hands-on activities, inquiry, and the science notebook.

*Sponsor: Homeyra Sadaghiani

Plenary: DreamWorks Studios "Waves Animation"

Location: Ballroom C
Date: Monday, Feb. 6
Time: 10:30–11:30 a.m.

Presider: Gay Stewart

Ron Henderson, DreamWorks Animation, Glendale, CA; Ron.Henderson@dreamworks.com

Riding a Digital Wave: Physics in Animation and Visual Effects

DreamWorks Animation produces family entertainment that is enjoyed by audiences worldwide. It is a major consumer of technology, and employs a skilled workforce of scientists and engineers working to advance the state of the art in computer graphics for film production. Our movies use the latest technology for animation, rendering, and visual effects, including techniques on physics simulation. Many environmental and character effects elements, e.g. fire, smoke, water, cloth, and hair, use sophisticated numerical models to produce motion that is acceptably close to the "real world" while maintaining a high level of art directability. Coupling between models is often a compromise between these competing requirements. In this talk we survey state-of-the-art simulation techniques for visual effects and animation, and discuss some of the challenges in applying these techniques in a creative environment.

AI05: 9:40-9:50 a.m. A Hands-on Instructional Unit on Wave Behavior for Middle School Classrooms

Contributed– Dale Ingram, LIGO Laboratory, Richland, WA 99352; ingram_d@ligo-wa.caltech.edu

Keith Plewman, Pasco School District

LIGO, the Laser Interferometer Gravitational-wave Observatory, collaborates with K-12 teachers near the project's Washington and Louisiana detector facilities to improve student learning related to wave behavior. Wave properties are fundamental to LIGO's research. Wave learning outcomes appear in the K-12 science standards of many states, including the Washington standards. To strengthen middle school science teachers' capabilities in the area of waves, LIGO has partnered with a 6th-grade teacher from the Pasco (WA) School District to develop and implement an inquiry-friendly unit of instruction that includes two sets of station-based interactive wave activities for students. The activities range from low-tech (ropes and Slinkies) to high-tech (function generators and computer-based oscilloscopes). This presentation will describe the instructional unit and the activities. Presenters will share some of the student and teacher outcomes that have arisen from the unit's use in Pasco middle schools.

Crkrbrl 1: Crackerbarrel for Physics Education Researchers

Location: Room 104B
Sponsor: Committee on Physics Education Resarch
Date: Monday, Feb. 6
Time: 11:45 a.m.–12:45 p.m.

Presider: Fran Mateycik

Physics Education Research continues to grow as an academic community. Many larger institutions already have well-established programs, but there are also many more small colleges with strong PER faculty. This Crackerbarrel is for all PER faculty, of all arenas, looking to better network with their colleagues. Discussion includes options for possible growth and strengthening of research efforts, and how institutions may be made better aware of the good work coming from their own, in-house Physics Education specialist(s).

Crkrbrl 2: Crackerbarrel for Planning the Next Two-Year College Tandem Meeting

Location: Room 106
Sponsor: Committee on Physics in Two-Year Colleges
Date: Monday, Feb. 6
Time: 11:45 a.m.–12:45 p.m.

Presider: Mary Beth Monroe

Participants will discuss the reactions to the Tandem Meeting scheduled for the Winter 2012 Meeting, especially contrasting this Winter Tandem Meeting to the Summer Tandem Meeting in Portland. Additional points to be addressed include: 1) Does the TYC Community want to regularly organize tandem meetings? If so, how often and do we rotate them between the summer and winter meetings. 2) Will the CPTYC take the lead in identifying organizers for these meetings and making sure the proceedings are published? 3) What will be the goals and outcomes of future tandem meetings? What can the TYC community accomplish with tandem meetings that it cannot accomplish within the regular AAPT meeting? What are some goals and/or themes we want to address with future meetings?

Crkrbrl 3: Crackerbarrel on Physics and Society

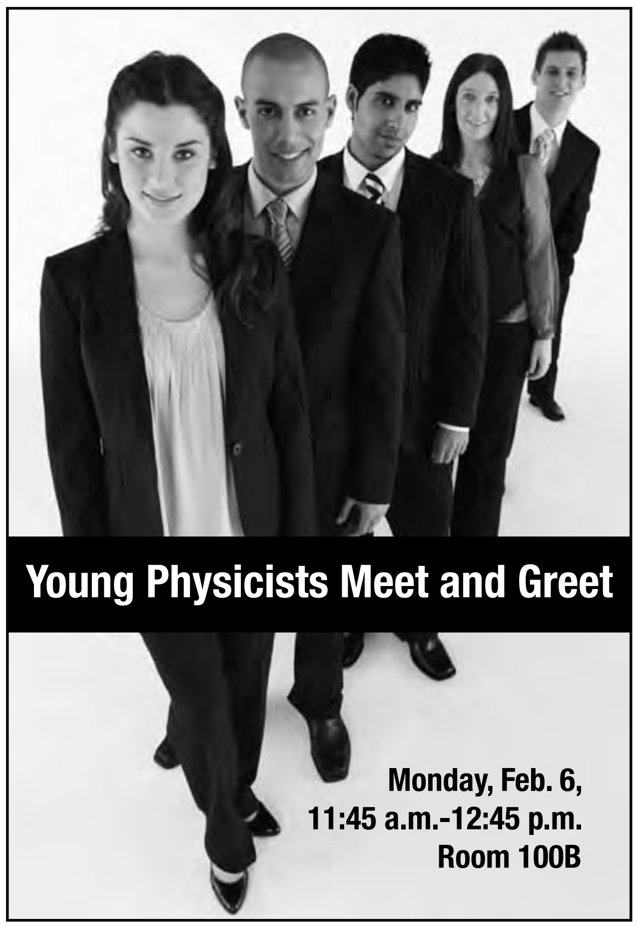
Location: Room 203C
Sponsor: Committee on Science Education for the Public
Date: Monday, Feb. 6
Time: 11:45 a.m.–12:45 p.m.

Presider: Steve Shropshire

Join your colleagues for a discussion of how AAPT members can contribute to the teaching of such physics-related societal issues as energy use, global warming, nuclear power, resource extraction, and pseudoscience.

Spouses and Guests Victoria Gardens Shopping Trip

This is a special shopping trip for spouses/guests of attendees only. Visit Victoria Gardens, a pedestrian oriented, open-air shopping mall in Rancho Cucamonga, CA.



Session BA: Astronomy Research at the Small Observatory

Location: Room 203AB
Sponsor: Committee on Space Science and Astronomy
Date: Monday, Feb. 6
Time: 12:45–2:35 p.m.

Presider: Don Olive

Productive astronomy research is often thought to be only done at the major observatories. In actuality, with modern computer controlled mounts and relatively inexpensive CCD imaging devices, real research can be done at the small college observatory and easily understood by undergraduates.

BA01: 12:45-1:15 p.m. State-of-the-Art Research at the Gettysburg College Observatory

Invited – Laurence A. Marschall, Gettysburg College, Gettysburg, PA 17325; marschal@gettysburg.edu

The Gettysburg College Observatory, for the past 20 years, has supported an active program of faculty and student research. It is equipped with a 16-inch f/11 reflecting telescope, which has been extensively modernized over the years (most recently in 2010), a research-quality CCD camera, and a versatile filter wheel assembly. Using this facility we are able to carry out observations of asteroids, supernovas, eclipsing binary stars, and transiting extrasolar planets, many of which have resulted in publications in professional journals. We'll describe the Gettysburg Observatory, illustrate some successful projects that are ideal for small telescopes, and provide some thoughts on what is important in establishing an active campus research program with modest equipment and limited technical staff.

BA02: 1:15-1:45 p.m. Selected Research Projects from the West Mountain Observatory

Invited – Michael D. Joner, Brigham Young University, Provo, UT 84602; jonerm@forty-two.byu.edu

The West Mountain Observatory is a small facility located away from most city lights at an elevation of almost 7000 feet approximately 20 miles southwest of the main campus of Brigham Young University. The observatory currently houses three small reflecting telescopes (0.3-m, 0.5-m, and 0.9-m) equipped with a variety of standard and custom filters and CCD detectors that allow for a wide range of astrophysical imaging projects at optical wavelengths. These projects are currently being pursued by undergraduates, graduates, and faculty observers at BYU. In addition, the WMO observers have been providing research quality data to support selected projects proposed by external investigators. This presentation will summarize the facilities and typical conditions available at the West Mountain Observatory, describe the work done by research observers, and present several examples of projects that have been done using these modest resources. We conclude with a brief description of possible future additions to the instrumentation in order to expand the scope of work that can be done at West Mountain. http://wmo.byu.edu

BA03: 1:45-2:15 p.m. Doing Science with a Small Telescope

Invited – Michael W. Richmond, Rochester Institute of Technology, Rochester, NY 14623; mwrsps@rit.edu

Just because small telescopes (8 to 16 inches in diameter) at suburban locations cannot acquire spectra of high-redshift quasars does not mean that they are doomed to taking pretty pictures. Small telescopes equipped with CCD cameras can carry out a number of projects that are both within the grasp of a dedicated student and interesting to the astronomical community. I will provide examples of projects involving variable stars, supernovae, asteroids, and exoplanets. Many of these projects require only a few nights of measurements, making them well suited for advanced projects at the end of a course on observational astronomy.

BA04: 2:15-2:25 p.m. Using Small Radio Telescopes in Undergraduate Education

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

Rexford Adelberger, Guilford College

Guilford College is unusual in the state of North Carolina in owning two small radio telescopes (SRTs). These 2.3-m dishes, manufactured by MIT's Haystack Observatory, are optimized to observe the 21-cm hydrogen line and continuum radiation in the L-band (1.42 GHz). I will report on how we have used these telescopes in our introductory physics laboratory to teach about the properties of waves and Doppler shifts. Our Observatory Practice course has enabled students to map the velocity distribution of clouds along the galactic plane. Advanced students have used these telescopes in senior thesis projects, using the two telescopes together as a 500-m baseline interferometer, demanding skills in programming, networking, and electronics. Groups of our students have developed an outreach curriculum to run these telescopes remotely from public school classrooms, to teach middle and grade school students about waves and to get them excited about exploring the radio sky.

BA05: 2:25-2:35 p.m. Comparison of Standard and Narrow Band Photometry for Stellar Classification and Variable Star Studies

Contributed – Kendall Mallory, Point Loma Nazarene University, San Diego, CA 92111; kmallory@pointloma.edu

We will report on undergraduate research projects comparing stellar photometric measurements made in Standard BVR bands with measurement made using narrow Hydrogen alpha, Oxygen III, and Sulfur II bands. We compare measurements made on various stellar clusters and unusual variable stars to study the usefulness of narrow band measurements. Our measurements are made with a high-precision portable stellar photometer used at remote sites and assembled for a reasonable cost. This apparatus should provide undergraduates with many opportunities to complete challenging research projects and analysis of large complex data sets.

Session BB: Physics Education Research Around the World

Location: Room 203C
Sponsor: Committee on International Physics Education
Co-Sponsor: Committee on Research in Physics Education
Date: Monday, Feb. 6
Time: 12:45–2:15 p.m.

Presider: Genaro Zavala

This is an invited and contributed session designed for reports from groups around the world working on Physics Education Research. Included are research approaches, perspectives, and results in different countries; successes and challenges of this area of research around the world; and the effect of the structure of different school systems on research.

BB01: 12:45-1:15 p.m. Teaching the Concept of Center of Gravity Using Educational Workshops

Invited – Jorge A. Villavicencio, Universidad Autónoma de Baja California, B.C. 22800 Mexico; villavics@uabc.edu.mx

Juan C. Tapia-Mercado, Pierre A. Pantaleón, Jesús R. Lerma-Aragón, Luis J. Villegas-Vicencio, Universidad Autónoma de Baja California

In this work we show the learning experiences obtained in educational workshops for teaching the concept of center of gravity, aimed to elementary school students, within the framework of the UABC Science Week. The goal of the workshop is to accomplish significative learning through lucid activities. By performing experimental demonstrations and by means of active learning, the student is capable of forming for himself the concept of center of gravity, eliminating common misconceptions about this phenomenon. Finally, using home-made materials the student carries out an experiment with which to reinforce the acquired knowledge.

BB02: 1:15-1:45 p.m. High School Students Face Superconductivity

Invited – Lorenzo Santi University of Udine, 33100 Italy; lorenzo.santi@uniud.it

Superconductivity is one of the most important discoveries of modern physics both for interpretation and for its important technological applications. We designed a didactic path to address, on a phenomenological basis, the main electrical and magnetic properties of superconductors. A set of over 40 experiments and relative tutorials were realized with low and high level technologies, within the European projects MOSEM and MOSEM2. Different experiments have been carried out proposing the educational path to more than 300 students. From written tutorials, questionnaires and monitoring elements, positive learning curves of students on the recognition of diamagnetism and zero resistivity of a superconductor emerged.

BB03: 1:45-1:55 p.m. Challenges for Interactive Engagement Physics Courses: A Gulf Arab Context

Contributed – George W. Hitt, Khalifa University of Science, Technology, and Research, United Arab Emirates (UAE); george.hitt@kustar.ac.ae

Abdel F. Isakovic, Muhammad S Bawa'aneh, Nayla El-Kork, Issam A Qattan, Khalifa University of Science, Technology, and Research

There's a growing constellation of universities in the developing world that teach physics far outside the Western cultural settings where interactive-engagement techniques were first developed. We report on efforts to design "Collaborative Workshop Physics" (CWP) at Khalifa University of Science, Technology, and Research in the UAE, to these authors' knowledge, the first interactive-engagement physics course in the Gulf region. A brief history of education in the UAE is given. In this context, a baseline is presented for our calculus-based first-semester freshman physics course in its traditional form, including conceptual survey data, exam grades, student evaluations, and interviews. The first semester delivered in the prototype CWP modality has revealed several key challenges for enhancing learning gains: (1) second-language acquisition, (2) pre-college academic preparation, and (3) gender issues. We characterize each of these both quantitatively; through analysis of pre/post-survey, course exam and standardized test data, and qualitatively; through course evaluations, observations and interviews. Open questions are identified and recommendations are made for future improvements.

BB04: 1:55-2:05 p.m. Experimenting an Inquired-based Learning Path on Electromagnetic Induction

Contributed – Stefano Vercellati, University of Udine, Italy via delle Scienze; stefano.vercellati@uniud.it

Marisa Michelini, University of Udine, Italy

In the framework of Design Based Research, an inquired-based learning path on electromagnetic induction is studied to overcome learning knots on electromagnetic phenomena in secondary school. Focusing on field line representation, argumentative discussions are oriented to developing formal thinking step by step. Research activity is carried out according to the Model of Educational Reconstruction (MER), and school experimentation is performed with two different modalities in a school-university cooperation project: a) pilot experimentation carried out together by a researcher and school teacher (in two classes), b) action-research experimentation done by teachers alone after co-planning with the researcher (one class). Results from in-out test and from tutorial sheets for monitoring learning step by step will be discussed.

BB05: 2:05-2:15 p.m. Developing ConcepTest Having Hierarchical Structure About Sinking and Floating

Contributed – Jiwon Lee, KNUE San7, Darakri, Gangnaemyeon Cheongwongun, Chung-Buk 363-791 S. KOREA; ljiwony@naver.com*

Jongwon Kim, Jungbog Kim, KNUE

We make ConcepTests for meaningful cognitive conflicts to elementary science-gifted students about sinking and floating based on students' misconceptions. We have found empirical evidence that some misconceptions change easily through Peer Instruction but other misconceptions are difficult to change. We think this difficulty is caused by lack of essential underlying conception. We have developed ConcepTest having a hierarchical structure about sinking and floating.This approach has turned out to be more efficient than one time ConcepTest. Based on the result, we can teach essential underlying conception first and consider hierarchical level of concepts for conceptual change.

*Sponsor: Jungbog Kim

Session BC: Best Practices for Outreach to Elementary or Middle School Teachers

Location: Room 103
Sponsor: Committee on Physics in Pre-High School Education
Date: Monday, Feb. 6
Time: 12:45– 2:15 p.m.

Presider: Jim Dunne

What are the benefits of outreach to elementary and middle school teachers? What are the longer term results? There are an increasing number of outreach efforts to enhance science learning in all parts of the country. This session will present programs that successfully bridge the gap between the science community and K-8 teachers.

BC01: 12:45-1:15 p.m. MSP-Supported Professional Development Opportunities for Middle School Physical Science Teachers

Invited – Taha Mzoughi, Kennesaw State University, Dept. of Biology and Physics, Kennesaw, GA 30144-5591; tmzoughi@kennesaw.edu

For the last four years, as part of Math and Science Partnership projects, and Teacher Quality projects, Kennesaw State University had been offering professional development opportunities to middle school physical science teachers. The teachers participated in workshops during the summer and follow-up activities during the school year. During the workshops, the teachers completed physics education inspired hands-on guided activities. The activities were chosen to address the concepts that students and sometimes teachers have difficulties with and to align with state standards. Care was taken to ensure that teachers can easily implement or adapt these activities to their teaching. It is also hoped that the guided-inquiry methods used in conducting the workshop will inspire the teachers into adopting similar methods in their teaching. The presentation will provide details about the workshops, the follow-up activities, and the hands-on activities that the teachers complete. It will also elaborate on the various other collaborative activities we engage in with the schools and the teachers. Some details about the projects and some example activities can be found at http://physci.kennesaw.edu/tips/

BC02: 1:15-1:25 p.m. Teaching Science Processes to Elementary Students through Outreach on Motion

Contributed – Stacey L. Carpenter, University of California, Santa Barbara, CA 93106-9490; scarpenter@education.ucsb.edu*

Danielle B. Harlow, University of California, Santa Barbara

I report on second graders' learning about the scientific practice of observing during an outreach program designed to help K-12 students develop science process skills. SciTrek is an outreach program at UCSB that partners undergraduate and graduate students in science with local K-12 schools. The SciTrek group is developing a series of modules that span the K-12 curriculum. Thus far modules have been developed and field tested for grades two and five. SciTrek modules emphasize the processes of science as well as specific grade level science content standards. This presentation will report on results from the second grade module about motion which focuses on the process of making observations while addressing applicable California content standards. An overview of the outreach program and findings from an assessment of student learning about making observations from the motion module will be presented.

*Sponsor: Danielle Harlow

BC03: 1:25-1:35 p.m. Green and Renewable Energies Workshop (GREW) for K-8 Teachers

Contributed – Joseph Kozminski, Lewis University, Romeoville, IL 60446; kozminjo@lewisu.edu

Jason Kelehe, Ray Klump, Lewis University

Faculty from various science departments and the College of Education at Lewis University developed and delivered an interdisciplinary workshop (GREW) on renewable energies for 25 K-8 teachers this past summer. We provided instruction to the teachers about various types of renewable energies and technological and societal issues associated with them. We also developed activities and resources for them to take back to their classrooms with the goal of giving them a new and current context for teaching critical math and science skills to elementary and middle school students. We will give an overview of the workshop, highlight some of the activities developed for this workshop, and discuss future plans. This workshop was funded by the Illinois Mathematics and Science Partnership (IMSP).

BC04: 1:35-1:45 p.m. Appliance of Peer Intruction for Elementary School Students

Contributed– Kyu Hwan Kim, Korea National University of Education, Busan 604-042 South Korea; rlarbghks94@hanmail.net

Jung Bog Kim, Korea National University of Education

Using peer instruction (PI) in introductory physics courses for undergraduates is growing at institutions across the U.S. However, using PI for younger students is very rare. So, we wanted to ascertain the effect of PI for Korean elementary school students. To ascertain the effect of PI in elementary school students, we applied PI experimentally for two classes composed of 24 students (n=48). As a result, PI is effective for elementary school students in some ways. We found two points. One is that repeated presentation of concepTests concering concept made many young students give up their own misconceptions and accept the concepts of correct answers (unfortunately, sometimes, this repetition may make a few students form their own concepts that look correct but may be wrong). The other is that concepTest is useful as a chance to apply principles that were taught in class. For one thing, to ascertain if disscussion alone about concepTest is possible to form the scientific concepts or not, we presented concepTests about simple themes to students step by step from a very easy level without a teacher's lecture. As a result, distracters in concepTests were used as a source of wrong arguments in many discussions. It was determined that the teacher's lecture was important.

BC05: 1:45-1:55 p.m. Teachers and Researchers: Using Renewable Energy for a Collaboration Theme*

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

The FREEDM Systems Center pre-college program promotes community engagement among graduate students. The program ensures that students are taught communication skills to convey their research to the public and to assist public school teachers and students. Students visit partner classrooms in underserved schools with a demo-kit of eight energy activities. The new model is the round-robin station approach to the activities and using a hands-on activity as a vehicle for raising college preparation awareness for young students. The students developed a package to assist teachers with extending the learning to produce student work products. The summer program gives teachers a five-week on campus experience to introduce electricity and the latest research on the power grid. This program is one small step towards supporting underrepresented groups to have an equal opportunity to become a part of the STEM and energy sustainability community.

*Sponsored in part by NSF Award #0812121, Division of Engineering Education and Centers.

BC06: 1:55-2:05 p.m. The Resistance of Learners to Changing Concepts in Peer Instruction

Contributed – Jongwon Kim, KNUE, Chungbuk 363-791 Korea; bellbesty@hotmail.com

Jiwon Lee, Jungbog, Kim KNUE

We have been incorporating peer instruction for training pre-service and in-service elementary teachers. We have found new pedagogical methods are not always welcome and also sometimes there is resistance to changing their scientific concepts. In this presentation, we present survey and interview data of peer instruction from pre-service and in-service teachers in elementary school. We will append arguments about the resistance of in-service teachers to scientific concepts as compared with results of university students who will be elementary teachers.

BC07: 2:05-2:15 p.m. Design-Driven Professional Development: Educators as Engineers at Cornell

Contributed – Lora K. Hine, Cornell University Wilson Laboratory, Ithaca, NY 14853; lkh24@cornell.edu

Mike Perkins, Tully Central School District in NY

Just as students are drawn into projects where designing and creating are fundamental to the learning experience, teachers also crave hands-on critical thinking activities to broaden their teaching abilities and enhance their professional skills. As part of its primary and secondary school outreach efforts, Cornell provides a devoted team of teachers with the necessary resources and guidance to introduce engineering, student-driven design, and innovative thinking into their science classrooms. Teachers involve a cohort of students in science exhibitions to pique their interest and set the tone for scientific exploration and dialogue in preparation for a project-based summer camp held on Cornell's campus. Collaborative planning with these teachers addresses multi-age and multidisciplinary content strands like "Waves" or Energy" that will be central to the summer experience. Classroom implementation strategies are discussed as teachers design, build, and troubleshoot projects. Following summer camp, we provide time to collectively reflect upon the experience.

Session BD: Online Physics Courses: Technology, Assessment, Experiences

Location: Room 106
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Research in Physics Education
Date: Monday, Feb. 6
Time: 12:45–2:25 p.m.

Presider: Barbara Hoeling

This session features those who have taught online or hybrid online physics courses who will share their experiences with the technologies available to teach physics online, or methods and results on student learning assessment.

Monday afternoon

BD01: 12:45-1:15 p.m. The End of the University as We Know It?

Invited – Wolfgang Bauer, Michigan State University, East Lansing, MI 48824-2320; bauer@pa.msu.edu

We have performed identical assessments of learning in lecture-based and virtual-university sections of introductory physics classes at Michigan State University. Our studies show that the learning outcomes in properly constructed virtual-university environments show no significant difference. In this presentation I will explore some of the necessary boundary conditions for this result, possible explanations of these findings, and potential future implications.

BD02: 1:15-1:45 p.m. Transforming Physics Curriculum by Teaching Physics Online

Invited – Zvonko Hlousek, California State University, Long Beach, CA 90840; hlousek@csulb.edu*

Teaching online has been old news for some time. There are a myriad of physics resources available scattered in several well- known repositories and in many other corners of the Internet. Most of us use one online homework system and possibly more, and yet almost nobody teaches fully online physics classes. In this talk we'll examine challenges of teaching physics in an online environment. We will address the fact that online teaching presents an opportunity to transform the physics curriculum for the better. This will help us understand why teaching physics online is difficult and why it has yet to happen.

*Sponsor: Barbara Hoeling

BD03: 1:45-1:55 p.m. Particle Physics Online

Contributed – Peter B. Siegel, California State Polytechnic University, Pomona, CA 91768; pbsiegel@csupomona.edu

Last spring we offered a synchronous online particle physics course at Cal Poly Pomona that was open to students throughout the California State University system. The goal of this course was to prepare students for a summer internship at CERN. While the 11 Cal Poly Pomona Students enrolled experienced the lecture face-to-face, five other students from two more campuses participated online using "Elluminate-Live" software. The syllabus and instructional methods for the class will be presented as well as a critique of its effectiveness and suitability for other online physics courses.

BD04: 1:55-2:05 p.m. Online and Blended Climate Change Courses for Educators from AMNH

Contributed – Robert V. Steiner, American Museum of Natural History, New York, NY 10024; rsteiner@amnh.org

The American Museum of Natural History (AMNH) has created both online and blended climate change education courses directed toward secondary school educators. The online course carries graduate credit and is authored by leading scientists at AMNH and at NASA's Goddard Institute for Space Studies. It focuses on weather and climate; sources of climate change; the response of the climate system to input; modeling, theory and observation; what we can learn from past climates; and potential consequences, risks and uncertainties. The blended course includes an abbreviated version of the online course along with additional activities, many suitable for classroom use. Both the online and blended course experiences will be reviewed, including the use of an educational version of NASA's Global Climate Model. Attendees will be provided with a DVD of Climate Change videos and data visualizations from the American Museum of Natural History. This work is supported through a generous grant from NASA's Innovations in Climate Education program.

BD05: 2:05-2:15 p.m. Tabletop Kits Help Students Grasp Concepts in Light

Contributed – Jacob Millspaw, Indiana University Purdue University Fort Wayne, Fort Wayne, IN 46805; millspaj@ipfw.edu

Light and color exploration kits have been in use face to face and in online courses with positive results. Students explore properties of light with experiments on topics such as the spectrum, color mixing, geometric and physical optics. In the class, students take part in scientific investigations developing and testing hypotheses based on observations made in their investigations.

BD06: 2:15-2:25 p.m. Avatars and Open Courseware in Distance Education Freshman Physics

Contributed – Farook Al-Shamali, Athabasca University, Athabasca, AB T9S 3A3 Canada, farooka@athabascau.ca

Martin Connors, Athabasca University

Athabasca University has engaged thousands of students in for-credit, noncalculus freshman physics over the past 15 years, a success in part attributable to innovative use of home laboratory technology. In now offering calculus-based courses suited to science, engineering or pre-med streams, we have found it advantageous to use MIT Open Courseware. Carefully selected segments provide quality video lectures and demonstrations in a form that is suited for viewing at home or on a mobile device. In addition, we have used Xtranormal© cartoon production facilities, with software based on text-to-speech technology, to provide continuity through use of a scriptable set of avatars. This introduced characters that students can relate to as they do individual home study distance education. In addition, we produced a number of animated discussion videos in a simulated classroom setting. As a result, we believe that we moved our courses one step closer to face-to-face teaching.

Session BE: Physics First

Location: Room 200C
Sponsor: Committee on Physics in High Schools
Co-Sponsor: Committee on Science Education for the Public
Date: Monday, Feb. 6
Time: 12:45–2:15 p.m.

Presider: Ann Brandon

With the push to increase the number of students taking physics in their high school career, several districts have opted to have a conceptually based physics course as a freshman requirement. Successes and challenges will be presented.

BE01: 12:45-1:15 p.m. Teaching Physics First – Can It Be Done and Does It Work?

Invited – Duane B. Merrell, Brigham Young University, Castle Dale, UT 84602; duane_merrell@byu.edu

Can physics really be taught first? When teaching physics to 9th and 10th graders what does the physics class look like? Is it a concern that they have not already taken or are concurrently taking upper level math or calculus? Teaching Physics First to many 10th grade students over 20 years in the public school was an experience that not only did I enjoy but the students thrived. State test scores on physics exams were high and students often went on to take more physics after the first experience. I will try to share what a physics first class looked like and why it was successful for students to take this as their first course in science in high school.

BE02: 1:15-1:45 p.m. Freshman Physics: A Modeling Approach

Invited – Deborah J. Rice, 6051 Kingsbury Ave., St. Louis, MO 63112; debrice@swbell.net

Physics has been taught in the freshman year in the Clayton Public Schools for more than 20 years. Over the years this course has evolved from an h.s course in a traditional high school sequence, B-C-P, to a freshman physics course for all in an inverted high school sequence, P-C-B. With slight modification to the modeling cycle, physics becomes more user friendly without compromising the elegance of the mathematical nature of physics.

BE03: 1:45-2:15 p.m. Physics Second

Invited – Zak Knott, 201 E. Jefferson St., Joliet, IL 60432; zknott@jths.org

The Joliet (Illinois) Township School District has adopted a unique science program of studies in which all students take physics as sophomores. With an increasing focus nationwide on preparing students for high-stakes testing, our course sequence (Biology, Physics, Chemistry) has shown promise in preparing our students for success. By requiring physics for all sophomores we are able to offer a course that is comparable in rigor to a traditional junior-level course both conceptually and mathematically. In this session I will further discuss the rationale behind our course sequence as well as the benefits it has brought to our students and the challenges we have faced.

Session BF: Physics by the #s: Mobile Communications in the Classroom (Including Diversity)

Location: Room 204
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Minorities in Physics
Date: Monday, Feb. 6
Time: 12:45–1:55 p.m.

Presider: Frances Mateycik

How are mobile communication devices used in the classroom to better serve physics students? Are students constructively utilizing their phones, ipads, and other app-based mobile devices in the classroom to enhance their understanding?

BF01: 12:45-1:15 p.m. Mediating Student Physics Challenges with Mobile Devices

Invited – Mark Geary, Dakota State University, Madison, SD 57042; mark.geary@dsu.edu*

Schools are making the transition from banning mobile devices to embracing them, but how they get implemented is still largely a function of individual teacher preference. This session will show four quick ways you can engage your physics students using the devices they carry in their pockets, their mobile phones. Educators across the country are recognizing the computing power inside the modern cell phone, and are combining that computing power with an increasingly mobile device-friendly Internet to create powerful learning opportunities for students. Don't be left out, join the session, and find out how to: 1. Use Google SMS to help students' comprehension of difficult reading material. 2. Facilitate robust discussions with SMS group discussion boards. 3. Give/Take a Poll via SMS text messaging. 4. Use the Cell Phone as a Planner that students WON'T lose! 5. Discover the latest and greatest mobile apps for Physics.

Sponsor: Fran Mateycik
http://www.homepages.dsu.edu/mgeary/

BF02: 1:15-1:45 p.m. iPads in Physics: Making it Matter

Invited – Lainie Rowell, 9692 Dumbreck Dr., Huntington Beach, CA 92646; lainie@me.com

Are you already using iPads in the classroom? Just considering an implementation? Either way, this session will be a rich source of ideas, resources, and information about learning with the iPad in the physics classroom. This fast-paced session will explore productivity tools, educational activities and more, using built-in and freely available applications for Apple's iPad. With the iPad, learners can perform research, collaborate, interact with experts, and produce creative works! We will examine the iPad's iOS platform, unique features that support student learning, and applications and activities that support differentiated mobile learning. We will also discover tips and tricks to get even more out of your Internet communication device. Participants are encouraged to bring their own iPad to participate.

BF03: 1:45-1:55 p.m. High School Students' Motion Analysis in Everyday Contexts with Smart Phones

Contributed – Il Lee, Seoul National University, South Korea; mute21@snu.ac.kr

Junhee Yoo, Seoul National Unviersity

Information technology enables the capture of data beyond the classroom at all hours of the day. Mobile devices with accelerometers and video cam could be used to measure and analyze motions as an all-in-one tool. With these devices, the accessibility of motion analysis in everyday contexts is improved and it could make students engage themselves in the laboratory activities. Also, the diversity of data about everyday motions could provide students with opportunities for scientific argumentation, especially evidence-based discussions during the data interpretation. The purposes of this study are to embody and refine the above two conjectures about using smart phones for learning physics. To embody the conjectures, eight hours of project-based learning sequence were developed for 11th graders. The participated students' dialogue and behaviors were analyzed by the frameworks of Hogan (1999) and Sampson & Clark (2011). The results could show the way to utilize the smart phone in physics teaching.

Session BG: How I Use Popular Media in Teaching Physics

Location: Room 200AB
Sponsor: Committee on Physics in Two-Year Colleges
Date: Monday, Feb. 6
Time: 12:45–2:35 p.m.

Presider: Todd Leif

How I use popular media to teach physics? This session features experiences using any form of media to teach physics, including comic books, movie clips from You Tube, singing, dancing, or excerpts from novels.

BG01: 12:45-1:15 p.m. Angry Bird Physics

Invited – Rhett Allain, Southeastern Louisiana University, Hammond, LA 70402; rallain@selu.edu

Everyone loves Angry Birds (the game). Why not use this popular game as a topic for exploration in introductory physics? Why are games like Angry Birds so nice for analysis? In this presentation, I will discuss the physics of Angry Birds and video games in general. I will also briefly discuss the advantages of using a blog to supplement introductory physics courses.

BG02: 1:15-1:45 p.m. 500 Web Physics Applications from the NY Times

Invited – John P. Cise, Austin Community College, Austin, TX 78746; jpcise@austincc.edu

For the past four years I have found more than 500 physics-rich applications in *New York Times* articles. I have edited the graphics and text to fit on one web page. The site is: http://CisePhysics.homestead.com/files/NYT.htm. My intent is to bring to introductory college physics and H.S. students current-in-the-news applications of introductory physics concepts. Physics concept applications are more current than in the latest physics texts. You might say it is physics of the "now." I use the one page web applications to: introduce concepts, quizz and test questions, student-produced extra credit. Each page has: a Focus(Kinematics), title, edited text and graphics from NYTimes, introduction, questions, hints, and answers. Some of the web pages have excellent physics concept video applications produced by the NYTimes. I will present examples of some of the best NYTimes physics application pages "rich" in data which can be verified with introductory physics level concepts and solutions.

BG03: 1:45-2:15 p.m. How My Students Use Social Media in Learning Renewable Energy

Invited – Chuck Stone, Colorado School of Mines, Golden, CO 80401; cstone@mines.edu

I do not own a smartphone (Apple iPhone, Blackberry Torch, T-Mobile Dash); portable media player (Apple iPod, Creative Zen, Microsoft Zune), tablet computer (Apple iPad, Google Android Touch Tablet, HP Slate), or subscribe to social networking services (Facebook, Twitter, web logs). Since my institution expects me to uphold and promote standards of academic honesty, the use of cellular telephones, personal computers, surfing the Internet, text messaging, and listening to music devices are strictly forbidden in my classes unless explicitly approved. Acknowledging the idiom, "If you can't beat them, join them," I challenged students in my fall 2011 Renewable Energy course to develop a specific lesson or activity that uses social media as a resource to enhance their appreciation and understanding of renewable energy. In this presentation I will share some of the activities created and describe the positive role they are playing in the ongoing development of the course.

BG04: 2:15-2:25 p.m. Using YouTube Videos in the Introductory Modern Physics Class

Contributed – Tatiana A. Krivosheev, Clayton State University, Morrow, GA 30260; TatianaKrivosheev@mail.clayton.edu

We present our experience of using YouTube videos in the Introductory Modern Physics class. In particular, we focus on an amazing popular science video on the foundations of Einstein's special relativity produced in 1964 in the former Soviet Union.

BG05: 2:25-2:35 p.m. Screencast Tutorials

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

Computer-based training systems are becoming popular. I'll discuss a couple of samples of screencast tutorials that I've been working on.

Session BH: Methods of Teacher Evaluation

Location: Room 104B
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, Feb. 6
Time: 12:45–2:05 p.m.

Presider: Monica Plisch

Teacher evaluation has been a hot topic in the national news. Physics, with a relatively long history of discipline-based education research, is in a position to contribute to the national discussion.

BH01: 12:45-1:15 p.m. Evaluation of Teachers, or of Teaching, for Improving Learning Outcomes

Invited – David E. Meltzer, Arizona State University, Mary Lou Fulton Teachers College, Mesa, AZ 85212; david.meltzer@asu.edu

Many studies have been done to evaluate effectiveness of physics instruction, e.g.: How well do students learn physics concepts, problem-solving skills, or scientific process skills, or develop expert-like attitudes? The wide range of studies reflects the diversity of teaching goals. The clear result from decades of research is that the most important factor in effective instruction is the nature of the instructional methods and curricular materials. The same instructor can get very good, very bad, or very average outcomes from the same group of students, depending on the goals and the methods and materials employed. Other research has demonstrated that the same instructor using the same materials may obtain very different outcomes depending on the background and preparation of the students. I will argue that attempts to adduce "instructor-dependent" effects that are independent of methods, materials, and students, are largely spurious, impractical, and obstructive of effecting genuine improvements in instruction.

BH02: 1:15-1:45 p.m. Evaluating the Colorado LA Program as a Teacher Preparation Program

Invited – Kara E. Gray, University of Colorado, Boulder, CO 80309; kara.gray@colorado.edu

Valerie K. Otero, University of Colorado, Boulder

Research on teacher preparation has resulted in inconclusive findings due to diversity of programs, lack of controls, and reliance on self-reports. We conducted a quasi-experimental study on the effects of the Colorado LA program on preparing secondary science and math teachers using a "control group." We compared teaching practices of teachers who entered the traditional teacher certification program directly to those who first participated in the Colorado LA Program. We report on results of two methodologies for investigating teachers' classroom practices—classroom observations using the Reformed Teaching Observation Protocol (RTOP)[1] and Scoop Notebooks,[2] artifact packages compiled and submitted by teachers. We will discuss findings from both data sources, as well as the relative advantages and disadvantages of each. The LA program serves as a supplement to traditional programs. Significant differences will be discussed as well as conjectures about aspects that seem to be critical for influencing classroom practices.

1. D. Sawada, M.D. Piburn, E. Judson, J. Turley, K. Falconer, R. Benford, and I. Bloom, *School Science and Mathematics* **102**, 245-253 (2002).
2. H. Borko, B.M. Stecher, A.C. Alonzo, S. Moncure, and S. McClam, *Educational Assessment* **10**, 73-104 (2005).

BH03: 1:45-1:55 p.m. Exploring Pre-Service Science Teacher Learning in a Museum-University Partnership*

Contributed – Richard N. Steinberg, City College of New York, New York, NY 10031 steinberg@ccny.cuny.edu

Preeti Gupta, New York Hall of Science

Barbara Schroder, CUNY Graduate Center

CLUSTER (The Collaboration for Leadership in Urban Science Teaching, Evaluation, and Research) is a partnership of the City College of New York, the New York Hall of Science, and the City University of New York's Center for Advanced Study in Education. The goal of the partnership is to design a model to recruit and prepare undergraduate science majors to become high school science teachers. The project integrates formal education, informal education, and education research. In this presentation, we describe both the model and several of the techniques that we are using to gauge our success at working with these pre-service science teachers.

*This project is supported by the National Science Foundation.

BH04: 1:55-2:05 p.m. Evaluating Teacher Candidates' Inquiry Instruction and Academic Language Development

Contributed – Katy Nilsen, University of California, Santa Barbara, CA 93111; katynilsen@gmail.com

Danielle B. Harlow, University of California, Santa Barbara

Inquiry instruction and promoting students' use of academic language often require opposing instructional strategies. For instance, learning through inquiry means allowing students to construct an understanding of scientific phenomena through the collection, analysis, and interpretation of data, whereas developing students' academic language usually necessitates modeling and scaffolding on the part of the instructor. However, in order for a science teacher to be successful and meet the needs of all students, (s)he must master these different techniques. The researchers plan to review secondary science Performance Assessments for California Teachers (PACTs) that scored high in both areas to detail how these teacher candidates were successfully able to teach inquiry science and address individual students' language needs.

Session BI: SPS Undergraduate Research and Outreach

Location: Room 202AB
Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, Feb. 6
Time: 12:45– 2:15 p.m.

Presider: Gary White

BI01: 12:45-1:15 p.m. SPS Outreach: Celebrating a Century of Revolution

Invited – Erin Grace, University of Delaware, Newark, DE 19711; eegrace@udel.edu

Amanda Palchak, University of Southern Mississippi

Gary White, American Institute of Physics (AIP)

One of the motivating goals of the Society of Physics Students (SPS)* is providing science outreach to colleges and their local communities. This year marks the 10th year of SPS's Science Outreach Catalyst Kit (SOCK) program. The 2011 kit's theme is "A Century of Revolution," which celebrates Rutherford's discovery of the atomic nucleus using the results of the Gold Foil Experiment. The kits were sent to SPS chapters who used the included activities and demonstrations in outreach events. In one activity, students solve a "gold robbery" by learning about collisions. Another activity is a model for the Gold Foil Experiment, in which students discover the contents of a mystery box. A lesson on nuclear fission includes a dramatic demonstration of chain reactions using mousetraps and Ping Pong balls. This talk will present the development of the 2011 SPS SOCK.

*SPS in an organization of the American Institute of Physics (AIP).

BI02: 1:15-1:25 p.m. Radiation Induced Structural Changes in Ultra High Molecular Weight Polyethylene

Contributed – Rui Li, Rhodes College, Memphis, TN 38112; liru@rhodes.edu

Ann Viano, Rhodes College

Ultra High Molecular Weight Polyethylene (UHMWPE) is one component of the roughly 750,000 hip and knee replacements implanted annually in the United States. This material, which serves as cartilage in the artificial joint, exhibits in vivo wear properties known to be affected by a required manufacturing sterilization step, irradiation. Manufacturers exploit the effects of irradiation to improve wear by varying the dose. In this research, transmission electron microscopy (TEM) was used to investigate changes in UHMWPE microstructure with varying radiation dose. Results show that the degree of cross-linking is not monotonic with radiation dose. Structural features associated with cross-linking are at first enhanced with increasing radiation dose but then subside at higher doses. We theorize that radiation changes dominant bonds, allowing for the formation of new molecular structures which affect the degree of cross-linking. This study may provide an explanation of wear mechanisms and suggest optimal parameters for UHMWPE manufacturing.

BI03: 1:25-1:35 p.m. Electrodeposition and Characterization of Nanoporous Nickel-Copper AlloyFilms

Contributed – Evan F. Nelsen, Memphis, TN 38112; nelef@rhodes.edu*

Jennifer Hampton, Hope College

Nanostructured materials have a number of interesting properties such as high surface area and enhanced reactivity. This project focuses on creating and characterizing nickel-copper alloy thin films. Using a BAS Epsilon electrochemical workstation and a Teflon electrochemical cell, nickel-copper thin films were deposited from solution onto uniformly gold-plated silicon wafers at various potentials. The resulting samples' structure and composition were examined using Scanning Electron Microscopy (SEM) and Energy Dispersive Spectrometry (EDS). The capacitance of the samples was measured in order to estimate their roughness. Moreover, copper was electrochemically removed from samples deposited using a specific deposit potential. The resulting nanoporous samples' structure, composition and capacitance were then analyzed. This material is based upon work supported by the National Science Foundation under NSF-REU Grant No. PHY/DMR-1104811, NSF-RUI Grant No. DMR-1104725 and NSF-MRI Grant No. CHE-0959282.

*Sponsor: Ann Viano

BI04: 1:35-1:45 p.m. Life as a Hilltern

Contributed – Courtney Lemon, California State Polytechnic University, Pomona, CA 91768; courtneylemon@gmail.com

The Mather Policy Intern Program, conducted through the Society of Physics Students, is an innovative internship encouraging physics students to get involved in science policy. Funded by the John and Jane Mather Foundation for Science and the Arts and the American Institute of Physics, Mather Interns spend a summer at the Capitol, working as congressional interns for a representative or committee. As the first female student inducted into the Mather Policy Intern program, Courtney Lemon presents Life as a Hilltern, her summer working with Representative Rush Holt, the only physicist currently serving in the U.S. House of Representatives.

BI05: 1:45-1:55 p.m. Proper Care and Feeding of a Dynamic SPS Chapter

Contributed – Brooke Haag, 791 Memorial Drive Hollister, CA 95023 bhaag@hartnell.edu

Advising a physics club at a two-year college can be a rewarding venture. Though rewarding, it does require a good amount of hard work to promote the goals of an SPS chapter consisting of a group of freshman and sophomore students with only the occasional physics major. By focusing on several specific goals, Hartnell college's SPS chapter consistently attracts a loyal following of students willing to dedicate the time and energy necessary for a robust program. The club has earned national recognition as well as a local reputation as one of the best and longest-lived clubs on campus. In this talk, recommendations for guiding a successful club will be presented. In addition, past mistakes, potential pitfalls, and future plans will be discussed.

BI06: 1:55-2:05 p.m. The Role of Student Culture in the Science Classroom*

*Contributed – Ebony Moore,** Chicago State University, Chicago, IL 60628; ebony.rose.spells@gmail.com*

Karla Jemison, Mel S. Sabella, Andrea Gay Van Duzor, Chicago State

The chemistry and physics department at Chicago State University has been involved in curriculum development and education research projects that target urban physics learners from the community on the south side of Chicago. As a result of this work we have begun to recognize specific cultural norms that our students bring to the science class. In some instances student culture aligns with the classroom environment and in other instances they conflict. In this talk we explore aspects of student culture at CSU and describe how an understanding of student culture may be used to improve the scientific learning environment.

*Supported by the NSF Noyce Program (DUE # 0833251) and a PhysTEC Grant from the American Physical Society.

BI07: 2:05-2:15 p.m. Modeling the Motion of a Magnet in the Presence of a Conductor

Contributed – Matthew R. Kemnetz, Loyola University Chicago, IL 60660; mkemnetz@luc.edu*

Benjamin J. Irvine, Asim Gangopadhyaya, Loyola University Chicago

We plan to develop an analytical model of magnetic damping. Magnetic damping occurs when a magnet moves in proximity to a conductor. The changing magnetic field produces an electric field, which generates currents in the conductor. These eddy currents then produce a magnetic field that opposes the motion of the magnet. This phenomenon is utilized in the braking systems of hybrid cars, some trains, and roller coasters. The major benefit of magnetic braking is that an object can be slowed down without losing energy to friction. The kinetic energy of an object is converted directly into electrical energy. For this reason, magnetic damping is fundamental to the development of future technology in regenerative braking. Magnetic braking is extensively used in industry where computational methods are employed to accurately model magnetic braking. Our improved analytical model will provide an excellent benchmark for any computational models.

*Sponsor: Asim Gangopadhyaya

AAPT Awards: Oersted Medal, DSCs, SPS Chapter Advisor

Location: Ballroom C
Date: Monday, Feb. 6
Time: 3–4:30 p.m.

Presider: David Cook

Charles H. Holbrow

Oersted Medal Awarded to Charles Holbrow

Making Physics Make Sense – Narratives, Content, Witz

Charles H. Holbrow, MIT, Physics Department, Cambridge, MA 02319

Physics is the syntax and grammar of science; it is the rules. Therefore, you must learn physics to write, speak, or do good science. But knowing the rules of physics won't make you a good physicist or a good physics teacher any more than knowing grammar will make you a good writer. To bring physics alive you need strong narratives and interesting content. I will describe three examples: A course—"The Physics of Living in Space"; a textbook—*Modern Introductory Physics*; and a project— Using Astronomy to Teach Physics. I will also explain with examples what I mean by "Witz" and why it is important.

AAPT Distinguished Service Citations Awarded to
Elizabeth Chesick, Peter Hopkinson and Jan Tobochnik

Elizabeth Chesick

Peter Hopkinson

Jan Tobochnik

Announcement of the Hashim A. Yamani Fund

SPS Chapter Advisor Award Given to
Brent Hoffmeister

Brent Hoffmeister

Session CA: Frontiers in Space Exploration

Location: Room 202AB
Sponsor: Committee on Space Science and Astronomy
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, Feb. 6
Time: 6–7 p.m.

Presider: Joe Heafner

CA01: 6-6:30 p.m. Exploring the Universe with the James Webb Space Telescope

Invited – Heidi B. Hammel, AURA, Washington, DC 20005; hbh@alum.mit.edu

The James Webb Space Telescope (JWST) is NASA's next Great Observatory, the scientific successor to both the Hubble and Spitzer Space Telescopes. Its scientific equipment will include several cameras to produce amazing images in the tradition of Hubble. JWST will see the first galaxies to form in the universe, and explore how stars are born and develop planetary systems. It will examine planets around other stars to investigate their potential for life, and study planets within our own Solar System. This innovative telescope represents a major step forward in technology, with a segmented mirror three times larger than Hubble that operates a million miles away in the cold, dark environment of Earth's Lagrange 2 point. Dr. Heidi B. Hammel is one of the six Interdisciplinary Scientists for this cutting-edge facility. In her talk, she will give a sneak preview of JWST's anticipated science and discuss the telescope's current status.

CA02: 6:30-7 p.m. The Interstellar Boundary Explorer (IBEX)

Invited – David J. McComas, Southwest Research Institute, San Antonio, TX 78228-0510; dmccomas@swri.edu

The Interstellar Boundary Explorer (IBEX) remotely observes the global interaction of our heliosphere (the region dominated by the Sun) with the local interstellar medium. IBEX provided the first all-sky maps of Energetic Neutral Atoms (ENAs) emanating from the heliospheric boundaries at energies from ~0.1-6 keV. The IBEX team discovered a smoothly varying, globally distributed ENA flux overlaid by a narrow "ribbon" of significantly enhanced ENA emissions. Since the publication of these results (Science, 2009) IBEX discovered time variations in the interaction, separated the ribbon from distributed fluxes, inferred ion source temperatures, and carried out many other observational and theoretical studies of the outer heliosphere. In addition, IBEX made the first observations of ENAs produced by backscatter and neutralization of the solar wind from the lunar regolith and provided the first energy and angle resolved ENA images of the subsolar magnetosheath, magnetospheric cusps, and terrestrial plasma sheet.

Session CB: Teaching Physics Around the World

Location: Room 200C
Sponsor: Committee on International Physics Education
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, Feb. 6
Time: 6–7:10 p.m.

Presider: Marina Milner-Bolotin

CB01: 6-6:30 p.m. The World Conference on Physics Education and Its Predecessors*

Invited – Dean Zollman, Kansas State University, Manhattan, KS 66506; dzollman@phys.ksu.edu

Each year several international organizations sponsor conferences that focus on the teaching and learning of physics. In 2012 most of these organizations are working together to create the first World Conference on Physics Education in Istanbul, 1-6 July. This conference is envisioned to be somewhat different from a typical conference in which individuals present papers and posters. Instead, it will be a working conference that will help build collaborations related to physics education research and development. The World Conference is being organized by the Groupe International de Recherche sur l'Enseignement de la Physique (GIREP) and the International Commission on Physics Education (ICPE) and endorsed by Latin American Physics Education Network (LAPEN), the Multimedia in Physics Teaching and Learning Group (MPTL), the Asian Physics Education Network (AsPEN) and AAPT. The regular conferences of each of these groups have unique characteristics and goals. Thus, the World Conference will combine features from these meetings, but also be a unique effort. How these conferences led to the format for the World Conference and plans for combined meetings beyond the first World Conference will be discussed.

* At present, financial support for the World Conference is being provided by the International Union of Pure and Applied Physics and the European Physical Society.

CB02: 6:30-7 p.m. Rethinking the Experimental Curriculum

Invited – Ian G. Bearden, Niels Bohr Institute, University of Copenhagen, Denmark; bearden@nbi.dk

We are currently redesigning the experimental component of our curriculum. This project has grown from a desire to ensure that all students master what we consider the basic experimental skills and competences required of physicists. In addition to traditional components of an experimental physics curriculum such as data analysis, error propagation, experimental procedures, etc., we aim to explicitly focus on other skills that are of vital importance to all physicists, regardless of whether they follow an academic or industrial career. Among these are oral and written communication, project planning and management, critical thinking, and team work—all skills that are often assumed to be obtained by students despite the lack of explicit focus on them in traditional curricula. This talk will give an overview of the initial stages of this process, in particular on the consensus reached among faculty and students regarding which skills and competences are, in fact, most important and how we are changing our curriculum to provide explicit education in these areas. In addition, the results of the first terms experience in this process and our evaluation procedures will be discussed.

CB03: 7-7:10 p.m. Cultural Content Knowledge as a Goal of Physics Education

Contributed – Igal Galili, The Hebrew University of Jerusalem Science Teaching Center, Jerusalem, 91904 Israel; igal@vms.huji.ac.il

The framework of discipline-culture suggested earlier for teaching physics theories in a cultural manner was applied by our physics education research group in Jerusalem. Within this perspective, physics knowledge appears as dynamic and structured. The correspondent curriculum aims at the Cultural Content Knowledge (CCK)[1] of physics exposing the fundamental theories of physics as stemming from the constructive dialogue of several paradigmatic ideas and models that establish the required for learning space of variation. Within the European project HIPST we developed several excurses into the history and philosophy of important physical concepts.

1. I. Galili, "Promotion of Content Cultural Knowledge through the use of the History and Philosophy of Science," *Science & Educ.*(2011); DOI 10.1007/s11191-011-9376-x.

Session CC: AP Physics B

Location: Room 106
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, Feb. 6
Time: 6–7 p.m.

Presider: Martha Lietz

1: 6-6:30 p.m. Development of the Two Course Model for AP Physics B*

Invited – Deborah M. Roudebush, Oakton High School, Vienna, VA 22181; droudebush@cox.net

The focus of the first of two presentations on the new AP Physics 1 and 2 courses is to provide a holistic look into the two-year curriculum that will be replacing the current one-year curriculum for the AP Physics B course. The new courses, AP Physics 1 and AP Physics 2, divide the current content material into two independent courses to align with best practices by increasing student exposure to academic rigor, deeper conceptual understanding, and problem-solving investigations. The history of the redesign process will recap the research behind the decision to split the current AP Physics B into the two new courses. This will include an overview of discussions related to college equivalence.

*This work was supported by College Board.

CC02: 6:30-7 p.m. Development of the Two Course Model for AP Physics B

Invited – Connie Wells, Pembroke Hill School, Kansas City, MO 64112; cwells@pembrokehill.org

The focus of the second of two presentations on the AP Physics 1 and 2 courses is to guide the audience through the new AP Physics 1 and 2 Curriculum Framework that clearly defines what students will be expected to know and do by the end of each course. An overview of the guiding science practices that are now paired with essential knowledge in physics to produce student learning outcomes for each course will be provided, along with examples of how these learning objectives will be used to inform the dramatic changes in test questions for the new exams—including the emphasis on inquiry-based exam questions. The most recent released information from The College Board will be shared with the audience.

Session CE: Best Practices in the Use of Educational Technologies

Location: Room 204
Sponsor: Committee on Educational Technologiese
Date: Monday, Feb. 6
Time: 6–7:30 p.m.

Presider: Scott Schultz

This session will be aimed at disseminating the absolute best use of technology in physics education.

CE01: 6-6:30 p.m. ComPADRE for the Classroom*

Invited – Bruce Mason, University of Oklahoma, Norman, OK 73019; bmason@ou.edu

For nearly a decade, the ComPADRE editors and staff have been providing a wide range of content and services to physics teachers and learners. This presentation will provide a whirlwind tour of some of the many ways that ComPADRE is being used to support physics classes. Ranging from editor-created resource collections for physical science topics to active learning in upper-level physics classes and from our members' personal collections to partnerships with curriculum developers, this talk will highlight some examples of how the ComPADRE technology impacts the teaching and learning of physics.

*This work is supported, in part, by NSF grants 0937836, 0532798, 0226192

CE02: 6:30-7 p.m. Teaching Physics with PhET Simulations: Engaging Students and Increasing Learning*

Invited – Katherine K. Perkins, University of Colorado, Boulder, CO 80305; Katherine.Perkins@colorado.edu

PhET Team

The PhET Interactive Simulations project at the University of Colorado offers over 100 free simulations (sims) for teaching and learning physics and chemistry. These sims are now widely used across grade levels—more than 22 million uses per year, from ninth grade physical science to introductory college physics to quantum mechanics. Each sim is based on education research and offers an intuitive, game-like environment where students learn through scientist-like exploration, where dynamic visual representations make the invisible visible, and where science ideas are connected to real-world phenomena. With their flexible design, PhET sims are used in many ways—as demos, homeworks, or inexpensive, accessible lab alternatives—and getting started is easy with our database of over 500 activities. Here we will highlight examples of how sims can be effectively incorporated into courses, guided by our research and experience of using them in middle school through college classes.

*The PhET Project is funded by the Hewlett Foundation, NSF CCLI #0817582, NSF DRK12 #1020362, JILA, University of Colorado Boulder, and the O'Donnell Foundation.

CE03: 7-7:10 p.m. Analyzing the Real World Motion of Humans, Mammals and Machines

Contributed – Jitendra Sharma, Gainesville State College School of STEM, Gainesville, GA 30504; jsharma@gsc.edu

The ubiquity of GPS technology allows the capture of the time varying position vector for any moving object on the surface of the Earth, and contains all the kinematics of the motion. If the mass of the moving object is known, the energy transactions involved in the motion can be inferred. A few case studies involving human, mammal, and machine movement will be presented. The thermodynamic efficiency associated with the movement can be calculated along with the energy/fuel consumed in the motion. The relation of the thermodynamic efficiency of mammals to fractal geometry will be illustrated. The exploration of the phase plots associated with the motion opens up several opportunities for scientific interpretation/writing and discovery based learning. For the most part, students are involved in the motion and this helps them connect the physical principles to their experiential domain.

CE04: 7:10-7:20 p.m. Using MBL as an Educational Technology in Introductory Physics

Contributed – Thomas L. O'Kuma, Lee College, Baytown, TX 77522-0818; tokuma@lee.edu

Microcomputer-Based Laboratory (MBL) has been around for over two decades. Coupled with research-based curriculum and ideas, MBL is a powerful tool for aiding student understanding of physics concepts. In this talk, I will discuss some of the MBL activities that we have implemented during this time with some student results.

CE05: 7:20–7:30 p.m. Moving from Multiple Choice to Alphanumeric Clickers

Contributed – Matt Evans, University of Wisconsin-Eau Claire, WI 54701; evansmm@uwec.edu

Socrates said that the unexamined life is not worth living. I say that unexamined clicker use is not worth using. After using standard five-response MC clickers for over six years, I switched to technology that supported alphanumeric entry and had to look carefully at the implementation of the new technology in my classroom. I will share instances where this expanded technology has helped me delve deeper into student understanding, and additionally where I feel the old system continues to excel.

Session CF: Physics and Society Education

Location: Room 200AB
Sponsor: Committee on Science Education for the Public
Date: Monday, Feb. 6
Time: 6–7:10 p.m.

Presider: Olga Livanis

To what degree does our current physics education provide society a working knowledge from where the public is able to interpret and participate in a discourse on relevant scientific issues? And what changes can be implemented to improve this educational process?

CF01: 6-6:10 p.m. General Science Materials for Developing Students' Scientific Literacy: Part I

Contributed – Jeff D. Marx, McDaniel College, Westminster, MD 21157; jmarx@mcdaniel.edu

Karen Cummings, Southern Connecticut State University

Under an award from the National Science Foundation, we have begun the development, implementation, and assessment of undergraduate, general-science-level course materials with a primary and explicit goal of improving students' scientific reasoning ability, science process skills, and understanding of the nature of science (collectively: "scientific literacy"). To facilitate the development of students, scientific literacy, we have crafted activities and discussion points that draw from a wide range of science disciplines. However, specific science content serves not as the principle focus of the class, but only as a mechanism to more deeply engage the students. In this, the first of two talks, we will present our arguments for why such materials are important, provide a general overview of how our materials are organized, and outline the various facets of scientific literacy addressed by our materials. Finally, we will discuss the progress of implementation at the speaker's home institute.

CF02: 6:10-6:20 p.m. General Science Materials for Developing Students' Scientific Literacy: Part II

Contributed – Karen Cummings, Southern Connecticut State University, New Haven, CT 06515; cummingsk2@southernct.edu

Jeffrey D. Marx, McDaniel College

Under an award from the National Science Foundation, we have begun the development, implementation, and assessment of undergraduate, general-science-level course materials with a primary and explicit goal of improving students' scientific reasoning ability, science process skills, and understanding of the nature of science. In this, the second of two talks, we will present examples of materials under development and discuss the progress of implementation at the speaker's home institute.

CF03: 6:20-6:30 p.m. Evidence of Student Success: Integrating Projects and Technology to Enhance the Learning of Physics Concepts

Contributed – Capitola D. Phillips, NorthWest Arkansas Community College, Bentonville, AR 72712; dphillips@nwacc.edu

Melody Thomas, Dixie Androes, Wendi Williams, Marvin Galloway, NorthWest Arkansas Community College

Physical Science faculty at NorthWest Arkansas Community College have developed a curriculum-driven, project-based learning model to enhance the learning of physics concepts in Introductory Physical Science courses (EMPACTS -Educationally Managed Projects Advancing Curriculum, Technology/Teams and Service). Learning is enhanced as students create their own learning experiences through the application of course content, use of collaborative projects and integration of technology and service. Students grow as students, individuals, and team members as they hone written and oral communication skills and learn new skills through the use of technology and collaboration within the community. Attitude and content assessments show a positive increase in student knowledge and dispositions in Astronomy, Intro to Physical Science and Physics and Human Affairs courses.

CF04: 6:30-6:40 p.m. Communicating Science to Our Students and the Public

Contributed – Gordon James Aubrecht, Ohio State University, Marion, OH 43302-5695; aubrecht.1@osu.edu

Unless something is done, millennium-length consequences of the greenhouse gases we have already released will cause harm to the planet. Groups of people supported by political forces and money have decided that denial of scientific data is not only reasonable, but a moral force that opposes that of stewardship. I characterize these people as "denialists," to distinguish them from true skeptics, scientists who must be skeptical to do their work. Denialists have succored the people who just want the problem to go away by sowing doubt about scientific integrity and distorting the meaning of scientific uncertainty. How scientists can change the framing of the issue and how individual scientists can influence the public through reasoning with fellow citizens and writing letters to their local papers countering misinformation is the focus of this talk.

CF05: 6:40-6:50 p.m. Modern Superstition: What Can a Physics Teacher do About It?

Contributed – Sadri Hassani, Illinois State University, Normal, IL 61790-4560; hassani@phy.ilstu.edu

Modern superstition has many faces and too many advocates. Some of these advocates are intellectuals—academic and nonacademic—who (ab)use science to attack science. One group, which has done considerable damage to the reputation of science among the faculty and students in humanities, is those philosophers of science who question the traditional scientific methodology and suggest certain nonscientific—even antiscientific—alternatives. As one of many examples of what we can do to educate our students about modern superstition, I will discuss Galileo's discovery of the first law of motion and differentiate between scientific methodology that led to that law and the methodology advocated by some philosophers of science. I'll also look at some absurd conclusions to which that methodology can lead.

CF06: 6:50-7 p.m. Physics Education Policy – A Call to Action

Contributed – Philip W. Hammer, American Institute of Physics, College Park, MD 20740 hammer@aip.org

STEM education as a policy priority is becoming increasingly visible in Washington, D.C., as the President, business leaders, professional societies, and yes, even Congress, recognize that continued revitalization of STEM education in the U.S. is vital to our nation's near-term and long-term national security and economic viability. Yet, the enduring recession and political gridlock are creating roadblocks for continued investments and reforms in science education that AAPT members have promoted. Our community has developed a rich body of research-validated pedagogies, and a national network of teacher preparation and professional development programs "most funded by NSF" yet we now find ourselves with an uncertain future in which there are no national mechanisms for scaling and sustaining what works. AAPT and AIP are leading a group of physical science organizations to propose a set of physical science education policy priorities in anticipation of Congress's reauthorization of No Child Left Behind, the major U.S. law governing K-12 education in the U.S.

CF07: 7-7:10 p.m. Global Warming in the Media: Science or Pseudoscience?

Contributed – Lynnette M. Hoerner, Red Rocks Community College, Lakewood, CO 80228, lynnette.hoerner@rrcc.edu

In the ongoing media discussion on global warming, it is sometimes difficult for the public to distinguish valid scientific claims from political rhetoric. This workshop covers a series of hands-on activities through which students explore the difference between pseudoscience and science. The activities promote an understanding of the scientific process and help students recognize the characteristics of true science. Students then use critical thinking to evaluate claims that appear to be scientific, ranging from those made by astrology to Newton's laws. They then participate in a research project and a laboratory activity to investigate the science behind the global warming debate. Finally, they apply what they have learned to critically and scientifically assess this important topic, separating the science from the hype. Electronic copies of the activities will be available to all attendees.

Session CG: Undergraduate Research and Two-Year Colleges

Location: Room 103
Sponsor: Committee on Physics in Two-Year Colleges
Date: Monday, Feb. 6
Time: 6–7:30 p.m.

Presider: Brian Holton

Physics is a research-oriented science—for that, there is no doubt. Providing research opportunities for students and faculty at most two-year colleges presents quite a challenge. This session discusses how two-year colleges have instituted successful programs involving students and faculty in physics research.

CG01: 6-6:30 p.m. Tapping the Potential of All Students: Undergraduate Research at Community Colleges

Invited – Nancy H. Hensel, Council on Undergraduate Research, 734 15th St. NW Suite 550, Washington, DC 20005; nancy@cur.org

The Council on Undergraduate Research currently has a National Science Foundation grant to work with about 100 community colleges to assist them in developing undergraduate research programs. Nearly 50% of all students in higher education begin their education at a community college. Community colleges prepare students to transfer to four-year colleges and to work as technicians in scientific jobs. For students who want to transfer, it is important that they have undergraduate research experiences early in their education as it will make the transfer process easier. Industry has suggested that students with undergraduate research experiences are more effective technicians than those without research experiences. Community colleges also prepare a significant number of underrepresented students and their participation in undergraduate research can increase the number of minority students who will become researchers, doctors, science writers and policy makers. This session will describe approaches to undergraduate research at two year colleges.

CG02: 6:30-7 p.m. Research and the Advancement of STEM Majors in Two-Year Colleges

Invited – David R. Brown, Southwestern College, Chula Vista, CA 91910; dbrown@swccd.edu

Undergraduate research is a mechanism through which students can strengthen their critical thinking skills, establish connections between various subjects in their discipline curricula, and mature as scientists and engineers. Government agencies and professional organizations, such as the National Science Foundation and the Council on Undergraduate Research, have supported efforts to increase the number of community colleges that participate in undergraduate research activities. This presentation will share examples of means of support for undergraduate research on the national level and will provide specific examples of research activities undertaken by community college students that have led them from laboratories at Southwestern College to the halls of the U.S. Congress.

CG03: 7-7:30 p.m. Mentoring Student Research at the Two-Year College.

Invited – Martin S. Mason, Mt. San Antonio College, Walnut, CA 91789; mmason@mtsac.edu

Over the past decade our program has placed a strong emphasis on student research by offering research courses for credit, hosting an annual research conference for lower division STEM students, providing seminars and mentoring on applying for summer REU programs, building collaborations with local four-year institutions to place students in research opportunities, and having active faculty research programs on campus that are accessible to lower division students. This emphasis on student research grows out of the project-based orientation of the introductory physics courses which provide a template for independent student work. An active student research program has helped to create increased interest and retention in STEM majors, an increase in transfer to R1 programs and a reinvigoration of faculty.

Session CH: Teaching Methods for Physics Teacher Preparation

Location: Room 203AB
Sponsor: Committee on Teacher Preparation
Date: Monday, Feb. 6
Time: 6–7:30 p.m.

Presider: Duane Merrell

What should be included in a methods course for physics teachers? What curriculum issues do you face? How do you balance physics content with education standards? How do you attract students to choose physics as their certification?

CH01: 6-6:30 p.m. Using the Learning Cycle for Teaching Methods for Physics Teacher Preparation

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

The University of Northern Iowa offers undergraduate secondary science teacher preparation programs in physics, chemistry, earth science, biology, all science, and middle/junior high school science. Programs like the BA Physics Major-Teaching are within the appropriate departments of the College of Humanities, Arts and Sciences. Students in these programs complete professional teacher education courses and secondary science methods courses that involve extensive field experiences at the university laboratory school and at local schools. Physics teaching majors and others with a physical science emphasis take a methods for teaching physical science course prior to student teaching. In this course, students are introduced to the learning cycle and various learning cycle curricula including Physics Resources and Instructional Strategies for Motivating Students (PRISMS) PLUS. Students develop and teach learning cycle lessons with feedback provided by the instructor and classroom teacher. The course and methods used will be described along with the challenges of teaching the course.

CH02: 6:30-7 p.m. Preparing Future Physics Teachers for Every-day Challenges of a High School Classroom

Invited – Eugenia Etkina, Rutgers University, New Brunswick, NJ 08901; eugenia.etkina@gse.rutgers.edu

Have you thought of what any physics teacher needs to know? First comes physics itself, its final product (all those concepts and equations) and the process. Then comes the knowledge of learners. Finally, the most complex of all, is the Pedagogical Content Knowledge, or PCK that helps teachers choose and implement productive instructional strategies coupled with meaningful assessment. But wait, where does learning to plan instruction fit? Where is learning to make physics exciting and meaningful for the students? Where is helping high school students develop their physics identities? Where are the intricate details of kinematics, dynamics, energy, etc. The list of "where is" is infinite? Is it possible for a teacher "in-the-making" to master even 10% of this? In this talk I will describe how the Rutgers program that has been producing large numbers of physics teachers answered the above questions.

CH03: 7-7:10 p.m. Learning to Identify and Value Children's Ideas through Informal Science

Contributed – Danielle B. Harlow, University of California at Santa Barbara, CA 93106-9490; dharlow@education.ucsb.edu

Anne E. Emerson, Katy J. Nilsen, University of California at Santa Barbara

We document the results of integrating informal science into a teacher education program. In this study, pre-service teachers facilitated stations at a family science night as a context for them to learn to identify, assess, and use children's science ideas. Assessment is already difficult in K-12 classrooms. Assessing learning in informal learning environments adds the complication that participation is largely voluntary. As such, controlling the learners' participation in ways that allow for systematic assessment of learning is counter to the intents of informal environments. We found that the student teachers self-reported greater self-efficacy and developed understandings about children's science ideas. Data included reflective postings by the pre-service teachers, class discussions, observations, written work, artifacts, and photographs. The findings contribute to understanding the value of multiple types of learning contexts in teacher preparation and lead to implications about leveraging a greater system of science education for educating our children and teachers.

CH04: 7:10-7:20 p.m. Physics Learning Assistants' Perspectives on Development of Reflective Teaching Practice

Contributed – Geraldine L. Cochran, Florida International University, Miami, FL 33199; gcoch001@fiu.edu

David Brookes, Eric Brewe, Laird Kramer, Florida International University

One of the goals of the Learning Assistants (LAs) Program at Florida International University is to help our LAs, prospective science and mathematics teachers, to develop reflective teaching practices. We endeavor to accomplish this by means of weekly content meetings with faculty members, weekly reflective homework assignments, and classroom discussions as a part of the LA Seminar course on science education and theory, and opportunities for teaching. To better understand the needs of our LAs in developing reflective teaching practice and their perspective on the relationship between their teaching experiences and their development of reflective teaching practice, we interviewed three of our physics LAs. Analysis of these interviews revealed LA perspectives on 1) how LAs engage in reflection, 2) experiences that spark their engagement in reflection, and 3) their perspective on efforts to help them develop reflective teaching practices.

CH05: 7:20-7:30 p.m. Adoption of Community Practices by Experienced Physics Teachers Through Peer-Instruction

Contributed – Wendi N. Wampler, Oregon State University, Corvallis, OR 97331; wamplerw@onid.orst.edu

Dave Bannon, Dedra Demaree, Oregon State

Adoption of reform-based curricula among physics instructors has been a point of interest in the physics education community. Oregon State University (OSU) and local community colleges are collaborating on a grant to promote department-wide, team-based, curricular reform. The purpose of this project is three-fold: to better coordinate our introductory courses, to develop and share the best of our curricular activities, and to document the shared knowledge in a way that helps incoming/rotating instructors adopt the courses. This talk will present a case study of an experienced instructor who is new to physics education research. We observed the instructor in lecture classes, conducted post-class interviews, and examined discussions during faculty development workshops. The focus will be on the instructor engaged in community discourse and in the process of adopting structural, pedagogical and curricular reforms in introductory calculus based physics.

Session CI: Teaching Across the Science Curricula: Engaging Students in Physics Curricula

Location: Room 104B
Sponsor: Committee on Physics in High Schools
Date: Monday, Feb. 6
Time: 6–7 p.m.

Presider: Jan Mader

Do you dissect eyeballs with the biology students and have them find the index of refraction of the humor and the focal length of the lens or examine the forces responsible for the plate tectonics? This session discusses techniques for engaging students in physics concepts in other science curricula.

CI01: 6-6:10 p.m. From Motors to Proteins

Contributed – Janet Y. Sheung, University of Illinois at Urbana-Champaign, Urbana, IL 61801; janetsheung@gmail.com

Jonathan Scott, Normal Community High School

Biophysics has been an exciting, active field of research for the past three decades, yet to this day few physics classes below the graduate level devote any time to this topic. We present a lesson developed in collaboration between researchers at the University of Illinois and local high school science teachers, which introduces students to an important protein whose job is to move cargo across the cells in our bodies. By drawing analogies between it and a motor doing work, students perform a guided, hands-on experiment where they use their knowledge of physics to make the same measurements on their fellow classmates as physicists made on this protein, to determine which is the more efficient motor. This lesson ties together disparate concepts such as displacement, refraction, springs, work, and statistics, and presents them in a relevant context. It will give students first-hand experience with the interdisciplinary nature of cutting-edge research.

CI02: 6:10-6:20 p.m. Improved Science Preparation in the Elementary Education Curriculum*

Contributed – Robert J. Culbertson, Arizona State University, Tempe, AZ 85287-1504; robert.culbertson@asu.edu

Ann Hammersly, Chaparral High School, Scottsdale, AZ

Tapati Sen, Charles B. Weeks, Arizona State University

Suzi D. Shoemaker, Central Arizona College

The curriculum for elementary education majors at Arizona State University is going through a major revision. In addition to an increase in mathematics credits and other requirements, the science requirements

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have been increased to three courses plus a signature course in sustainability. In parallel with this curriculum revision, 40 new courses, including eight science courses, are being developed for elementary education majors under the Teaching Foundations Project, funded by the U.S. Department of Education. These courses and all associated course materials will soon be available for distribution. Two of the science courses, Music in Motion: The Design and Construction of Musical Instruments, and Physical Universe, will be described.

*Partially funded by The National Science Foundation (Award No. 0737142) and the U.S. Department of Education (Award No. 10015535).

CI03: 6:20-6:30 p.m. Using Backwards Faded Scaffolding to Support ASTRO101 Inquiry Teaching

Contributed – Timothy F. Slater, University of Wyoming, Laramie, WY 82071; timslaterwyo@gmail.com

Stephanie J. Slater, CAPER Center for Astronomy & Physics Education Research

Daniel J. Lyons, University of Chicago

Kendra Sibbernsen, Metropolitan Community College

Katie Berryhill, American Public University System

In the course of learning astronomy, it is generally accepted that successful science learning experiences should result in learners developing a meaningful understanding of the nature of science as inquiry where: (i) students are engaged in questions; (ii) students are designing plans to pursue data; and (iii) students are generating and defending conclusions based on evidence they have collected. We are field-testing a series of computer-mediated, inquiry-learning experiences for non-science majoring undergraduates in introductory astronomy, ASTRO101, based upon an inquiry-oriented teaching approach framed by the notions of backwards faded-scaffolding as an overarching theme for instruction. Backwards faded-scaffolding is a strategy where the linear scientific method is turned on its head and students are first taught how to create conclusions based on evidence, then how experimental design creates evidence, and then supports students inventing scientifically appropriate questions. (Supported by NSF.)

CI04: 6:30-6:40 p.m. Biomedical Physics for Life Sciences Students and Physics Majors

Contributed – Fang Liu, The Richard Stockton College of New Jersey, Galloway, NJ 08205-9441; fang.liu@stockton.edu

The growing number of premedicine and pre-physical therapy students has influenced the development of an undergraduate level biomedical physics course for both life sciences students and physics majors. The primary objective of this course is for students to develop a basic understanding of the key physical principles underlying biological applications and medical technologies. In this course students are introduced to the following topics: biomechanics in sport medicine, exponential growth and decay in medicine, ultrasound, X ray, Computed Tomography, ionizing radiation and radioactivity, nuclear medicine, Magnetic Resonance Imaging, radiation therapy and radiation safety. As a result the application-oriented objective helped students engage with course materials and enabled students to appreciate the deep connections between the physical and life sciences.

CI05: 6:40-6:50 p.m. Estimating the Size of Onion Epidermal Cells from Diffraction Patterns

Contributed – Jeffrey R. Groff, Shepherd University, Shepherdstown, WV 25443; jgroff@shepherd.edu

Bioscience and pre-medical profession students are a major demographic served by introductory physics courses at many colleges and universities. Exposing these students to biological applications of physical principles will help them to appreciate physics as a useful tool for their future professions. An experiment suitable for introductory physics is described where principles of wave optics are applied to probe the size of onion epidermal cells. The epidermis tissue is composed of cells of relatively uniform size and shape so the tissue acts like a one-dimensional transmission diffraction grating. The diffraction patterns generated when a laser beam passes through the tissue are analyzed to estimate the average width of individual onion epidermal cells. These results can be compared to direct measurements taken using a light microscope. The use of microscopes and plant-cell tissue slides create opportunities for cross-discipline collaboration between physics and biology instructors.

CI06: 6:50-7 p.m. Using the MCAT as a Syllabus for Your Physics Course

Contributed – Donald G. Franklin, Mercer University, Hampton, GA 30228; dgfrank1@aol.com

When preparing Life Science majors who are looking at medical careers, it becomes important to look at the core test they must take. Look at the physics requirements and adjust your syllabus to cover this material. Two major topics appear: Use of engineering code for math problems and applications of math problems to their field. Looking for solutions? Explore the material that is available to the instructor.

The Out-Laws of Physics Perform for AAPT!

This lively five-piece band is made up of members of the Physics Department at California State Polytechnic University, Pomona

Tuesday, February 7
Ballroom B • 6:00–7:00 p.m.

Tickets: $20 (fundraiser for AAPT)
Purchase your tickets at the Registration Desk

Drummer Harvey Leff of the Out-Laws of Physics

PST1: Poster Session 1

Location: Ballroom A
Date: Monday, Feb. 6
Time: 7:30–9 p.m.

Odd number poster authors will be present 7:30–8:15 p.m.
Even number poster authors will be present 8:15–9 p.m.
(Posters should be set up by 9 a.m. Monday and taken down by 10 p.m. Monday)

Astronomy

PST1A01: 7:30-8:15 p.m. 15 Years of BYU's Small Astronomical Observatory Research

Poster – Eric G. Hintz, Brigham Young University, Provo, UT 84602; doctor@tardis.byu.edu

Victor Migenes, J. Ward Moody, Denise C. Stephens, Michael D. Joner, Brigham Young University

Over the last 15 years BYU has developed a program of undergraduate astronomy research that makes use of a number of small observatory facilities. These facilities have been used as part of our Physics and Astronomy Major to provide our students with hands-on research experiences and give our descriptive astronomy students exposure to real research equipment. We will feature three facilities in this presentation. First is the campus Orson Pratt Observatory 0.4-m telescope which provides a teaching telescope for our introductory observational astronomy class. Second is the ROVOR 0.4-m telescope, located in Delta, Utah, which provides remote telescope access to our students. Finally, there is our new 4.0-m radio dish on the roof near our campus optical telescope. We will present information on how we make use of these facilities to teach both our majors and non-major students.

PST1A02: 8:15-9 p.m. Electromagnetic Spectrum and the Study of Life

Poster – Lloyd Lytle, Roybal High School, Los Angeles, CA 90027; lloydlytle@yahoo.com

This poster shows a lesson that helps students gain an understanding of how the electromagnetic spectrum can help scientists search for life in the universe. The lesson is geared toward high school physics students. Students work in groups. Each group chooses one band in the electromagnetic spectrum. They make a presentation about the band and explain how it is used in the study and search for life. They then build a model of an instrument that uses the band in a scientific manner. This project was inspired by a workshop for high school science teachers at the University of Hawaii's Alii Astrobiology summer program, with funding from NASA's Astrobiology Initiative.

PST1A03: 7:30-8:15 p.m. HI STAR Student Astronomy and Astrobiology Research Projects

Poster – Mary Ann Kadooka, University of Hawaii Institute for Astronomy, Honolulu, HI 96822; kadooka@ifa.hawaii.edu

James D. Armstrong, Michael Nassir University of Hawaii Institute for Astronomy

How do you motivate 12 to 16-year-old students to conduct authentic research projects after a one-week summer program? Recruit those passionate about astronomy to learn telescope remote observing and image processing research skills. Astronomers mentor students on group projects about comets, asteroids, extrasolar planets, stars, and heliophysics at HI STAR. Inspired to continue their research, the students have entered projects in the junior and senior research divisions at state and International Science Fairs and received awards. These projects will be described. The goal of HI STAR is to encourage pre-college students to select STEM majors in college. Summative evaluations, results, and case studies will be presented. Key to meeting HI STAR's goal has been our network of stakeholders, especially the volunteer mentors. Initially funded by a NASA grant in 2007, HI STAR has been sustained with donations and NASA astrobiology and heliophysics grants which subsidize student and teacher costs.

PST1A04: 8:15-9 p.m. "Stellar" Interferometry in the Advanced Lab

Poster – Alan J. DeWeerd, University of Redlands, Redlands, CA 92373[alan_deweerd@redlands.edu

Eric Hill ,University of Redlands

We describe how an experiment in optical "stellar" interferometry was adapted for our advanced laboratory. Previously, others have described demonstration experiments with double apertures in front of binoculars or a telescope, which can be used to estimate angular sizes of light sources. As the separation of the apertures (the baseline) is increased, the visibility of the resulting fringe pattern varies. In our experiment, students used a telescope and CCD camera to make quantitative measurements of the fringe visibility as a function of the angular frequency (baseline divided by wavelength). The visibility data was fit to theoretical visibility curves to determine angular sizes of objects. The experiment was performed indoors with illuminated pinholes as sources.

PST1A05: 7:30-8:15 p.m. Two High School Science Fair Projects in Heliophysics

Poster – Mary Kadooka, University of Hawaii Institute for Astronomy, Honolulu, HI 96822; kadooka@ifa.hawaii.edu

Kathryn Whitman, University of Hawaii at Manoa

The Hawaii Center for Advancing $ystemic Heliophysics Education (HI CA$HEd) is an educational center that was created in 2009 to engage teachers and students in educational activities that promote the conceptual understanding of the Sun and solar physics. Over the 2010-2011 school year, HI CA$HEd graduate student Katie Whitman mentored two students who completed heliophysics research projects for the Hawaii State Science Fair. Ninth-grade student Malia Swartz searched for a possible relationship between medical epidemics and solar activity by comparing sunspot number and historical medical records from the past 300 years. Sophomore Kira Fox searched for long-term cyclic behavior exhibited by the Sun employing a periodogram analysis of Beryllium 10 data that led her to identify possible solar cycles as long as 120,000 years. Both projects received awards. Kira and Malia continue to work on heliophysics projects for the 2012 Hawaii State Science Fair.

PST1A06: 8:15-9 p.m. Whitworth University Robotic Observatory

Poster – Richard Stevens, Whitworth University, Spokane, WA 99251; rstevens@whitworth.edu

Lucas Brouwer, Bobby Aldridge, Whitworth University

Whitworth University recently completed an astronomical observatory in a remote mountaintop area near Newport, WA. The site had no facilities at the start, requiring the installation of solar arrays and batteries to run the robotic observatory. The observatory currently houses Whitworth University's 14-inch Schmidt-Cassegrain telescope with a 3 megapixel CCD Camera. The telescope will have the capability to operate remotely from Whitworth's campus. The observatory building is completed, and the telescope is currently being tested and calibrated. This presentation will cover the construction challenges, telescope calibration, and future research and classroom goals for the observatory.

Physics Education Research

PST1B01: 7:30-8:15 p.m. A Multi-Representational Buoyancy Lab and Assessment

Poster – James Vesenka, University of New England Department of Chemistry and Physics, Biddeford, ME 04005; jvesenka@une.edu

Matthijs van den Berg, Jessica Oliveira, Meredith Weglarz, University of New England

Buoyancy is a particularly confounding concept for students to fathom and instructors to teach. Loverude and Heron identified essential tools for student success in developing accurate buoyancy models: a sound understanding of mechanics and solid comprehension of density.[1] To help with the teaching aspect we have combined these buoyancy fundamentals into a suite of integrated activities: 1. A buoyancy lab complete with multi-representational analysis. 2. A supportive graphical simulation. 3. A quantitative deployment activity based on the Cartesian Diver. 4. A validated and reliable buoyancy assessment tool. One of the interesting results extracted from deployment of these activities is the superiority of diagrammatic representation (free body diagrams), even when students claim a preference for mathematical or verbal solutions. The entire suite of activities is available at: http://faculty.une.edu/cas/jvesenka/scholarship/index.htm

1. Loverude et. al. *AJP* **71**, pp. 1178-1188, Heron et al. *AJP* **71**, pp. 1188-1195

Supported by NSF DUE 0737458 and DUE 1044154

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PST1B02: 8:15-9 p.m. Assessing Wide Range of Instructional Goals for K-12 Teacher Professional Development*

Poster – Amy D. Robertson, Seattle Pacific University, Seattle, WA 98119; robertsona2@spu.edu

Sarah B. McKagan, Rachel E. Scherr, Stamatis Vokos, Seattle Pacific University

Science educators often want professional development to increase the extent to which teachers attend to the disciplinary substance of K-12 students' ideas, see themselves as participants in the construction of scientific knowledge, and autonomously formulate relevant questions about physical scenarios. The PER community has some evidence for teacher growth in these areas, and the Energy Project at SPU is seeking to discern how such growth manifests itself. In doing so, we hope to develop new ways of assessing K-12 teacher professional development. These new assessments will add to existing assessments of K-12 teachers, conceptual understanding of physics, beliefs/attitudes about science, or use of inquiry in the classroom (e.g., open-ended conceptual assessments; the FCI; the CLASS and the MPEX; or the RTOP, respectively).

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

PST1B03: 7:30-8:15 p.m. Assessing Student Reasoning About Proportions and Ratio Quantities*

Poster – Stephen Kanim, New Mexico State University, Las Cruces, NM 88005; skanim@nmsu.edu

Andrew Boudreaux, Western Washington University

Suzanne Brahmia, Rutgers University

This poster reports progress on the development of an assessment instrument to gauge student facility with ratio reasoning. Results from physics and mathematics education research suggest that proportional reasoning is not a monolithic ability. We have thus created an initial list of sub-skills, or constructs, integral to success, and are developing and testing assessment tasks that span this list. We will share selected tasks and give examples of student responses.

*Supported by NSF grants DUE-1045227, DUE-1045231, & DUE-1045250.

PST1B04: 8:15-9 p.m. Assessment of a Propaedeutic Reform in Physics

Poster – Jesús Madrigal-Melchor, Universidad Autónoma de Zacatecas, Física Calzada Solidaridad esq. Paseo a la Bufa s/n Zacatecas, 98060 México; jmadrigal.melchor@fisica.uaz.edu.mx

Isaac Rodríguez-Vargas, Juan Manuel Rivera-Juárez Universidad Autónoma de Zacatecas, Física

We present the evaluation of a physics reform that is based on one-year propaedeutic basic courses. This reform was undertaken in the Academic Unit of Physics of the Autonomous University of Zacatecas México in 2002 in order to give the physics and mathematic grounds to the freshman students that, for multiple reasons, were not acquired in their high school preparation, but they present a suitable profile for scientific studies from the abstract, logic, and curiosity stand points. We compare the data of four generations of the five-year program (propaedeutic) and the four-year program (traditional) finding practically no difference in the students' performance between both programs. In most cases, the students' performance of the propaedeutic program is slightly better than the traditional one. However, rates such as graduation and efficacy are worse in the five-year program.

PST1B05: 7:30-8:15 p.m. Communication About Integrals as a Tool for Instruction and Assessment.

Poster – Joshua S. Von Korff, Kansas State University, Manhattan, KS 66506-2601; vonkorff@phys.ksu.edu

Dehui Hu, N. Sanjay Rebello, Kansas State University

We taught six lessons about integration in an introductory mechanics context using a reformed approach to instruction. During these lessons, the instructor guided discussion, but did not lecture. Students considered "debate problems," in which they read a discussion between fictitious students and attempted to draw conclusions about the merits of the students' claims. Participants communicated with one another in multiple ways. They discussed physics while writing on whiteboards at their tables of four, then each table made a presentation to the other table using their whiteboard, and finally they recorded individual written and audio presentations using a smartpen This "pencast" presentation was later reviewed and critiqued by other students as well as by the student who created it. We qualitatively analyze the pencasts, and consider the students' learning progress. Supported in part by NSF grant 0816207

PST1B06: 8:15-9 p.m. Computational Modeling Integrated with ASU Modeling Instruction

Poster – John M. Aiken Georgia State University, Atlanta, GA 30303; jaiken1@student.gsu.edu

Michael F. Schatz, Georgia Institute of Technology

John B. Burk, The Westminster Schools

Marcos D. Caballero, University of Colorado Boulder

Brian D. Thoms, Georgia State University

We describe the implementation and assessment of computational modeling in a ninth-grade classroom in the context of the Arizona Modeling Instruction physics curriculum. Using a high-level programming environment (VPython), students develop computational models to predict the motion of objects under a variety of physical situations (e.g., constant net force), to simulate real world phenomenon (e.g., car crash), and to visualize abstract quantities (e.g., acceleration). The impact of teaching computation is evaluated through a proctored assignment that asks the students to complete a provided program to represent the correct motion. The students are given an open ended essay question that asks them to explain the steps they would use to model a physical situation. We also investigate the attitudes and prior experiences of each student using the Computation Modeling in Physics Attitudinal Student Survey (COMPASS) developed at Georgia Tech as well as a prior computational experiences survey.

PST1B07: 7:30-8:15 p.m. Epistemic Knowledge Levels Emergent in Students' Self-Selected Problem Comparisons

Poster – Frances A. Mateycik, Penn State Altoona, Altoona, PA 16601; fam13@psu.edu

Kendra E Sheaffer, Penn State Altoona

Physics educators aspire to facilitate students' depth of problem solving in physics. Strong physics problem solvers are able to associate new problems with the concept/principles of a previously solved problem, while weaker problem solvers tend to rely on surface features within a problem to cue the solution method. In this study, we offer insight as to how students assess the importance of principles and concepts for problem solving.

Students in an algebra-based physics course were asked to choose two problems from each of their weekly homework assignments which they found to be most similar. The two problems selected by students were then explicitly compared and contrasted in writing. The written statements were then divided by clause topics and further categorized into levels of epistemic reasoning. This poster will summarize the observed epistemic trends associated with each week.

PST1B08: 8:15-9 p.m. Gender and the FCI: Does Context Make a Difference?

Poster – Laura McCullough, University of Wisconsin-Stout, Menomonie, WI 54751; mcculloughl@uwstout.edu

A female-stereotyped version of the FCI previously developed (McCullough, 2004) was given to physics students as a pre-test and post-test, along with the original test. Results suggest that changing the context does affect student response. Overall score averages were similar between the versions, but individual questions show large variation between the versions. The pre-test showed a stronger effect than the post-test. Details from the analysis will be presented in the poster.

PST1B09: 7:30-8:15 p.m. Invention Tasks as a Framework for Mathematical Sense-Making

Poster – Suzanne White Brahmia, Rutgers, the State University of New Jersey, Piscataway, NJ 08854-8019; brahmia@physics.rutgers.edu

Andrew Boudreaux ,Western Washington University

Stephen Kanim, New Mexico State University

Mathematical sense-making is essential to understanding physics. Although reasoning with numbers is ubiquitous in physics, we know our students often leave our courses without having mastered this important skill. In an ongoing collaboration between Rutgers, WWU, and NMSU, we develop curricular materials and methods using invention as a preparation for instruction, building the foundation for mathematical sense-making in the context of physics. Invention tasks are based on inventing-with-contrasting-cases, piloted at Stanford University*; the tasks present students with open-ended situations in which they must invent a quantity or procedure in order to make meaningful comparisons. Through creative thinking and struggle, students construct mathematically sensible ways to characterize systems and reason numerically about them. This poster describes invention sequences, which were developed and used in our physics courses to precede formal instruction of a topic. We also present results on how these sequences have affected the students that use them.

* http://aaalab.stanford.edu/ This work is supported by NSF DUE-1045227, NSF DUE-1045231, NSF DUE-1045250

PST1B10: 8:15-9 p.m. Investigating Departmental Expectations for Physics Undergraduate Students

Poster – Renee Michelle Goertzen, Florida International University, Miami, FL 33199; rgoertze@fiu.edu

Eric Brewe, David T. Brookes, Laird Kramer, Florida International University

We are investigating the goals physics faculty at our institution hold for the students majoring in physics. We present preliminary results of interviews with physics faculty that explore what attitudes, abilities, and characteristics they expect students to have developed by the time they graduate with a Bachelor's degree from our institution. The goal of the work is to build a deeper understanding of the expectations physics faculty hold for their students, which will allow us to better assess whether students meet these expectations, and whether the physics program provides sufficient opportunities for students to develop these desired attitudes and abilities. This increased understanding should also facilitate comparison of how the goals of physics professors and of the physics education research community.

PST1B11: 7:30-8:15 p.m. Learners' Understanding of Energy: Conservation of Amount, Decrease of Value*

Poster – Abigail R. Daane, Seattle Pacific University, Seattle, WA 98119; abigail.daane@gmail.com

Lane Seeley, Amy D. Robertson, Stamatis Vokos, Rachel E. Scherr, Seattle Pacific University

In a summer professional development course on energy in physics, secondary teachers spontaneously considered not only the amount and forms of energy involved in physical processes, but also the energy's usefulness. For example, some teachers discussed situations in which they viewed energy as losing value during a process, even when they explicitly acknowledged that the total amount of energy was constant. Others articulated that the quality, usefulness, or availability of the energy decreased when it changed form (e.g., from kinetic to thermal). These ideas might be resources from which to construct a coherent model for energy usefulness, dissipation, and degradation which can be applied across a wide range of physical scenarios. They might also be the basis for a meaningful connection between energy that is conserved (in a physics context) and energy that is used up (in a sociopolitical context).

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

PST1B12: 8:15-9 p.m. Learning About Teaching Physics: New Podcast on Education Research Results

Poster – Stephanie V. Chasteen, sciencegeekgirl enterprises and University of Colorado at Boulder, Boulder, CO 80301; stephanie@sciencegeekgirl.com

Michael Fuchs, Boulder High School

Want to get the inside scoop on the latest research on teaching and learning? Curious about physics education research results, but don't have the time to keep up with the journals? Now you can keep up with the literature during your daily commute or trip to the gym with a new audio podcast, "Learning About Teaching Physics." Each short, well-produced podcast* pairs education researchers and teachers to talk about an interesting result from the field, such as research on lecture demos, new research on the use of clickers, and whether tests can help students learn. What do these results mean? How does it relate to classroom practices? What challenges might a teacher face in trying to use such an idea? Stop by the poster to learn about the project, talk about the need to communicate between PER and practicing teachings, and to pick up a CD with the podcasts.

*Podcasts can be found at http://perusersguide.org/podcasts and at http://sciencegeekgirl.com.

PST1B13: 7:30-8:15 p.m. Lexical Availability for Academic Unit of Physics, UAZ México

Poster – Jesús Madrigal-Melchor, Universidad Autónoma de Zacatecas/ Física, México; jmadrigal.melchor@fisica.uaz.edu.mx

Diana Isabel Tachiquín-Ramírez, Juan Manuel Rivera-Juárez, Agustín Enciso-Muñoz, Universidad Autónoma de Zacatecas / Física

Juan López-Chávez, Universidad Autónoma de Zacatecas / Letras

The Lexical Availability Index (IDL), which arise from lexicometry, reflects the mental order of vocabulary from specific subject—interest center. We generated a database of domain terminological in the area of mechanics for teachers and students using the IDL, and the coefficient of relation between words (CRV). 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 a better and more efficient learning from the students. The results are compared with the corresponding results of the experts.

PST1B14: 8:15-9 p.m. Measuring Scientific Reasoning Ability at the Middle School Level

Poster – Jennifer L. Esswein, The Ohio State University, Columbus, OH 43210; esswein.5@osu.edu

Jerome Mescher, Hilliard City School District

Bruce Patton, The Ohio State University

The physics education community has used measurements of scientific reasoning ability in order to evaluate, formatively and summatively, both the effects of various pedagogies used with students at the high school and college level, as well as to compare progress of those among different demographic backgrounds. While well-tested measures exist for older age groups, little work has been done with elementary and middle school students. Furthermore, newly released science standards at the national level call for more critical thinking and reasoning ability skills than ever before. This study presents a Rasch model item response theory (IRT) analysis of a set of multi-level items developed and administered to a large group of middle school students. The results show that test items that possess varying levels of difficulty within the latent ability of scientific reasoning may be identified, and also reflect Piaget's theory of cognitive development.

PST1B15: 7:30-8:15 p.m. Numerical vs Algebraic Expertise: Ignore the Signs and Derive

Poster – Thomas Foster, Southern Illinois University, Edwardsville, IL 62026-1654; tfoster@siue.edu

Imparting the age-old advice to our students of waiting until the conclusion to insert numbers into problem solutions assumes the students are competent enough in algebra to forgo their comfort with numbers. This assumption is that students are much closer to expertise with numbers than with algebra and therefore will struggle to abandon their successful skills in arithmetic for their shaky skills in algebra. To test this assumption, this presentation reports a portion of our ongoing research to measure student ability level in simple arithmetic and in algebra. Here we present student results from their solutions to isomorphic algebraic and arithmetic problems. The students were drawn from SIUE's conceptual physics and University physics courses. If this assumption is valid, then asking students to solve algebraically (without additional support) is like asking them to take drivers education before they can read.

PST1B17: 7:30-8:15 p.m. Optics Concept Assessment

Poster – Timothy T. Grove, IPFW, Fort Wayne, IN 46805; grovet@ipfw.edu

Mark F. Masters, IPFW

Ernest Behringer, Eastern Michigan University

In order to assess student learning of optics, we have created an optics concept assessment exam. Optics is a broad subfield of physics (wave model of light, ray model of light, mirrors, lenses, interference, etc.) and this exam was designed to assess a broad range of these basic tenets. Testing for common misconceptions while using plain, student language, we have probed to better understand student thinking. We will show our preliminary findings.

PST1B18: 8:15-9 p.m. Representing Energy Transfers and Transformations*

Poster – Rachel E. Scherr, Seattle Pacific University, Seattle, WA 98119;3 rescherr@gmail.com

Hunter G. Close Texas State University

Lane Seeley, Sarah B. McKagan, Seattle Pacific University

Common representations of energy in physics—including bar charts, graphs of energy vs. time, and pie charts—promote quantitative calculations of relative amounts of energy that are present in a system at a given moment. The Energy Project at Seattle Pacific University has developed a family of representations that enforce energy conservation while enabling detailed modeling of energy dynamics, particularly the complex transfers and transformations of energy that take place during real physical events. These representations variously use human bodies, computer animation, wooden cubes, and graphic diagrams to represent units of energy during dynamic processes in physical phenomena. Each representation provides a unique framework for collaborative construction of physics ideas. We provide evidence that these representations are not only expressive but are also rigorous in the sense that their disciplined application raises new questions about the phenomena being represented.

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

PST1B19: 7:30-8:15 p.m. The 7th and 8th Grade Students' Learning Progression for Modelling

Poster – Daesung Bae, Seoul National University, Seoul, 151090 Korea; highbrow21@hanmail.net

Junhee Yoo, Seoul National University

According to "A Framework for K-12 Science Education" by NRC(2011), curricula should stress the role of scientific model and modelling as tools to elaborate students' idea. The purpose of this study is to investigate students' learning progression for and their difficulties in modeling. Model schema with domain, composition, structure, organization, and concept schema with scope, expression, organization, quantification are the two modeling schemata in our framework of modelling competency as Halloun's research(2006). The test items developed by Lopes and Costa(2007) have been revised. The subject is 59 high-achievers of the seventh and eighth grades. The results show that most of the students are in low levels of learning progression for modeling. They have difficulties in relating various model components with appropriate laws in modeling. They can't figure out agents that interact with objects. Thus they fail to construct models with appropriate interaction in causal facet.

PST1B20: 8:15-9 p.m. The Effects of Single-Sex Education on the Self-Efficacy of College Students Taking Introductory Physics - Part 2

Poster – Jennifer Blue, Miami University, Oxford, OH 45056; bluejm@muohio.edu

Mary E. Mills, Indiana University

Previous research has shown that young women can benefit from taking their science classes in single-sex classrooms and that women's colleges produce a disproportionate number of female scientists. There had been less research on the effects of single-sex education on young men. In the present study, which was Mary Mills' MS project at Miami University, we investigated the effects of single-sex education on the self-efficacy of college physics students by surveying students at four colleges. Quantitative data, presented at the Winter 2011 meeting, indicate that there is an interaction between the educational system and the sex of the respondent. This poster will briefly review that interaction and then present more detailed results of the five interviews that Mary Mills conducted.

PST1B21: 7:30-8:15 p.m. The Maine Physical Sciences Partnership: Building Meaningful Collaborations

Poster – Michael C. Wittmann, University of Maine, Orono, ME 04469-5709; mwittmann@maine.edu

Susan McKay, John R. Thompson, Mitchell Bruce University of Maine

Owen Maurais, Penobscot River Educational Partnership

In an NSF-funded Math and Science Partnership project, the University of Maine, 36 middle schools, and 12 high schools, several non-profits, and the state of Maine are working together to improve the teaching and learning of the physical sciences in grades six to nine and to effect change in physical science courses at the university. Our activities include: ongoing evening collaboratives that build community, trust, and a shared set of project goals; facilitating teachers choosing new, reform-based or validated instructional materials; professional development through week-long academies and more; and a community website that fosters communication and allows insight into each other's teaching. Course reform, professional development, and research into teaching and learning stand on equal footing in this project. We present on the design and implementation of our project, as well as preliminary results from our research.

PST1B22: 8:15–9 p.m. The Tuning Project in Physics Area in Mexico

Poster – Mario Humberto Ramírez Díaz, CICATA IPN Legaria 694 Col. Irrigacion México, DF 11500 Mexico; mramirezd@ipn.mx

Eduardo Chavez Lima, ESCOM IPN

The Latin American Tuning Project has been made since 2007 in 12 countries, including Mexico. However, in the physics area the participation was only 16 people (nine academics and seven students), so the study's validity is questionable. The focus of this project is to remake the studies in Mexico, including a longer number of faculties in physics. A change with respect to the original report is just include three agents instead of four (academics, students and graduate) excluding employers because—in general—they are the same universities. On the other hand, the original report proposed 22 competences to the graduates in physics and give five questions to answer about the competences: Are they unrelated or transversal competences?, With what area of physics are they related, and at what level?, How can the learning of these competences be assessed? How should the learning time for these competences be established? And, in what way must the teaching methods be modified, in order to favor the learning of these competences?

PST1B23: 7:30-8:15 p.m. Thinking in Physics and Gender Effects

Poster – Vincent P. Coletta, Loyola Marymount University, Los Angeles, CA 90045; vcoletta@lmu.edu

Jeffrey A. Phillips, Raquel Sena, Loyola Marymount University

The Thinking in Physics project has resulted in students in our introductory mechanics classes demonstrating improved conceptual understanding and problem-solving skills. However, there are significant differences in male and female performance on the FCI. We shall discuss these gender differences.

PST1B24: 8:15-9 p.m. Using Community Expertise to Enhance Curricular Reform, Prof. Development

Poster – Dedra Demaree, Oregon State University, Corvallis, OR 97330; demareed@physics.oregonstate.edu

Wendi Wampler, David Bannon, Oregon State University

Oregon State University (OSU) is working on an NSF-funded collaboration with a range of faculty within OSU and two local community colleges. The overall purpose of this project is three-fold: to better coordinate our introductory courses, to develop and share the best of our curricular activities, and to document the shared knowledge in a way that helps incoming/rotating instructors adopt the courses. We are developing a community of practitioners with a shared vocabulary and refined discourse on curricular issues. One method used in the project is having an observer in the classroom, which all community members feel is highly valuable. We have extended this model to peer teaching where neither teacher is viewed as the expert; this holds promise for an authentic model of professional development. This poster will outline the main project goals, our model for community and professional development, and our outcomes to date.

PST1B25: 7:30-8:15 p.m. Using Systemic Functional Linguistics to Analyze Academic Language

Poster – Jacquelyn Kelly, Arizona State University, Gilbert, AZ 85296; j.e.kelly@asu.edu

Students can use technical language consistent with science and engineering norms yet may not know the meaning of these words. This phenomenon has been examined in science classrooms by many researchers. In order to understand and interpret student academic language, a lens to analyze and quantify it is required. I will describe how a functional view of linguistics will be used as a theoretical framework for interpreting academic language. While traditional views of language focus primarily on grammar, which works with the structure of sentences, a functional view of linguistics examines the relationships between these structural components of language and their contexts and meanings. In this poster, systemic functional linguistics will be used as a theoretical framework for analyzing academic language. Challenges, affordances, and an implementation will be discussed examining student writing samples in an undergraduate STEM classroom.

PST1B26: 8:15–9 p.m. What's So Special About Question 23?

Poster – Richard D. Dietz, University of Northern Colorado, Greeley, CO 80639; rdietz@unco.edu

Wendy K. Adams, Matthew R. Semak, Courtney W. Willis, University of Northern Colorado

Recent gender studies employing Differential Item Functioning (DIF) have shown that Question 23 on the Force Concept Inventory exhibits significant DIF in favor of males. Question 23 is the third in a quartet of questions that examine the motion of a rocket in outer space. We present further analysis of the responses to these four questions in an effort to determine why this particular question exhibits gender bias.

Posters Lecture/Classrooms

PST1C01: 7:30-8:15 p.m. 10 Years of Creating Virtual Worlds to Teach Physics

Poster – Ricardo J. Rademacher, Futur-E-Scape, LLC 503 McAlpin Ave Cincinnati, OH 45220; ricardo@rademacher.com

For the last 10 years, Dr. Rademacher has pursued the creation of a three-dimensional online virtual world dedicated to teaching physics. In this poster, three different virtual world implementations will be shown with an emphasis on the pedagogy that is present in each. The first implementation presented will be the Virtual Online Laboratory (VOL) as a testbed in translating offline physics labs to the three-dimensional online world. Next, the Massively Multi-User Synchronous Collaborative Learning environment (MMUSCLE) is presented as the next logical step in the VOL with the addition of stronger social elements and introduces the use of video game development techniques and software. Finally, Physics Adventures in Space Time (PAST) is presented as the latest version, which incorporates all of the above but adds role-playing game elements to help move the pedagogy along. For more information, please visit http://thevniversity.com.

PST1C02: 8:15-9 p.m. Building Together: An Undergraduate Freshman Class Defines Physics Model

Poster – Gina Quan, University of California, Berkeley, Berkeley, CA 94704; ginaquan@berkeley.edu

This poster focuses on an analysis of a constructive whole-class discussion around the definition of a physics model that occurred as part of an elective freshman course at the University of California, Berkeley. The course is taught as part of The Compass Project, a program that supports physical science students during the critical freshman transition into college. The course had students explore physics models through open-ended research questions around the ray model of light. The course structure parallels physics research groups; students work in small groups and the results are discussed in whole-class conversations. The conversation analyzed for this poster involved the need for class consensus around the definition of a physics model. I will identify and characterize the participant moves that led to making the conversation constructive.

PST1C03: 7:30-8:15 p.m. Doorway to Upper Level Physics: Oral Exams for Sophomores

Poster – Dawn Hollenbeck, Rochester Institute of Technology, Rochester, NY 14623; dmhsps@rit.edu

Vern Lindberg, L. S. Barton, Rochester Institute of Technology

As physics majors enter third-year courses, there is a significant increase in rigor relative to the introductory courses. At RIT we use a Comprehensive Oral Exam (CORE) to help students review introductory physics (including modern physics) and prepare for their final two years. After a quarter of review and practice, students each come before a panel of four faculty who ask them to solve problems at the introductory level. Students who succeed view this as an empowering experience for their subsequent undergraduate career. The experience of solving problems, and explaining the solution while standing at a white board, helps prepare students for subsequent oral presentations. Students who have trouble take the time to evaluate their career plans, either redoubling their efforts, or seeking a major that better fits their strengths. The implementation and outcomes of CORE at RIT will be discussed.

PST1C04: 8:15–9 p.m. Eat Dessert First: Teaching Modern Physics to Freshmen

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

Headlines scream of faster than light neutrinos, extra dimensions, and particle smashers that will create black holes to destroy the Earth. There is great public interest in physics, but when they enter a first-semester physics class, students struggle to see the connections between what we present them and the bizarre ideas that brought them there. I will present a description of our calculus-based introductory physics class that begins with modern physics. We first build the standard model through a quasi-historical approach, and we finish the semester with a treatment of Special Relativity. I will present the advantages and challenges inherent to this approach in a small liberal arts college setting. In our experience, this approach lets students see right away that physics is an active field filled with mysteries while also giving them the thinking skills to develop as scientists.

PST1C05: 7:30-8:15 p.m. Educational Materials Created by the Acoustical Society of America

Poster – Wendy K. Adams, Acoustical Society of America and the University of Northern Colorado, Greeley, CO 80639; wendy.adams@colorado.edu

The Acoustical Society of America has recently been focusing effort on K-14 outreach through a partnership with the Optical Society of America and AAPT/PTRAs (Physics Teaching Resource Agents). This year the Acoustical Society has created a FREE activity kit for teachers and a website with activities for students and materials for teachers at http://exploresound.org. The material addresses the science of sound including physics, music, our ears, animal bioacoustics, architectural acoustics, underwater acoustics, speech and medical acoustics. We've also put together a poster series with guidebooks. All materials are research-based and tested with students. In this poster we will describe the type and breadth of material that's available and where to find it.

PST1C06: 8:15-9 p.m. Implementation of a Mandatory Senior Capstone Project: Issues and Solutions

Poster – Linda S. Barton, Rochester Institute of Technology, Rochester, NY 14623; linda.barton@rit.edu

Scott V. Franklin, Rochester Institute of Technology

RIT is in the fifth year of the implementation of a mandatory year-long (three quarters) capstone project for all physics major seniors. To date, 69 students have participated in this process. The capstone sequence includes a one-quarter Capstone Prep course to assist students in finding a mentor and project, followed by two quarters of capstone research. Each quarter culminates in student oral presentations to the entire department as well as a formal journal-style paper, and submission of the project notebook. While each project is supervised by an individual faculty mentor, all assessment is done by a four-person departmental Capstone Committee. The committee ensures that uniform and high standards, and consistent grading, are maintained across the spectrum of students, projects, and mentors. This structure has resulted in strongly positive outcomes for a range of students and projects. Problems and pitfalls we've encountered, along with some solutions, will be presented.

PST1C07: 7:30-8:15 p.m. Student Success in the STEMS: Evidence of Student Success Using a Curriculum Driven, Project-based Learning Model

Poster – Capitola D. Phillips, NorthWest Arkansas Community College, Bentonville, AR 72712; dphillips@nwacc.edu

Melody Thomas, Dixie Androes, NorthWest Arkansas Community College

NorthWest Arkansas Community College has developed a curriculum driven, project-based learning model, EMPACTS, (Educationally Managed Projects Advancing Curriculum, Technology/Teams and Service), which engages students in an active learning experience. The delivery system has been integrated into core courses across a broad curriculum and has generated over 600 community projects over the past six years. Students work in teams as they apply course content and create their own self-directed learning experiences. Examples of student success, with special emphasis on the STEM disciplines, will be presented in this poster.

PST1C08: 8:15–9 p.m. Tabletop Kits Help Students Grasp Concepts in Light

Poster – Jacob Millspaw, Indiana University Purdue University Fort Wayne, Fort Wayne, IN 46805; millspaj@ipfw.edu

Light and color exploration kits have been in use face to face and in online courses with positive results. Students explore properties of light with experiments on topics such as the spectrum, color mixing, geometric and physical optics. In the class, students take part in scientific investigations developing and testing hypotheses based on observations made in their investigations.

PST1C09: 7:30-8:15 p.m. Where Does Physics Fit into the Green Energy Education Picture?

Poster – Barbra Maher, Red Rocks Community College, Lakewood, CO 80127; barbra.maher@rrcc.edu

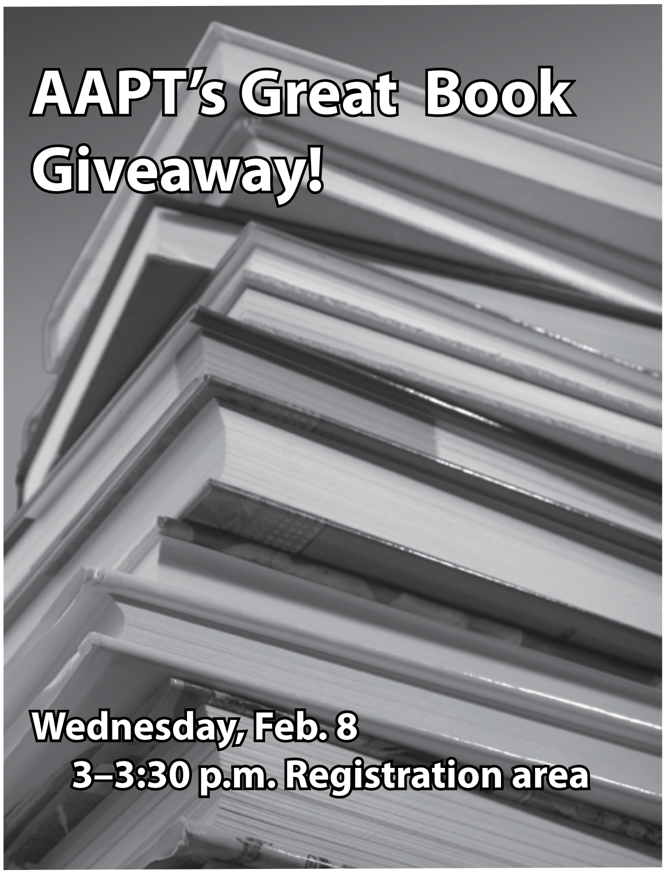
The recent push for community colleges to become a major part of preparing the workforce for green jobs provides a unique opportunity. Physics needs to be at the forefront of providing students with a solid foundation in the physics of energy and energy technology. This push needs to go beyond the traditional introductory-level physics offerings. Often, students entering renewable technology programs do not have the math background necessary for many physics courses. Also, most physics courses do not focus on the physics specifically involved in renewable energy technology. Red Rocks Community College partnered with the NSF to develop two new physics course offerings to fill these needs. Energy Science and Technology is an introductory-level, lab-based course exploring many aspects of energy. Energy for Engineers is intended to be an in-depth look at renewable energy technology. Both courses help connect students entering the green workforce with physics.

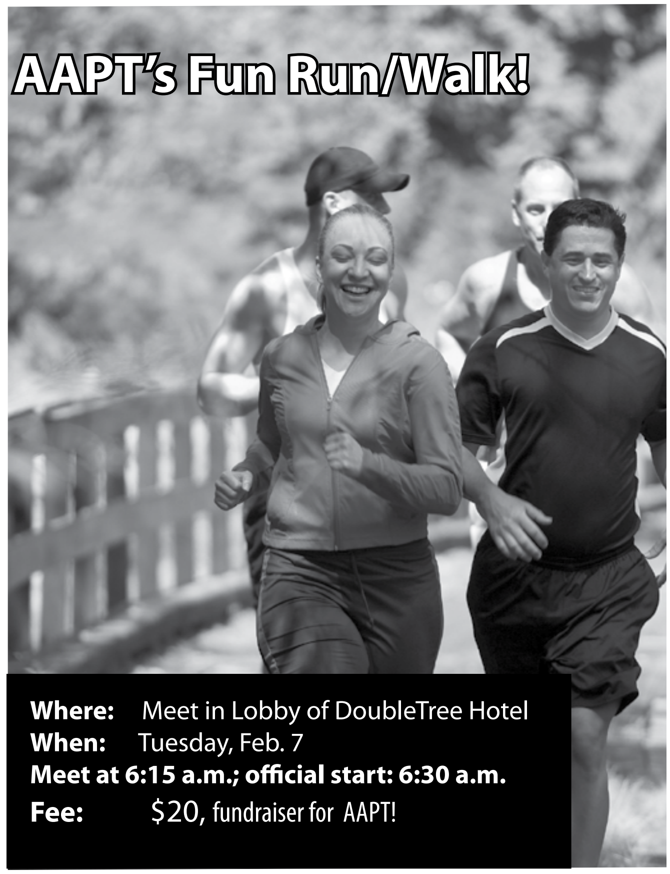
PST1C10: 8:15–9 p.m. Writing to Learn Physics in the Laboratory

Poster – Mark F. Masters, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Timothy T. Grove, IPFW Department of Physics

We describe our project in which students write to learn about their investigation. One critical aspect of this is to force attention to an audience —other students—so that the author actually learns through the process of writing. We present our results of using writing and reviewing of papers in two distinct situations. The first is in the introductory laboratory, in which students reviewed their classmates' brief articles. The second situation is in the advanced laboratory, where students submit papers to an online journal and review papers submitted by students at another institution.





Poster Sessions

with Refreshments

Poster Session 1

7:30–9:00 p.m.
Monday, Feb. 6
Ballroom A
Brownies and Lemonade!

Poster Session 2

7:30–9:00 p.m.
Tuesday, Feb. 7
Ballroom A
Cheesecake Bites and Punch!

Tuesday, Feb. 7 Highlights

REGISTRATION	7 a.m–4:30 p.m.	North Lobby
Fun Run/Walk	6:30–7:30 a.m.	DoubleTree
Exhibit Hall Opens	10 a.m.–4 p.m.	Exhibit Hall B

RICHTMYER AWARD 9:40–10:40 a.m. Ballroom C

Brian Greene —"Cosmology, Dark Energy and String Theory"

J.D. JACKSON AWARD 11:10 a.m.–12:10 p.m.

Kip Thorne — "Black-Hole Research: A New Golden Age" **Ballroom C**

BOOK SIGNINGS AT AAPT BOOTH Exhibit Hall B

11 a.m–12 p.m. – Brian Greene

12:30–1:30 p.m. – Kip Thorne

COMMERCIAL WORKSHOPS 12:15–1:15 p.m.

CW02: Perfection Learning	201AB
CW04: Oceanside Photo & Telescope	103

Multicultural Luncheon 12:15–1:15 p.m. 100B

Afternoon Break 3:15–3:45 p.m. Exhibit Hall B

AAPT SYMPOSIUM ON PHYSICS EDUC. POLICY

3:45–5:20 p.m. Ballroom C

COMMITTEE MEETINGS, 5:30–7 p.m.

–Research in Physics Education	105
–Physics in Pre-High School Education	107A
–Graduate Education in Physics	107B
–Space Science and Astronomy	104A
–Interests of Senior Physicists	205
–PIRA	107C

OUT-LAWS OF PHYSICS PERFORMANCE

6–7 p.m. Ballroom B

Poster Session II 7:30–9 p.m. Ballroom A

Session DA: Using the Riches of Astronomy to Teach Physics

Location: Room 103
Sponsor: Committee on Space Science and Astronomy
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, Feb. 7
Time: 8–9:20 a.m.

Presider: Richard Gelderman

Decades of research in physics, astronomy, and space science have led to remarkable new instruments and technologies and astonishing discoveries. This session will emphasize the physics content of astronomical discoveries and technologies in ways that will help physicists use them in their teaching; identify basic concepts needed for students to understand the discoveries and technologies of astronomy and space science, and to explore how the discoveries and technologies can be presented to most effectively realize the goals of physics instruction.

DA01: 8-8:30 a.m. Using Black Holes and Extrasolar Planets to Teach Kepler's Laws

Invited – Seth D. Hornstein, University of Colorado Boulder, CO 80309-0391; seth.hornstein@colorado.edu

Douglas Duncan, University of Colorado Boulder

Jessica R. Lu, Insitute for Astronomy, University of Hawaii

Two popular topics in an introductory astronomy course are supermassive black holes and extrasolar planets. In this talk, I will discuss two labs/recitation activities that can be used to harness this interest to teach orbital properties. In the first activity, students are provided with a Lego Orrery (as designed by the Kepler Mission Education team) and, using a light sensor and computer, develop a relationship between orbital radius and period as well as a relationship between extrasolar planet radius and detected light intensity drop. In a second activity, students are given a plot of the orbits of stars around the supermassive black hole (SMBH) at the Galactic Center. Using the actual orbital elements, students use Newton's version of Kepler's third law to determine the mass of the SMBH. In both cases, students have reported enjoying the activities due to their portrayal of actual scientific methods and use of research-based data.

DA02: 8:30-9 a.m. Solar Coronal Loops: Faraday Constrained

Invited – Gordon Emslie, Westerm Kentucky University, Bowling Green, KY 42101; gordon.emslie@wku.edu*

Images of solar coronal loops in ultraviolet and X-ray radiation are used to motivate a discussion of Faraday's law of induction. Even though the resistivity of the solar atmosphere is similar to that of copper, the huge (~100,000 km) extent of a solar active region makes the overall resistance very small. Further, there is a limit to how much current can flow ? the limiting current density is given by the charge density times the local sound speed. This combination of low resistance and finite current severely restricts the voltage differences that can exist, and hence, by Faraday's law, the speed at which a current element in the solar atmosphere can cross magnetic field lines. As a result, the gas is effectively "frozen-in" to the magnetic field, resulting in the dramatic (and beautiful) manner in which radiating material delineates the loop-like magnetic field geometry of a solar active region.

*Sponsor: Richard Gelderman

DA03: 9-9:10 a.m. Measurement of Spherical Balloon Circumference Using Eratosthenes' Method

Contributed – Seiji A. Takemae, University of Minnesota at Morris, Division of Science and Math, Morris, MN 56267; stakemae@morris.umn.edu

Gordon McIntosh, University of Minnesota at Morris

We present an activity, based on Eratosthenes' method of estimating Earth's circumference, of measuring the circumference of an inflated rubber balloon. Suction-cup darts are attached to the surface of the balloon along a meridian. The experimental circumference is obtained from multiple measurements of shadows cast by the darts. This measurement is then compared with the circumference obtained using a cloth measuring tape. An assessment of uncertainties is given. The activity presented is suitable for astronomy, physics, or math classes or laboratories.

DA04: 9:10-9:20 a.m. Kepler's Second Law and Conservation of Angular Momentum

Contributed – Pari D. Spolter, Orb Publishing Co., Granada Hills, CA 91344-2753; orbpublishing@msn.com

Kepler's second law is calculated for 18 planets and asteroids. It is shown that equal areas are swept in equal intervals of time only near the perihelion (P) and the aphelion (A). A highly significant relation between the ratio of the area swept at the average of P and A to the area swept at semi-major (S) in the same interval of time and the eccentricity is presented. The equation is ratio = a.eb+c with a = -0.617, b = 2, and c = 1.00. The correlation coefficient is 0.9975. The ratio is equal to the square root of $1 - e^2$, which is equal to sin θ, where θ is the smaller angle between the two vectors v and r. Angular momentum is a vector perpendicular to the plane formed by v and r and is conserved, indicating that there is no torque in the direction vertical to the plane of the orbits.

Session DB: Professional Exchanges for Physics Teachers at the College and Pre-college Levels

Location: Room 106
Sponsor: Committee on International Physics Education
Co-Sponsor: Committee on Professional Concerns
Date: Tuesday, Feb. 7
Time: 8–9:20 a.m.

Presider: Tiberiu Dragoiu

This session includes invited and contributed talks from teachers who have taught abroad via Fulbright Teachers Exchange program. For those interested, there are many other opportunities for teaching abroad: DoDEA; Search Associates; ISS; Carney, Sandoe & Associates; US-AID; Peace Corps; U.S .Dept of State-Education Division.

DB01: 8-8:30 a.m. Exploring the Fulbright Teacher Exchange Program

Invited – James M. Newton, East Haven High School, East Haven, CT 06513; jamesnewton@gmail.com*

As a physics teacher I am naturally curious about the world around me and constantly learning new things. Recently these two character traits led me half way around the world to a high school in India through the Fulbright Teacher Exchange. After researching several overseas teaching experiences, I found The Fulbright program to be the ideal vehicle for such an excursion. I am an advocate of other physics teachers taking part in the Fulbright program and hope to share my knowledge of the application, interview, selection, preparation, and ultimately participation in this program.

*Sponsor: Tiberiu Dragoiu

DB02: 8:30-9 a.m. Fulbright Experience – Teaching Introductory Physics in India

Invited – Hasan Fakhruddin, The Indiana Academy for Science, Mathematics and Humanties, Ball State University, Muncie, IN 47306; hfakhrud@bsu.edu

OBJECTIVE: To present the valuable Fulbright opportunities available to high school and college teachers to teach in another country; To share my own experience as a Fulbright Exchange Teacher in fall 2008 in India. METHODOLOGY: The session will be interactive; will give a PowerPoint presentation regarding the Fulbright Teacher Exchange Program. This includes history, information about various Fulbright educational programs, great overseas Fulbright teaching opportunities available to high school and college physics teachers, focus on Teachers Exchange program, application process, screening process, pre-departure meetings, do's and don'ts in the host country, wrap up in the host country, post-program events and activities, question and answer session.

DB03: 9-9:10 a.m. The Einstein Fellowship and the Joint Science Education Project

Contributed – Shelly F. Hynes. National Science Foundation, Office of Polar Programs, Arlington, VA 22230; shynes@nsf.gov

The Albert Einstein Distinguished Educator Fellowship is a one-year teacher fellowship open to STEM teachers in K-12 classrooms funded through the Department of Energy and managed by the Triangle Coalition for Science and Technology Education. Fellows live in Washington, D.C., and work within federal agencies or congressional offices to increase the federal government's understanding of STEM educational issues. In return, fellows gain insight and provide input into the STEM programs, policies and initiatives the federal government undertakes. My primary role at the National Science Foundation's Office of Polar Programs is to lead the Joint Science Education Project (JSEP), a collaboration between Greenland, Denmark and the U.S. where students participate in a research expedition to Greenland during the summer. Since its inception in 2008, JSEP has served 31 students and 13 teacher participants, directly impacting five schools in Greenland, four schools in Denmark, and seven schools in the United States.

DB04: 9:10-9:20 a.m. LHC Physics: Teaching Ideas for Introducing High Energy Physics in High School Classroom

Contributed – Kris Whelan, University of Washington, Seattle, WA 98195-1560; kkwhelan@uw.edu

Kenneth Cecire, University of Notre Dame

With the successes of the Large Hadron Collider at CERN, students and teachers have developed more of an interest in high-energy physics. Particle physics, however, is often not included in the normal high school physics curriculum. QuarkNet, a program funded by the National Science Foundation and the Department of Energy, has developed materials and resources that teachers can use in their classrooms. These resources have been developed by a group of teachers who have been selected and trained to be Fellows in the QuarkNet program. In addition, an LHC workshop is available for teachers who are members of one of the 50+ QuarkNet Centers in the United States. We will discuss teaching strategies as well as the QuarkNet program and will provide contact information for those who are interested in joining a center.

Session DC: PER: Topical Understanding and Attitudes

Location: Room 104B
Sponsor: Committee on Physics Education Research
Date: Tuesday, Feb. 7
Time: 8–9 a.m.

Presider: Wendy K. Adams

DC01: 8-8:10 a.m. Making Physics Comprehensible for ELL Students

Contributed – Thomas Haff, 700 2nd Ave. SE, Issaquah, WA 98027; Hafft@Issaquah.wednet.edu

Many foreign students in our district have been and are placed into a high school physics class because of their math skills and an assumption that vocabulary is less important than other courses. This has led to some interesting situations when dealing with ELL students. This talk will address that what a student may actually hear when direct instruction is used to explain concepts is different than what is intended. Some students do not have the necessary phonemes in their native language and are not use to hearing certain sounds. Thus misunderstanding and misconceptions can occur. It will also suggest some strategies to make physics comprehensible for ELL students.

DC02: 8:10-8:20 a.m. Using Physics History to Impact Student Learning and Attitude

Contributed – Sarah Garcia, Cal Poly Pomona, Pomona, CA 91768; sarahcgarcia@csupomona.edu

April Hankins, Homeyra Sadaghiani, Cal Poly Pomona

The purpose of this study is to investigate student learning of Newtonian mechanics through the study of its history and the development of the relevant ideas since the time of ancient Greece. The hypothesis is that not only will students learn the basic concepts of mechanics, but they also will develop a more positive attitude and appreciation for physics. To assess the students' conceptual understanding, we administer Force Concept Inventory (FCI) and for the measurement of student attitude change, we employed the Colorado Learning Attitudes about Science Survey (CLASS); both were given as pre- and post-tests. Additionally, at the end of the quarter, a survey was given out to see how students perceived the different course components and which ones they found helpful in their learning. This paper will present our preliminary results on such a study.

DC03: 8:20-8:30 a.m. Student Understanding and Application of the Dirac Delta Function

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

Hunter G. Close, Texas State University-San Marcos

We will present the analysis of student responses to a survey designed to test their understanding of and ability to use the Dirac delta function to solve problems in an upper division electrodynamics course. Students were asked to solve three different problems involving the Delta function, and to articulate the reasoning they were using to solve the problem. Results indicate that: 1. students view two-dimensional and three-dimensional problems as independent concepts rather than one being a special case of the other. 2. Students understand the Dirac delta function as acting as a "localization operator", but are not able to employ the delta function in a mathematically formal way. 3. Students view the Dirac delta function as similar to the Kronecker delta. Namely that it is a piecewise continuous function.

DC04: 8:30-8:40 a.m. Asymmetries and Hierarchies in Understanding Force, Velocity, and Acceleration

Contributed – Andrew Heckler, Ohio State University, Columbus, OH 43210; heckler.6@osu.edu

Rebecca Rosenblatt

We investigate student conceptual understanding of the relationships between the directions of net force, velocity, and acceleration in one dimension and report on data collected from over 650 students. Unlike previous work, we simultaneously studied all six possible conditional relations between force, velocity, and acceleration in order to obtain a coherent picture of student understanding of the relations between all three concepts. We found that there were asymmetries in responding to conditional relations. For example, students answered questions of the form "Given the velocity, what can be inferred about the net force?" differently than converse questions: "Given the net force, what can be inferred about the velocity?" Additionally, there was evidence of hierarchies in student responses, suggesting for example that understanding the relation between velocity and acceleration is necessary for understanding the relation between velocity and force, but the converse is not true.

DC05: 8:40-8:50 a.m. Biographical Material in Teaching Physics

Contributed – Genrikh Golin, Touro College, Brooklyn, NY 11224; genrikhgolin@yahoo.com

"Science thrills us, when we are interested in the lives of famous scientists, we start to follow the history of their discoveries." (J.C. Maxwell) Biographical material has to be based on concrete facts, and should constitute a part of the logical presentation of the information offered by the teacher. The deep understanding of the most important fundamental ideas, laws, and theories in the secondary school course of physics can often be achieved only by describing the scientist's road to discovery. For example, understanding the essence and significance of Newtonian mechanics can be achieved only by familiarizing the students with the history of overcoming Aristotelian ideas in physics. In this case "controversy over generations" between Aristotle and Galileo is the basic ground in studying of Newton's first law and Galileo's principle of relativity. In general, biographical material stimulates mastering the difficulties of the educational material by the students (especially by those for whom physics is their weak point). In this case, the explanation of new material should start from an illustrative example, showing the scientist's inventiveness, his diligence, and persistence in achieving the goal, etc.

DC06: 8:50-9 a.m. Research-based Instruction in Upper-Division Physics Courses

Contributed – Michael E. Loverude, California State University Fullerton, Fullerton, CA 92834; mloverude@fullerton.edu

Research in physics education came of age in the context of introductory-level courses that serve students who are primarily non-physics majors. More recently, a number of researchers have extended this focus into the middle- and upper-division courses taken by physics majors. The apparent assumption in standard courses at this level has been that these students are well-matched to the lecture-based traditional curriculum and that understanding would naturally follow from mastery of mathematical techniques. In this talk, we examine these assumptions and document the response of physics majors in an upper-division course to research-based instructional strategies and standard and modified assessment strategies.

*Supported in part by NSF grant DUE-0817335.

Session DD: Wave Nature of Matter Part II

Location: Room 200C
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Apparatus
Date: Tuesday, Feb. 7
Time: 8–9:10 a.m.

Presider: Gabriel C. Spalding

DD01: 8-8:30 a.m. Simple Undergraduate Lab Experiment Showing the Quantized Conductance of Nanocontacts

Invited – Donald Candela, University of Massachusetts Amherst, Hasbrouck Lab, Amherst, MA 01003; candela@physics.umass.edu

It was discovered over 20 years ago that the electrical conductance of nano-sized wires is quantized, directly demonstrating the wave nature of electrons in metals. Since then a wide variety of experiments have been devised to show the quantization of conductance. I describe our experience using the simplest possible setup, two wires loosely touching each other, in a junior-level teaching lab. A simple op-amp circuit and an oscilloscope complete the apparatus needed. I also describe how the physics of quantized conductance can be effectively taught to students who have not taken a course in solid-state physics. In particular, the conductance quantum can be derived without explicitly mentioning the concept of the density of states (although of course this concept is implicitly lurking in the derivation).

DD02: 8:30-9 a.m. Stanford's Advanced Undergraduate Laboratory and an Example Project

Invited – Katherine Luna, Stanford University, Stanford, CA 94305; kluna@stanford.edu*

I will present an overview of Stanford's most advanced undergraduate laboratory, where students select a project of interest and work in a team to carry it out during the quarter. One such project that I will discuss in detail is the superconductor-normal metal point-contact spectroscopy experiment between a niobium thin film and a gold tip. By measuring the differential conductance as a function of voltage (dI/dV vs V) and fitting this to Blonder-Tinkham-Klapwijk theory, one can obtain information about the superconducting energy gap, a lower bound on the Fermi velocity and coherence length. At a technical level, the project exposes the students to cryogenic measurements, mechanical instrument design, data acquisition and processing, and rudiments of the theory of superconductivity.
*Sponsor: Gabriel Spalding

DD03: 9-9:10 a.m. Exploring the Mechanical Effects of Light (and Other Wave/Particle Bombardments)

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

Labs exploring the momentum and angular momentum carried by waves may be used to clarify student understanding on such issues as what "orbital" angular momentum means in the "stationary states" encountered in quantum mechanics.

Session DE: Physics on Parade

Location: Room 202AB
Sponsor: Committee on Physics in High Schools
Date: Tuesday, Feb. 7
Time: 8–9:30 a.m.

Presider: Jan Mader

DE01: 8-8:30 a.m. Physics Outreach in the Northern Rockies

Invited – Steven L. Shropshire, Idaho State University, Pocatello, ID 83209; shrostev@isu.edu

Idaho State University Physics Outreach has many aspects, from workshops for teachers, demonstration presentations for schools and community groups, Science Olympics, science festivals, and a Haunted Science Lab. An overview of these programs will be presented, followed by a more detailed description of the mechanics and methods that have made physics outreach programs at ISU a success. Suggestions on how to get started with science outreach, get funding, involve student and community members, and convince your colleagues and administration that these efforts are worth supporting will be provided.

DE02: 8:30-9 a.m. Public Engagement Benefits: Not Just for Kids Anymore

Invited – Toni D. Sauncy, Angelo State University, San Angelo, TX 76909; toni.sauncy@angelo.edu

Society of Physics Students, Angelo State University

The Angelo State University Society of Physics Students chapter has been actively involved in a variety of different public engagement activities for over 10 years. Our efforts are aimed at K-12 students, and have been broad in scope, ranging from the adoption of a fifth-grade class to audience style presentations for students at all grade levels. While the focus of these efforts claims to be the "enhancement of attitudes" for the audience participants, the benefits of these public engagement opportunities go well beyond getting the younger students excited about science. The undergraduate student presenters are also engaged as professional scientists; they are immersed in the true culture of scientific citizenship, taking ownership of not only the physics they present, but also the impact that they potentially have on the students with which they interact, and on the profession of physics in general. As undergraduate physics programs across the nation find themselves facing programmatic cuts, the value of engaging undergraduate students in purposeful service as a means of retention in the major should be well considered. Assessment of the programs, conducted by the undergraduate presenters has been a focus of our programs, with several years of statistically significant evidence pointing toward a positive impact for all involved.

DE03: 9-9:30 a.m. Building Communication Skills and Motivating Students through Demonstration-based Physics Presentations

Invited – Kathleen A. Hinko, JILA Physics Frontier Center, University of Colorado, Boulder, CO; 80309; kathleen.hinko@jila.colorado.edu*

What is the role of a traveling demonstration show in the context of a broader informal science program? What is the impact on students as well as on the presenters? I will discuss the model for an exciting, single event, science presentation developed by the University of Texas at Austin, Physics Department for elementary, middle, and high school audiences. I will discuss the goals of this program, its facilitation, and the motivating impact it has on the students who see the presentation as well as the communication skills of university students who actively do the demonstrations. Additionally, I will present efforts from the JILA Physics Frontier Center at the University of Colorado, Boulder, to partner an after-school science program with a demonstration show to the mutual benefit of both programs.
*Sponsor: Jill Marshall

Session DF: Teaching Science Writing/ Writing in Science

Location: Room 203C
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Physics in Pre-High School Education
Date: Tuesday, Feb. 7
Time: 8–9:10 a.m.

Presider: Eleanor Close

This is an invited/contributed session focused on writing in science. It includes use of science notebooks in K-12 teaching and teacher preparation; use of writing in physics/science teaching for development and communication of scientific ideas; and finding, evaluating, and understanding relevant information written by others (e.g., research papers, Internet resources).

DF01: 8-8:30 a.m. Science Notebooks: Tools to Promote Student Scientific Thinking and Teacher Formative Assessment*

Invited – Lezlie DeWater, Seattle Pacific University, Seattle, WA 98119-1997; dewater@spu.edu

To better engage students' minds in their hands-on science explorations, elementary teachers in Seattle Public Schools (SPS) have implemented a nationally recognized writing program as an integral component of a well-established kit-based program. Use of science notebooks and expository writing provide the modeling, scaffolding, and support that budding young scientists need to reflect critically on, and make meaning of, their science experiences. At the same time the writing provides teachers with insights into student thinking and informs classroom practice. Because of a close collaboration between the instructors of the science methods courses at Seattle Pacific University and the SPS Science Program, participation in Seattle?s exemplary science writing workshops for inservice teachers is extended to all elementary teacher candidates. Strategies, student writing samples, and writing templates provided allow SPU students to implement science notebooks in their intern assignments. Examples of such strategies and student writing will be shared in this talk.

B. Rupp-Fulwiler, *Writing in Science in Action: Strategies, Tools, and Classroom Video*, (2011); Heineman, *Writing in Science: How to Scaffold Instruction to Support Learning* (2007).

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

DF02: 8:30-9 a.m. Beyond Google: Integrating Information Competencies into the Science Curriculum

Invited – Marion C. Peters, UCLA Librarian Emeritus, 9612 Beverlywood St., Los Angeles, CA 90034-1825; mpeters@chem.ucla.edu

Released May 2011 and recently updated, the second edition of *Information Competencies for Chemistry Undergraduates: The elements of information literacy,* at http://units.sla.org/division/dche/il/cheminfolit.pdf, offers a model for other scientific disciplines. Among the sections included are these two, covering a) the library and scientific literature and b) scientific communication and ethical conduct, while developed for chemistry undergraduates, should be applicable equally for physics students. Also covered in "Information Competencies" are some of the skills and knowledge that students should have by the time they graduate. Knowing how to navigate the scientific literature will help them be more successful in their undergraduate careers, prepare them for graduate school, and be more competitive in the job market. Integrating information competencies into the science curriculum provides opportunities for librarian and faculty partnerships as students develop needed skills in finding, evaluating, and understanding relevant information written by others.

DF03: 9-9:10 a.m. Writing to Learn in the Introductory, Intermediate and Advanced Laboratory

Contributed – Mark F. Masters, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Timothy T. Grove, IPFW Department of Physics

We will present our work with student writing and reviewing papers about their laboratory investigations. We have used this technique in many of our laboratories from introductory to advanced. Of special interest is the work on the Journal of the Advanced Undergraduate Laboratory Investigation in which students from one university review the papers by students at another university.

Session DG: Supporting Emergency Professional Development: Career Changers and Non-Physicists as Teachers

Location: Room 203AB
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Professional Concerns
Date: Tuesday, Feb. 7
Time: 8–9:30 a.m.

Presider: Steven Maier

Teacher preparation includes so much more than teaching a group of full-time undergraduates through a prescribed set of courses. Many school districts face a shortage of physics teachers, and returning veterans and other career-changers can be candidates for the job.

DG01: 8-8:30 a.m. Formulating a State Approach to Professional Development

Invited – Saeed Sarani, Oklahoma State Regents for Higher Education, Oklahoma City, OK 73104; ssarani@osrhe.edu

When viewed from the perspective of an entire state's needs, the challenges of designing professional development programs to meet the requirements of No Child Left Behind are daunting. In rural states such as Oklahoma, the concerns about delivering effective professional development programs to rural and urban populations that contain a variety of underserved populations are further complicated by the differences in the way sciences are structured as different disciplines. I will describe science model programs designed for pre-K-12 teachers of physics and physical science which take varying approaches. However, the programs have three common elements that make them highly successful. Each one fully engages teachers, seeks to change learning by impacting teachers' pedagogical content knowledge, and strives to establish a productive network among participants. The success and sustainability of these programs is evidenced by qualitative data, quantitative data, and by the continued correspondence among participants beyond the onsite summer institutes.

DG02: 8:30-9 a.m. If You Provide It, They Will Come...

Invited – Karen J. Matsler, UT Arlington, Arlington, TX 76001; kmatsler@me.com*

Jan Mader, Great Falls HS

Determining the impact of professional development is difficult and expensive, but it can be done. This session will focus on data collected by AAPT for the PTRA professional development program related to the changes in content understanding and confidence for over 1000 teachers. An overwhelming majority of the teachers were not physics majors and

were teaching out of field. Analysis includes correlations to gender and ethnic backgrounds as well as changes in content understanding, confidence, and classroom practice for both teachers and students.
*Jan Mader will present for Karen Jo.

DG03: 9-9:30 a.m. Emergency Professional Development at Arizona State University

Invited – Jane Jackson, Arizona State University, Tempe, AZ 85287-1504; jane.jackson@asu.edu

Each summer, 80 high school physics and chemistry teachers come to ASU to take a three-week Modeling Workshop. For some Arizona teachers, their Modeling Workshop is "emergency professional development." In other words, their school has assigned them to teach physics or chemistry, yet they do not have a degree in the subject and have never taught it. I will outline the ASU program, tell how it meets their needs, and share ideas for future work. Resource: www.phy.ilstu.edu/jpteo/issues/jpteo5(4)sum10.pdf

Session DI: *Panel:* What Is the Point of the Instructional Lab?

Location: Room 204
Sponsor: Committee on Laboratories
Date: Tuesday, Feb. 7
Time: 8–9:30 a.m.

Presider: Dean Hudek

Instructional labs have been an integral part of physics education for a very long time; arguably since the creation of the discipline. However, to this date there is no clear concise agreement on what the real point is of a lab. That is, what do we want the students to take away from the experience? What specifically is the pedagogical advantage of a lab? Why not just teach theory in a classroom, it is much cheaper and less time consuming? If we don't know the answers to these questions it is very difficult to maximize the effectiveness of our labs and to successfully compete for appropriate funding. In this session, five panel members will have 10 minutes to express their views with the remaining half hour for questions and open discussion.

Panelists:

– Priscilla W. Laws, Dickinson College
– Linda Barton, Rochester Institute of Technology
– Mark F. Masters, IPFW
– Randy Tagg, University of Colorado Denver
– Noah Finkelstein, University of Colorado Boulder

Richtmyer Memorial Lecture Award: *Brian Greene*

Location: Ballroom C
Date: Tuesday, Feb. 7
Time: 9:40–10:40 a.m.

Presider: David Cook

Brian Greene, Columbia University, Mathematics & Physics Department, New York City

Cosmology, Dark Energy and String Theory

I'll describe various developments in cosmology and string theory that have led to the controversial suggestion that our universe is one of many.

J.D. Jackson Excellence in Graduate Physics Education Award: *Kip Thorne*

Location: Ballroom C
Date: Tuesday, Feb. 7
Time: 11:10 a.m.–12:10 p.m.

Presider: David Cook

Kip Thorne, California Institute of Technology, Pasadena, CA

Black-Hole Research: A New Golden Age

We are entering a new "golden age" of research on black holes. This golden age is being triggered by numerical simulations, and it will culminate in observations with gravitational-wave detectors. Among the recent discoveries are vortexes of twisting space: When two spinning black holes collide, the merged hole that they form has six vortexes sticking out of it. As they rotate and slosh, these vortexes generate gravitational waves that will be detected by gravitational-wave observatories such as LIGO, VIRGO and GEO.

NOTE: *Both award winners will be signing copies of their best-selling books at the AAPT booth in the Exhibit Hall following their lectures.*

Brian Greene: 11 a.m.–12 p.m.
Kip Thorne: 12:30–1:30 p.m.

Tuesday morning

Crkrbrl 4: Crackerbarrel for PER Graduate Students

Location: Room 106
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Graduate Education in Physics
Date: Tuesday, Feb. 7
Time: 12:15 a.m.–1:15 p.m.

Presider: Meghan West

This is a session for PER graduate students to discuss PER-related issues.

Crkrbrl 5: Future Directions of the Committee on Physics in Two-Year Colleges

Location: Room 204
Sponsor: Committee on Physics in Two-Year Colleges
Date: Tuesday, Feb. 7
Time: 12:15 a.m.–1:15 p.m.

Presider: John Griffith

The Committee on Physics in Two-Year Colleges (CPTYC) is the AAPT area committee concerned with "exploring topics of professional concern to two-year college teachers, including the framework of conditions and extra-classroom activities that affect the teacher and educational process" and is also tasked with facilitating communication among two-year college faculty and between this group of teachers and the AAPT. Participants in this session will help shape the direction of the committee and discuss possible goals the committee might set for the next one to three years. The mission of the CPTYC will be presented and discussed to see how it might need to be modified to better serve the TYC community. Friends of the CPTYC, particularly those in the areas to which we connect (high school and university) are invited and encouraged to participate.

Crkrbrl 6: Crackerbarrel on The Physics Educator

Location: Room 203C
Date: Tuesday, Feb. 7
Time: 12:15 a.m.–1:15 p.m.

Presider: David Wolfe

Physics educators lack a single source from which to draw timely and concise information on professional development. In today's physics education journals, the scope of the articles is either limited to a specific education level or to type of educational institution. The American Association of Physics Teachers has decided to bring to physics educators a one-stop source on current topics in professional development that will stress the many aspects of teaching, learning, and research. This source will bring to the forefront issues of professional development important to physics education at all levels whether K-12, two-year college, four-year college, or university. To accomplish this goal, AAPT has decided to produce a new monthly online journal. The content will include guest editorials, summaries of articles with links to complete works, and more. An overview of the structure of this journal will be presented with suggestions on content entertained.

Session EA: PER Graduate Student Curriculum Beyond the Core Courses

Location: Room 104B
Sponsor: Committee on Research in Physics Education
Date: Tuesday, Feb. 7
Time: 1:15–3:15 p.m.

Presider: Sanjay Rebello

EA01: 1:15-1:45 p.m. A PER Course Emphasizing the Foundations of the Field

Invited – Michael C. Wittmann, University of Maine, Orono, ME 04469-5709; mwittmann@maine.edu

John R. Thompson, University of Maine

Much of what graduate students learn happens outside the classroom, in the typical apprenticeship of a research lab. For this work to succeed, coursework must lay a foundation of necessary skills. At the University of Maine, we have developed two courses in physics education research. In these courses, we use the literature about well-known curricula and learning materials to teach about research methods used in PER as well as give evidence for the value and meaning of these materials. We teach the canonical physics topics (kinematics, dynamics, circuits, energy, etc.) while giving students the chance to learn, practice, and develop seminal research skills (surveys, open-ended questions, interviews, video-based classroom observations). Students are primarily seeking a Master of Science in Teaching or a PhD in physics. We present examples of students learning about many ways of teaching and learning about energy.

EA02: 1:45-2:15 p.m. Beyond Courses: Graduate Curricula as Cognitive Apprenticeship

Invitedl – Andrew Elby, University of Maryland, College Park, MD 20742-1115; elby@umd.edu

Ayush Gupta, University of Maryland

Although graduate school "curricula" and graduate school "courses" are sometimes viewed as nearly synonymous, our PER group finds it productive to think in terms of curricular elements that cut across courses, project meetings, seminars, and other parts of graduate students' experiences. One such element we emphasize is group video analysis.[1] As part of courses, but more intensively as part of research group meetings and work-in-progress seminars, our graduate students gradually transition from more peripheral to more central participation[2] in analysis of classroom and interview video—spotting interesting episodes, formulating emerging hypotheses about the conceptual, epistemological, and affective dynamics, finding confirmatory and/or disconfirmatory evidence for those hypotheses, and so on. In other words, we teach video analysis through cognitive apprenticeship[3]] and consider it central to our curriculum though it does not correspond to any one course.

1. B. Jordan & A. Henderson, "Interaction analysis: Foundations and practice," *The Journal of the Learning Sciences* **4**(1), 39-103 (1995).
2. J. Lave & E. Wenger, *Situated Learning: Legitimate Peripheral Participation* (New York, Cambridge University Press, 1991).
3. A. Collins, J.S. Brown, & S. E. Newman, "Cognitive apprenticeship: Teaching the craft of reading, writing, and mathematics," In L. B. Resnick (Ed.), *Knowing, Learning, and Instruction: Essays in H. of Robert Glaser* (Erlbaum, Hillsdale, NJ, 1989).

EA03: 2:15-2:45 p.m. A Model for Graduate Education in PER as a Subdiscipline of Physics

Invited– Noah D. Finkelstein, University of Colorado, Boulder CO 80304; noah.finkelstein@colorado.edu

Steven Pollock, Benjamin VanDusen, University of Colorado Boulder

At the University of Colorado Boulder we have established a robust program of graduate student PER preparation that parallels the other subdisciplines of physics. The course work is designed to simultaneously provide rigorous grounding in the canon of physics (the standard core) while supporting individualized PER research efforts through specialized courses in PER and research methods, leading to a PhD in physics for work in PER. Working in conjunction with the physics department, CU Boulder's School of Education offers a sister PER program through its Science Education doctoral track. A cornerstone of each of these two graduate tracks is a core graduate course in PER: Teaching and Learning Physics. This course coordinates theories, research, pedagogical approaches, and curricula developed in PER. Throughout the course students are engaged in a practicum in which they conduct research on teaching and learning that forms the basis of a semester-long project and provides students a framework to evaluate current PER reforms. CU offers a variety of formal and informal structures that support graduate preparation in PER and extend beyond coursework, such as weekly group meetings, informal reading groups, and a broader discipline-based educational research group. More at: per.colorado.edu

EA04: 2:45-3:15 p.m. Mentoring Graduate Students in PER: An Apprenticeship Model

Invited – Paula R. Heron, University of Washington, Seattle, WA 98195-1560; pheron@uw.edu

Peter S. Shaffer, Lillian C. McDermott, University of Washington

MacKenzie R. Stetzer, University of Maine

Since the 1970s students in the Physics Education Group at the University of Washington have been earning PhD and MS degrees in physics for research on the learning and teaching of physics. They take the same graduate physics courses as other PhD students in the department and must pass the same examinations. More than 20 students have graduated with PhDs and most are now faculty members in physics departments. A primary goal of the program is to prepare students to conduct novel, independent research and to think critically about all aspects of education. A secondary goal is to prepare graduates who can take leadership roles in the education of K-12 teachers. As is the case in other groups in our department, their professional development is based on an apprenticeship model. A description of the program and important aspects of their mentoring will be discussed.

Session EB: Teaching with Technology

Location: Room 203C
Sponsor: Committee on Educational Technologies
Date: Tuesday, Feb. 7
Time: 1:15–2:45 p.m.

Presider: Anne Cox

Features innovative and/or effective ways you use technology in teaching.

EB01: 1:15-1:25 p.m. Video Analysis in a Two-Year College Classroom

Contributed – Todd R. Leif, Cloud County Community College, Concordia, KS 66901; United States tleif@cloud.edu

Video analysis has been around for a number of years now but until recently it wasn't nearly as simple or accessible to everybody who teaches physics. A video analysis software program such as Video Point, Logger Pro, or Tracker and a mechanism for recording or collecting digital video is all you need to do video analysis. I will discuss a collection of interesting videos that students in my classes have examined during the past couple of years. These videos have come from many sources including using an IPod Touch as the digital recording device. Model Trains, Swimming Fish, and Wind Turbines are just a few of the projects that will be looked at during this talk.

EB02: 1:25-1:35 p.m. Implementing Clickers into Your Classroom

Contributed – Michael C. Faleski, Delta College, University Center, MI 48710; michaelfaleski@delta.edu

The use of clickers (personal response system) is one of many techniques that results in the interaction of students during class. Beginning in the fall semester of 2006, clickers were introduced into all of my classes. Not only was student feedback about clicker usage overwhelmingly positive, but also there was disappointment when they weren't used. Consequently, clickers have since become a staple of many more activities. The focus of this presentation will be how to introduce clicker usage into your classes without having the questions developed to use them every day.

EB03: 1:35-1:45 p.m. Overcoming Class Size by Use of Technology

Contributed – George A. Kuck, Cal State University Long Beach (CSULB), Long Beach, CA 90840; galbertk@aol.com

As education budgets have shrunk, introductory class sizes have grown due to the cancelation of class sections. A 10-year study of the learning gain of my Physical Science students showed that these changes can be ameliorated by an increased use of technology. Using one test developed to encompass the entire range of class material, an observational learning database was developed for class sizes ranging from 60 to 150 students. Once the class size factor was accounted for, it was found that two major class changes offset the learning decrease due to class size. The first factor was the introduction of online homework using the school computer system. The second was the use of clickers in conjunction with pair share student discussions.

EB04: 1:45-1:55 p.m. Two Ways to Build Sounds

Contributed – David Keeports, Mills College, Oakland, CA 94613; dave@mills.edu

In brief, there are two general ways to synthesize sounds. Additive synthesis constructs waves of general shapes as linear combinations of sinusoidal functions. The PASCO Fourier Synthesizer provides a standard classroom demonstration, the program Audacity provides a convenient software substitute, and a drawbar organ provides a musical example of additive synthesis. Subtractive synthesis, on the other hand, begins with rich harmonic mixtures such as those that square waves and saw tooth waves provide. Unwanted frequencies are then filtered out to produce desired sounds. I will discuss some fundamentals of musical synthesizers through sound demonstrations and through representations of sound waves in both the time and frequency domains.

EB05: 1:55-2:05 p.m. Teaching Physics Using Virtual Reality

Contributed – Craig M. Savage, The Australian National University, Physics Education Centre, Canberra, Australia; craig.savage@anu.edu.au

Dominic McGrath, Tim McIntyre, Margaret Wegener, The University of Queensland

We present an investigation of three-dimensional, first person, game-like simulations for physics teaching. We report on the effectiveness of the "Real Time Relativity" simulation for learning special relativity. Through its use students have become more confident, judged relativity as less abstract, performed better on relevant subsequent assessment, and act more like experts in the field. Many of the difficulties in learning special relativity arise from its disconnectedness from everyday experience—not only do students have no direct experience of special relativity, but it conflicts with deeply-held everyday beliefs about space and time. Real Time Relativity connects students to special relativity through a virtual reality experience. We argue that the simulation not only enhances traditional learning, but also enables new types of learning that challenge the traditional curriculum. The lessons drawn from this work are being applied to the development of a simulation for enhancing learning of quantum mechanics.

Teaching physics using virtual reality, project website: www.anu.edu.au/Physics/vrproject

EB06: 2:05-2:15 p.m. Improving Physics Teaching Through Technology*

Contributed – Nouredine Zettili, Jacksonville State University, Jacksonville, AL 36265; nzettili@jsu.edu

We want to discuss our outreach initiative designed to help improve the teaching of physics through technology. This initiative is part of Project IMPACTSEED (IMproving Physics And Chemistry Teaching in SEcondary EDucation), funded by a grant from the Alabama Commission on Higher Education intended to offer year-round support to a number of high schools in Alabama. This project is motivated by a major pressing local need: A large number of high school physics teachers teach out of field. IMPACTSEED is designed to achieve a double aim: (a) to make physics and chemistry understandable and fun to learn within a hands-on, inquiry-based setting; (b) to overcome the fear-factor for physics and chemistry among students. Through a two-week long summer institute, a series of weekend workshops designed to help bring technology into physics classrooms, onsite support, and a hotline, we have been providing year-round support to the physics and chemistry teachers in this area. A key component of the project is to help improve the teaching of physics though a rich collection of hands-on activities. IMPACTSEED aims at providing our students with a physics and chemistry education that enjoys a great deal of continuity and consistency from high school to college.

*Supported by the Alabama Commission on Higher Education

EB07: 2:15-2:25 p.m. JiTT with Joomla

Contributed – Paul D. Schmelzenbach, Point Loma Nazarene University, San Diego, CA 92110; paulschmelzenbach@pointloma.edu

In this talk I will highlight ways that I have used Joomla, an open source content management system, to better connect with my students in both upper and lower division courses. I will emphasize the way I use it to incorporate Just in Time Teaching (JiTT), how it can improve efficiency from the instructor's standpoint, and compare its use to systems like Blackboard.

EB08: 2:25-2:35 p.m. Promoting Active Learning in the Classroom Using Interactive Spreadsheet Animations

Contributed – Kandiah Manivannan, Missouri State University, Springfield, MO 65897; ManiManivannan@MissouriState.edu

Anjali Manivannan, New York University

Geometrical methods such as ray tracing communicate the physical interpretation of image formation by an optical element much more effectively than lens formulas. This presentation shows how actual ray tracing can easily be done with the use of computer spreadsheets such as Microsoft Excel. The spreadsheet is user-friendly, has powerful graphing capabilities, and has been recognized as a powerful tool in teaching physics. A significant advantage of the spreadsheet is that if we change input variables such as the position or size of the object, the new rays will be drawn instantly to display the new image. We will also present several computer-based "low-tech" computer animations of optical phenomena such as spherical aberration and image distortion of an axially placed 2-D object. Our innovative approach of utilizing spreadsheets can be very effective in communicating physical concepts to students. Furthermore, these activities seamlessly lend themselves to Just-in-Time Teaching (JiTT).

EB09: 2:35-2:45 p.m. Simulations vs. Real Equipment

Contributed – Wendy K. Adams, University of Northern Colorado, Greeley, CO 80639; wendy.adams@unco.edu

Cynthia Galovich, University of Northern Colorado

Student response to simulations in laboratories has been very positive at the University of Northern Colorado. In fact, the response has been too positive. The simulation program 5Spice is being used in conjunction with real equipment in an upper-division electronics course for physics majors, and PhET Interactive Simulations have been integrated into the introductory algebra-based physics course. In both courses students prefer working with the simulations over real equipment. Studies have shown that PhET simulations are more effective for conceptual understanding; however, there are many goals of hands-on labs that simulations do not address, for example, specific skills relating to the functioning of equipment. In this talk we'll present data on student response to labs and discuss our goals for each of these laboratories. We believe it may be most effective to use a combination of simulations and real equipment but order matters.

Session EC: Best Practices for Increasing the Numbers of Women in Physics

Location: Room 200C
Sponsor: Committee on Women in Physics
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, Feb. 7
Time: 1:15–2:55 p.m.

Presider: Ted Hodapp

EC01: 1:15-1:45 p.m. The Conference for Undergraduate Women in Physics: Advancing Graduate Education in Physics

Invited – Noelle R. B. Stiles, California Institute of Technology, Pasadena, CA 91125-9300; nstiles@caltech.edu

Armand R. Tanguay, Jr., University of Southern California

The Conference for Undergraduate Women in Physics (CUWiP) unites undergraduate women physicists with women professors, industrial scientists, and graduate students to encourage the pursuit of a doctoral degree in physics. The U.S. is ranked 11th internationally in physics bachelor's degree gender diversity, and at each higher career stage, the percentage of women decreases. In particular, the transition between a physics bachelor's degree and a PhD is critical. Twenty-one percent of physics bachelor's degrees were awarded to women in the U.S. in 1999-2000, in contrast to 13 percent of physics doctoral degrees. CUWiP encourages women at the critical transition between undergraduate and graduate degrees by providing critical support, networking, and mentoring activities in a conference environment. CUWiP began at the University of Southern California in 2006, and has been held annually ever since. Each year, more universities hold simultaneous conferences across the country and share an interactive all-site keynote address.

EC02: 1:45-2:15 p.m. How to Eliminate the Need for this Session!

Invited – Patricia Rankin, University of Colorado, Boulder, CO 80309-0018; Patricia.Rankin@colorado.edu*

Efforts to increase the representation of women in physics have been under way since the presenter was an undergraduate (and before). These efforts have been and are well meaning, have undoubtedly helped many individuals, and are usually organized at a grass-roots level. The presenter, who has worked at both the grass-roots level and at higher levels, will discuss how to have an immediate impact and how to work to address barriers over the longer term. The goal will be to both provide useful ideas for implementation and to encourage a strategic approach based on an understanding of organizational change. The presenter will also touch on how focusing on increasing the inclusion of women can lead to best practices that benefit all students of physics.

*Sponsor: Theodore Hodapp

EC03: 2:15-2:45 p.m. Encouraging Women to Major in Physics: Be Persistent

Invited – Earl D. Blodgett University of Wisconsin - River Falls, River Falls, WI 54022; earl.d.blodgett@uwrf.edu

UW-River Falls is a mid-sized public university (total enrollment < 6800) offering undergraduate physics degrees in physics, applied physics and physics education. Over the past 25 years, we have worked hard to encourage more women to major in physics, succeeding in maintaining about 20 to 25 percent women graduates. During that same time span, the over-all student population has gone from about 50 percent women to about 65 percent women. Why has our proportion of women in physics not grown correspondingly? Our students have consistently given us good marks for a welcoming and supportive environment. We have employed a number of strategies for encouraging women to major in physics, with varying success. We have learned two main lessons: there is no substitute for personal interaction between faculty and students, and consistent enthusiastic effort is required; complacency after a successful initiative is deadly.

EC04: 2:45-2:55 p.m. Increasing the Participation of Women in Physics in the U.S. and Across the Globe

Contributed – Beth A. Cunningham, American Association of Physics Teachers, College Park, MD 20740; bcunningham@aapt.org

Luz Martinez-Miranda, University of Maryland

In the last eight years, the number of women earning physics bachelor's degrees in the U.S. has increased slower than the bachelor's degrees attained by men, resulting in the first substantial proportional decline in decades. To change this trend, the physics community needs deeper understandings, more targeted strategies, and active engagement by all practicing physicists. In this paper members of the U.S. delegation to the Fourth International Conference on Women in Physics report the statistics of women and under-represented minorities in physics at all levels in the U.S.; possible strategies for increasing their participation; evaluations of those strategies, where available; and possible intersections with the concerns and activities of our international colleagues. In addition to these strategies, resolutions developed by all delegates will be reported as well as steps that AAPT and its members can take to increase the participation of women in physics.

Session ED: Student Understanding of Concepts that Underlie the Interpretation of Astronomical Data and Models

Location: Room 204
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Space Science and Astronomy
Date: Tuesday, Feb. 7
Time: 1:15–3:05 p.m.

Presider: Peter Shaffer

Current findings from astronomy and astrophysics are expanding our view of the universe. Ability to interpret these findings, however, requires an understanding of many physics concepts (relativity, atomic spectra, Doppler shift, etc.). Papers reflect on student thinking about physics topics related to astronomy and/or the design of instruction to help students apply physics in interpreting astronomical evidence.

ED01: 1:15-1:45 p.m. Using Research to Investigate and Enhance Student Understanding of Light as an Electromagnetic Wave

Invited – Bradley S. Ambrose, Grand Valley State University, Allendale, MI 49401; ambroseb@gvsu.edu

In astronomy it is crucial to understand that light is an electromagnetic wave that can exhibit interference and polarization phenomena. For many years, however, research in physics education has shown that physics students, both mainstream introductory students and physics majors, encounter serious difficulties when they endeavor to develop and apply a wave model to the behavior of light. This presentation will focus on well-identified difficulties—some of them deeply seated alternate conception—suggested by the analysis of student responses to various research tasks (ungraded quizzes, written exams, individual student interviews). Also to be discussed are examples of teaching-by-questioning strategies that seem effective in addressing these difficulties. All examples come from research previously conducted at the University of Washington in the context of the introductory calculus-based waves and optics course or from more recent work at Grand Valley State University in a sophomore-level modern physics course.

ED02: 1:45-2:15 p.m. Student Understanding of Galilean Relativity: Implications for Naked-Eye Astronomy

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

Accounting for the daily and annual motions of the sun, moon and stars is facilitated by changes in frame, from geocentric to heliocentric, and by the application of Galilean relativity, for example in explaining how it is that the set of lunar features presented to Earth does not vary. Yet students experience substantial difficulty applying even basic ideas of relative motion. This talk explores student understanding of Galilean relativity, with an emphasis on implications for the teaching of topics in visual astronomy.

ED03: 2:15-2:45 p.m. Cosmology for Introductory Physics Students

Invited – Colin S. Wallace, Center for Astronomy Education (CAE), Steward Observatory, University of Arizona, Tucson, AZ 85721; cswallace@email.arizona.edu

Edward E. Prather, Center for Astronomy Education (CAE), Steward Observatory, University of Arizona

In order to inspire students' natural curiosity and motivate their interest in contemporary scientific investigations, we must move beyond traditional problems, such as inclined planes and Atwood machines, that dominate introductory physics. One universally interesting topic for students is cosmology. Cosmology addresses fundamental issues about reality, such as the age, composition, and evolution of the universe. In this talk, we discuss common student conceptual and reasoning difficulties related to cosmology, and how instructors can use topics from cosmology to elevate students' intellectual engagement in traditional physics lessons. This material is based in part upon work supported by the National Science Foundation under Grant Nos. 0833364 and 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.

ED04: 2:45-2:55 p.m. But, What Does It Mean? Getting at the Underlying Physics

Contributed – Eric G. Hintz, Brigham Young University, Provo, UT 84602 doctor@tardis.byu.edu

One of the most difficult tasks in teaching undergraduate astronomy research is to get students to stop thinking that measuring a magnitude is a sufficient result. We always have to ask; "But, what does it mean?" to get the students thinking about the underlying astrophysics. In our observational astronomy class (which is open to all students, not just majors), we teach the acquisition and processing of data, but then put a strong emphasis on the interpretation of the results. During the course of the semester the students are required to read 10 journal articles related to the research being done in class. The final results of the class are presented in the form of two journal style papers and a meeting poster. The students must clearly show they know what their measurements mean to succeed on these assignments. Some results from the class will be presented.

ED05: 2:55-3:05 p.m. Effective Learning About Diffraction and the Wave/Particle Nature of Light

Contributed – Richard Gelderman, Western Kentucky University, Bowling Green, KY 42101-1077; richard.gelderman@wku.edu

Using astronomical examples of diffraction-limited resolution and multi-aperture interferometry is a way to present the dual wave-particle nature of light to students in an introductory physics class. We present examples of conceptual activities such as ranking questions and think-pair-share questions that use astronomical examples to motivate learning about diffraction, interference, and modern optics.

Session EE: SPIN-UP Ten Years Later

Location: Room 106
Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, Feb. 7
Time: 1:15–2:45 p.m.

Presider: Robert Hilborn

EE01: 1:15-1:45 p.m. SPIN-UP Ten Years Later*

Invited – Ruth Howes, Ball State University (Emerita), Santa Fe, NM 87501; rhowes@bsu.edu

Ten years ago, the SPIN-UP Report produced by the National Task Force on Undergraduate Physics identified several key characteristics of thriving undergraduate physics programs. Since that time, the number of physics majors graduating has increased each year. Nevertheless, the rate of growth has slowed in the last several years, and many departments are threatened in the current financial crisis because of low undergraduate enrollments. During the past three years, NSF has supported five regional workshops for physics departments which have allowed the SPIN-UP team to stay up to date with the situation in undergraduate physics programs. This is an appropriate time to revisit the conclusions of the SPIN-UP report and consider its recommendations and new ideas to continue the growth of robust undergraduate physics programs.

*Work supported by NSF grant DUE0741560.

EE02: 1:45-2:15 p.m. Growing Physics and Astronomy at James Madison University

Invited – C. Steve Whisnant, James Madison University, Harrisonburg, VA 22807; whisnacs@jmu.edu

James Madison University is a public, primarily undergraduate institution with a student enrollment of approximately 18,000. The Department of Physics and Astronomy now serves approximately 110 majors. There are 15 tenured/tenure-track and six nontenure-track full-time faculty in the department. Graduation rates have grown from five or fewer/year to typically 15-20/year. All tenured/tenure-track faculty engage undergraduates in research; 11 are externally funded. Forty-eight students were engaged in research last year. The growth of our department is due to a variety of reforms. The initiation of our multi-track BS and BA degree programs and a renewed focus on undergraduate research are paramount. These and other significant factors contributing to our success such as student recruiting, outreach, teaching and research integration/balance, promotion of a department culture, visibility on-and off-campus, and university support will be discussed.

EE03: 02:15-2:45 p.m. Sustaining Small Programs: Lessons from the Trenches

Invited – James H. Stith, American Institute of Physics, College Park, MD 20740; jstith@aip.org

The challenge facing small physics departments has never been more critical than they are today. This is especially true of small departments at minority serving institutions (MSI's). This talk will highlight the outcomes of a meeting of department chairs of Historically Black Colleges and Universities (HBCUs). The meeting focused on what departments could do to increase enrollment in physics programs, how departments could work with the senior leadership at their institutions to sustain and vitalize programs, and ways that departments could work across institutions to revitalize programs.

Session EF: Teacher Preparation Around the World

Location: Room 103
Sponsor: Committee on International Physics Education
Co-Sponsor: Committee on Teacher Preparation
Date: Tuesday, Feb. 7
Time: 1:15–2:55 p.m.

Presider: Robert Poel

EF01: 1:15-01:45 p.m. Online Course to In-service Science Teachers Regarding Scientific Literacy in Mexico

Invited – Genaro Zavala, Tecnologico de Monterrey, Garza Sada 2501, Monterrey, NL 64890 Mexico; genaro.zavala@itesm.mx

Silvia Tecpan, Tecnologico de Monterrey

PISA tests have shown that Mexico is a country with great educational problems. Our students have performed well below average in all types of the PISA tests that have been administered; in particular when evaluating science. This problem has been addressed with different visions, from the perspective of the curriculum, culture, educational management, and from the educational system. Our vision is taking the teacher as the core part of education. The in-service science teacher at the pre-university level might not have the elements needed to educate their students in scientific literacy. This presentation will show the design and some results of an online course regarding scientific literacy that is given to in-service science teachers from all regions of Mexico.

EF02: 1:45-2:15 p.m. Physics Teachers' Preparation in Canada: Challenges and Successes

Invited – Marina Milner-Bolotin, The University of British Columbia, Vancouver, Canada; marina.milner-bolotin@ubc.ca

Teacher certification in Canada is a provincial responsibility. To become a public school physics teacher in Canada, one must earn a Physics/Engineering degree and then be certified as a physics/mathematics or physics/chemistry teacher. A typical Canadian Teacher Certification program lasts between 12-24 months. Most Canadian provinces do not lack certified physics teachers, yet many physics classrooms are taught by non-physics teachers, because senior science teachers will have priority in teaching physics over younger certified physics teachers. Moreover, there is a shortage of physics teachers in smaller towns and remote areas. These physics teachers have very limited access to quality professional development. For example, Canada has only four AAPT Sections. In addition, the diversity of admission requirements to Canadian post-secondary institutions and the way high school provincial exams are administered, creates additional challenges and inequities. The ways Canadian educators are attempting to address these challenges will be discussed in this talk.

EF03: 2:15-2:45 p.m. Discussion of the Physics Teacher Formation in Italy and of Some Research-based Formative Intervention Modules.

Invited – Marisa Michelini, Physics Section of DCFA - University of Udine via delle Scienze 208 Udine, 33100 Italy; marisa.michelini@uniud.it

The teacher formation scenario in Italy is changing. It started very late (1999-2000) with a very good curricular plan at the university level organized in four areas (teaching professional formation, subject-related education, education labs, apprenticeship). Primary teacher formation will be structured in a five-year degree, after an experience of four-year degree up to now. The certification to teach in secondary school will come after a specific biannual Master for Teaching (MT), plus an extra year integrated with apprenticeship (total = three years, 180 ECT). Specific subject degrees (180 cts) are required for each MT. The research-based physics teacher formation experience carried out in the biannual Specialization School for Secondary Teaching SSST active until 2008 and some pilot Masters will inspire the way to form the Pedagogical Content Knowledge of future teachers. The contribution will discuss the characteristics of some significant PER Models implemented for physics teacher formation.

EF04: 2:45-2:55 p.m. Physics Teacher Education in Germany

Contributed – Barbara M. Hoeling, California State Polytechnic University, Pomona CA 91768; bmhoeling@csupomona.edu

Compared to the U.S., Germany produces about three times the number of physics degrees per capita. However, physics is not particularly popular in society or in the schools, where every student has to take at least two years of physics courses. In recent years, substantial changes have therefore been implemented at the universities in the education of physics teachers. I will report on what I learned last summer about physics teacher education programs when visiting two universities in different German states. With a strong emphasis on lecture demonstrations and practical applications and an excellent support structure for new in-service teachers, the German system features elements that are interesting to consider for emulation in the United States.

Session EG: PER: Student Reasoning

Location: Room 200AB
Sponsor: Committee on Physics Education Research
Date: Tuesday, Feb. 7
Time: 1:15–2:55 p.m.

Presider: Dylan McBride

EG01: 1:15-1:25 p.m. Representing Energy Transfers and Transformations*

Contributed – Rachel E, Scherr, Seattle Pacific University, West Seattle, WA 98119; rescherr@gmail.com

Hunter G. Close, Texas State University

Lane Seeley, Sarah B. McKagan, Seattle Pacific University

Common representations of energy in physics, including bar charts, graphs of energy vs. time, and pie charts, promote quantitative calculations of relative amounts of energy that are present in a system at a given moment. The Energy Project at Seattle Pacific University has developed a family of representations that enforce energy conservation while enabling detailed modeling of energy dynamics, particularly the complex transfers and transformations of energy that take place during real physical events. These representations variously use human bodies, computer animation, wooden cubes, and graphic diagrams to represent units of energy during dynamic processes in physical phenomena. Each representation provides a unique framework for collaborative construction of physics ideas. We provide evidence that these representations are not only expressive but are also rigorous in the sense that their disciplined application raises new questions about the phenomena being represented.

*Supported in part by NSF DRL 0822342 & Seattle Pacific University Science Initiative

EG02: 1:25-1:35 p.m Learners' Understanding of Energy: Conservation of Amount, Decrease of Value*

Contributed – Abigail R. Daane, Seattle Pacific University, Seattle, WA 98119; abigail.daane@gmail.com

Lane Seeley Seattle, Amy D. Robertson, Stamatis, Rachel E. Scherr, Seattle Pacific University

In a summer professional development course on energy in physics, secondary teachers spontaneously considered not only the amount and forms of energy involved in physical processes, but also the energy's usefulness. For example, some teachers discussed situations in which they viewed energy as losing value during a process, even when they explicitly acknowledged that the total amount of energy was constant. Others articulated that the quality, usefulness, or availability of the energy decreased when it changed form (e.g., from kinetic to thermal). These ideas might be resources from which to construct a coherent model for energy usefulness, dissipation, and degradation which can be applied across a wide range of physical scenarios. They might also be the basis for a meaningful connection between energy that is conserved (in a physics context) and energy that is used up (in a sociopolitical context).

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

EG03: 1:35-1:45 p.m. A Conceptual Blending Theory Analysis of Energy Theater*

Contributed – Hunter G. Close, Texas State University - San Marcos, San Marcos, TX 78666; hgclose@txstate.edu

Eleanor W. Close, Texas State University - San Marcos

Rachel E. Scherr, Seattle Pacific University

Sarah B. McKagan, McKagan Enterprises

Conceptual blending theory (CBT)[1] offers an elaborate theoretical apparatus for explaining how the human imagination creates unreal situations that, by their relations to reality, teach us about reality. In these imaginary blended situations, we establish new correspondences, interactions, and dynamics, and the outcomes of the dynamics lend insight to the nature of various real situations that were used to compose the unreal blend. The general idea of CBT has charmed the PER community for a few years, but it has gained little traction in affecting how we do business, perhaps because we have not demanded more from the theory in its relation to our data. In this presentation, we attempt to test some of the finer points of CBT by challenging it to explain Energy Theater,[2] both generally in terms of the design of the activity, and specifically in terms of the actual interactions of participants in one episode.

* Supported in part by NSF DRL 0822342

1. G. Fauconnier & M. Turner, *The Way We Think: Conceptual Blending and the Mind's Hidden Complexities* (Basic Books, New York City, 2002.)
2. R. E. Scherr, H. G. Close, S. B. McKagan, & E. W. Close, "Energy Theater": Using the body symbolically to understand energy, in C. Singh, M. Sabella, & S. Rebello (Eds.) *2010 Physics Education Research Conference Proceedings* (AIP Press, Melville, NY, 2010.)

EG04: 1:45-1:55 p.m. Assessing a Wide Range of Instructional Goals for K-12 Teacher Professional Development*

Contributed – Amy D. Robertson, Seattle Pacific University, Seattle, WA 98119; robertsona2@spu.edu

Sarah B. McKagan, Rachel E. Scherr, Stamatis Vokos, Seattle Pacific University

Science educators often want professional development to increase the extent to which teachers attend to the disciplinary substance of K-12 students' ideas, see themselves as participants in the construction of scientific knowledge, and autonomously formulate relevant questions about physical scenarios. The PER community has some evidence for teacher growth in these areas, and the Energy Project at SPU is seeking to discern how such growth manifests itself. In doing so, we hope to develop new ways of assessing K-12 teacher professional development. These new assessments will add to existing assessments of K-12 teachers' conceptual understanding of physics, beliefs/attitudes about science, or use of inquiry in the classroom (e.g., open-ended conceptual assessments; the FCI; the CLASS and the MPEX; or the RTOP, respectively).

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

EG05: 1:55-2:05 p.m. Examining Student Approaches to Interpreting and Applying Multi-Variable Expressions

Contributed – Cody Gette, North Dakota State University, Fargo, ND 58108-6050; Cody.Gette@ndsu.edu

Mila Kryjevskaia ,North Dakota State University

Student reasoning difficulties with interpreting and applying multi-variable expressions have been reported previously. For example, students tend to treat the relationship between the wavelength, propagation speed, and frequency as a mathematical identity. That often leads to erroneous conclusions such as "the frequency is changed by changing the speed." We extended this investigation to the contexts of electric field, electric potential, and capacitance. A variety of questions were designed that required students to analyze relationships between various quantities. Significant differences in student reasoning approaches were identified that appeared to depend on whether (1) information presented to students was given in written text and the written text was explicitly translated to the mathematical expression(s) in standard symbolic form or (2) the information was presented in the written form only.

EG06: 2:05-2:15 p.m. Dissecting Proportional Reasoning: Constructs and Student Thinking*

Contributed – Andrew Boudreaux, Western Washington University, Bellingham, WA 98225; andrew.boudreaux@wwu.edu

Suzanne Brahmia, Rutgers University

Stephen E. Kanim, New Mexico State University

Proportional reasoning is sometimes treated as a monolithic ability that "switches on" at a particular stage of development. However, results from research in both mathematics and physics education suggest that proportional reasoning is multi-faceted and often context-dependent. A collaborative project between Western Washington University, Rutgers University, and New Mexico State University seeks to develop and assess classroom activities to promote student facility with ratio reasoning. This talk will provide a brief outline of the project and present an example of assessing student reasoning. Those who are interested may wish to view related posters at this meeting by Brahmia and Kanim.

*Supported by NSF grants DUE-1045227, DUE-1045231, & DUE-1045250.

EG07: 2:15-2:25 p.m. Spatial Reasoning, a Potential Roadblock to Conceptual Understanding of Waves

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

As a part of a multi-year investigation of student understanding of mechanical waves in introductory courses, a set of tutorials[1] on wave behavior at a boundary has been developed. However, even after the targeted instruction many students still are not able to systematically analyze complex unfamiliar situations. We hypothesized that poor performance on some post-tests may be attributable to difficulties in visualizing and reasoning spatially about transformations in the shape of a spring that occur over time as a complex pulse reflects from a boundary. We probed the extent to which student performance hinges on their abilities to visualize and reason spatially by examining the degree of association between student performance on the post-tests and on a spatial visualization test (paper folding test).

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

EG08: 2:25-2:35 p.m. Rediscovering Galileo: The Productivity of Thinking of Forces as "Stuff"

Contributed – Andrew Elby, University of Maryland, College Park, MD 20742-1115; elby@umd.edu

Ayush Gupta, University of Maryland

Among the many student difficulties addressed by PER, misconceptions stemming from "mis-ontologies" "incorrect views about what kind of entity a given quantity "is" are viewed by some researchers as particularly pernicious. For instance, some researchers argue that viewing force as a kind of substance ("stuff") carried by an object is particularly harmful to productive conceptual development, and hence, learners should be guided away from such conceptions.[1] While acknowledging that force is not a substance, we dispute the claim that substance-based metaphors for force hinder conceptual development. We present data from a teacher professional development workshop, where a group of elementary school science teachers start from substance-based metaphors for gravity to build a sophisticated Galilean explanation for why objects of different masses accelerate at the same rate due to gravity. Instructional interventions should tap these productive substance-based ways of thinking rather than categorizing them as pure misconceptions.

1. M. Reiner, J.D. Slotta, M.T. Chi, & L.B. Resnick, "Naive physics reasoning: A commitment to substance-based conceptions," *Cognition and Instruction* **18**(1), 1-34, (2000); D. Brookes, *The Role of Language in Learning Physics* (Rutgers University Ph.D. dissertation, 2006), Retrieved October 10, 2011, from http://research.physics.illinois.edu/PER/David/thesis_Y2.pdf

EG09: 2:35-2:45 p.m. Leveraging Embodied Cognition to Enhance Student Understanding of Angular Momentum

Contributed – Daniel J. Lyons, University of Chicago, Chicago, IL 60637; danjlyons@gmail.com

Carly Kontra, Sian L. Beilock, University of Chicago

Susan M. Fischer, Depaul University

A novel instrument for physics education research called the Torque Judgment Task (TJT) was developed to assess students' ability to determine the relative torques felt when tilting bicycle wheel gyroscopes, an apparatus commonly used in introductory physics courses to demonstrate properties of torque and angular momentum. Results from laboratory experiments involving dual-wheel gyroscopes show that individuals who play active roles in manipulating the gyroscope apparatus show more improvement on the TJT than those who participate solely as observers, especially on problems related to angular momentum vector addition and cancellation. A laboratory activity for introductory physics based around these experimental results was also designed in an effort to leverage theories of embodied cognition (the idea that our physical experiences can improve learning by grounding our understanding of abstract concepts—e.g. torque and angular momentum—in concrete physical terms) in teaching and learning about the vector nature of torque and angular momentum.

EG10: 2:45-2:55 p.m. Conceptions on Mechanical Waves of Students in Introductory Physics

Contributed – Jung Bog Kim, Korea National University, Chungbuk, CB 363-791 Korea; jbkim@knue.ac.kr

Gwangsoo Kim, Jae Sool Kwon, Korea National University of Education

Concepts on mechanical waves have been investigated to undergraduate students in introductory physics courses by using the MWCS (Mechanical Wave Conceptual Survey) tool. It consists of a total of 22 questions in wave propagation, superposition, reflection, and standing wave parts. Students have difficulties in traveling of a pulse wave and a standing wave. The types of misconception could be grouped into work-and-energy connected model, dualistic thinking model, particle-pulse wave model, amplitude-dependent model, immature conceptual model, categorical conceptual model, and force-and-motion model. We will introduce various types of misconception in detail.

Session EH: Physics of Games, Animations & Game Interfaces

Location: Room 202AB
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, Feb. 7
Time: 1:15–1:45 p.m.

Presider: Aaron Titus

Physics has an impact on motion sensing capability and motion processing technology for personal video game systems. Physics also impacts how programmers use motion sensing data to develop games with compelling realism. Contributed papers are requested on topics related to the physics used in video games, animation, and game interfaces as well as how to teach physics using these devices.

EH01: 1:15-1:25 p.m. The Physics of Osmos

Contributed – Joshua Gates, The Tatnall School, Wilmington, DE 19807; jgates@tatnall.org

The use of video games as a springboard to the study of physical principles has been valuable in terms of student engagement and subject visibility, as the recent popularity of physical analysis of Angry Birds has demonstrated. The ambient video game "Osmos" (www.hemispheregames.com/osmos/) presents many of the same opportunities, but with a much richer palette of physical principles. The gameplay presents the chance for students to gain intuitive knowledge of Newton's laws, conservation of momentum, relative motion, non-inertial reference frames, and orbital mechanics. Orbital mechanics, in particular, can suffer for lack of classroom demonstration and application opportunities, which are pleasantly abundant here. The chance for students to model the interactions can be invaluable discovery learning. Because the "laws" of this physical universe are not easily accessible to students via textbook or Internet search, there can be no "short circuiting" of the discovery process via research.

EH02: 1:25-1:35 p.m. Using the Xbox Kinect Sensor for Positional Data Acquisition

Contributed – Jorge L. Ballester, Emporia State University, Emporia, KS 66801; jballest@emporia.edu

Chuck B. Pheatt, Emporia State University

We describe the use of the Xbox Kinect motion sensing input device for use in physics experiments that require acquisition of three-dimensional positional data. This device provides video and depth sensor outputs that can be used to assess object motion in three-dimensions over time. The Kinect can be interfaced directly to a personal computer using freely available software. The intricacies of acquiring three-dimensional positional data will be discussed along with the performance characteristics of the Kinect. Several standard physics experiments are analyzed using the device. We conclude that the Kinect has significant potential for use by teachers and students of physics.

EH03: 1:35-1:45 p.m. Physics and Halo 2 Video Game

Contributed – Igor V. Proleiko, McKinley Classical Academy, St. Louis, MO 63104; igor.proleiko@slps.org

Julian K. Proleiko, School of Independent Thought

The Halo video game franchise unfolds as a science fiction story. The parameters of Halo Universe and the equipment used by the characters are analysed and explored. The comparison with the our measurable universe is discussed. The question whether the game story requires different rules of physcs is investigated.

Session EI: Effective Practices in the Instructional Laboratory

Location: Room 203AB
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Research in Physics Education
Date: Tuesday, Feb. 7
Time: 1:15–2:45 p.m.

Presider: Steve Lindaas

EI01: 1:15-1:25 p.m. Which Accelerates Faster? A Falling Ball or a Porsche?

Contributed – Wathiq Abdul-Razzaq, West Virginia University, Morgantown, WV 26506; wabdulra@wvu.edu

James Rall, West Virginia University

An introductory physics experiment has been developed to address the issues seen in conventional physics lab classes including assumption verification, technological dependencies, and real-world motivation for the experiment. The experiment has little technology dependence and compares the acceleration due to gravity by using position-versus-time graphs and the kinematic equation. The students are also asked to compare the acceleration they find to the acceleration of a Porsche car, which they seem surprised when they learn about. Overall, the students at West Virginia University seem more appreciative of the scope of this lab due to its simplicity.

EI02: 1:25-1:35 p.m. Scientific Writing and Research Experience in the Undergraduate Student Lab

Contributed – Nina Abramzon, California State Polytechnic University, Pomona, CA 91768; nabramzon@csupomona.edu

Barbara M. Hoeling, California State Polytechnic University, Pomona

We report on our experiences with implementing experiments using modern quantum optics and spectroscopy equipment in an undergraduate laboratory course. In our sophomore modern physics lab, students analyze spectra of unknown sources using either an optical emission spectrometer or a high-resolution gamma detector. In our senior optics lab, they measure photon statistics with single photon counting modules. For both courses, students write a report in the format of a scientific paper, which is reviewed by one of their peers and by the instructor and revised according to the reviewers' comments. Students thus gain experience in scientific writing in the format of a professional journal publication, about measurements taken with state-of-the-art research equipment. Results of student learning are presented, including an assessment of the students' ability to participate in written scientific communication, and students' attitudes toward the experience.

EI03: 1:35-1:45 p.m. Bringing Concepts from Nuclear High Energy Physics into College & High School Classroom*

*Contributed – Edmundo Garcia,** Chicago State University, Chicago, IL 60628; edmundo.garcia@csu.edu*

Karla Jemison, Britney Keys,Thomas Kuhn, Mel Sabella, 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. In addition to creating a nuclear high energy physics thread in the undergraduate curriculum, we are also working with in-service teachers from the Chicago Public Schools. This past summer we conducted our first workshop with about 10 participants. In addition to developing concepts in detector physics, we also discussed how to take these ideas into the high school classroom. In this talk we report on the status of the project and highlight some of the results from the summer professional development workshop.

*Supported by NSF-CCLI grant DUE-0941034.

**Sponsor: Mel Sabella

EI04: 1:45-1:55 p.m. May the Best Theory Win

Contributed – Doug Bradley-Hutchison, Sinclair Community College, Dayton, OH 45402; douglas.bradley-hutc@sinclair.edu

Kathleen Koenig, University of Cincinnati

Designing experiments to test competing hypotheses is a fundamental process in science. Yet thinking in the hypothetical is a higher order skill that students often lack. The term hypothesis, for example, is commonly identified as an educated guess, thus equivalent to a prediction. We describe examples of laboratory activities where students are asked to predict the outcome of an experiment from the perspective of two competing theories. This is in contrast to the traditional laboratory where the goal is to confirm only the accepted theory. Using this approach one can also formulate misconceptions (e.g. Aristotelian ideas) as testable hypotheses offering students an opportunity to test their common-sense beliefs in a formal manner. Examples developed both for physics courses and a course specifically designed to teach scientific thinking skills (to science and engineering majors) will be discussed.

EI05: 1:55-2:05 p.m. Slipping Spheres and Sliding Blocks: The "Role" of Kinetic Friction

Contributed – Kevin P. Greene, California Baptist University, Riverside, CA 92504; achediak@calbaptist.edu

Justin S. Mueller, Alex Chediak, California Baptist University

If a rolling sphere and a sliding block, each of the same material, were to race down the same incline plane, which would win? We have developed a theoretical model, confirmed with experimental data, which shows that at low angles the rolling object wins whereas at high angles the sliding object wins. Experimentally, a cross-over angle of 36º was observed, which implies from our model that mu_k,block = 0.21, in agreement with direct measurements using a force sensor. The sphere beings to slip at 47º, which implies that mu_s,sphere = 0.31, also in agreement with direct measurements using a force sensor. However, at higher angles, in which the sphere slips, our data indicates that the sphere's acceleration never reaches that of the block—in apparent disagreement with theoretical expectations (since mu_k, sphere is found to be less than mu_k,block). This will be explored and the latest results presented.

EI06: 2:05-2:15 p.m. Teaching Optics in the Introductory Mechanics Laboratory

Contributed – Timothy T. Grove, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Mark F. Masters, IPFW Department of Physics

Laboratory often is simply an adjunct to the class as a hands-on demonstration. Previously, we had significantly modified our first semester and second semester laboratories in recognition of the fact that if you change physical concepts and equipment in every laboratory class, the labs must devolve into instruction following activities. In the second semester, we have the students learn about circuits through investigation in the laboratory and removed the topic from the lecture. The first semester laboratories (mechanics) were modified so that the focus, while still mechanics was much more narrow and concerned with application of kinematics and Newton's laws. Being radical, we decided to put all of the laboratories into the lecture as interactive lecture investigations and used the laboratory time to have the students learn about geometric optics through investigation. This presentation will describe our approach and the measures of student learning in optics and mechanics.

EI07: 2:15-2:25 p.m. Assessing Student Learning of Error Propagation in the Undergraduate Lab

Contributed – Brent W. Barker, Michigan State University, Lansing, MI 48824-1321; barker@nscl.msu.edu

A pre-and post-survey was conducted during an introductory calculus-based physics laboratory to test students' basic skills in error-propagation. Additionally, students participated in a "think-pair-share" activity during the course. Overall, based on the surveys, students improved, especially in the case where they did not have any misconceptions initially. Qualitative assessment of the think-pair-share activity contrasts with the results of the post-survey.

EI08: 2:25-2:35 p.m. Examining Student Understanding of IV Characteristics*

Contributed – David P. Smith, University of Washington, Seattle, WA 98195; dsmith4@uw.edu

Christos P. Papanikolaou, University of Athens

MacKenzie R. Stetzer, University of Maine

In the last three decades, there has been a great deal of research on the learning and teaching of electric circuits. Much of this work has focused on simple circuits consisting of batteries and bulbs. This research is being extended as part of a multi-institutional investigation into student understanding of analog electronics. The effort has included research on student understanding of current-voltage characteristics and the function of electronic devices, such as LEDs. The findings are helping inform the development of instructional materials for the introductory level while also providing valuable insights into the treatment of this material in upper-division courses. Selected findings from representative pre- and post-tests will be presented.

*This work has been supported in part by the National Science Foundation under Grant No. DUE-0618185.

EI09: 2:35-2:45 p.m. Brownian Motion: Measuring Avogadro's Constant (Within a Few Percent) for $70

Contributed – Beth Parks, Colgate University, Hamilton, NY 13346; meparks@colgate.edu

Rebecca Metzler, Colgate University

We implemented a Brownian Motion lab in our introductory physics course for first-year students. We used 1 micron polystyrene spheres in a dilute saline solution viewed with a Celestron LCD microscope. Rather than taking a video and using particle tracking, students simply took a snapshot (screen capture) every four seconds. These snapshots were easily uploaded to a computer, and students clicked on a sphere in successive snapshots, using ImageJ to capture the x-y coordinates. These data were transferred to a spreadsheet and analyzed to find the average squared displacement in 4 s, 8 s, and 12 s intervals. The slope of the resulting line typically yielded Avogadro's number within a few percent. The entire data collection and analysis can be completed in about 15 minutes.

Session EJ: Mentoring: Stories and Strategies

Location: Room 202AB
Sponsor: Committee on Women in Physics
Co-Sponsor: Committee on Professional Concerns
Date: Tuesday, Feb. 7
Time: 2–2:40 p.m.

Presider: Patty Palko

This is an invited and contributed session designed for reports from groups investigating or providing transformative mentoring in physics or Physics Education Research. This includes successful stories and strategies regarding recruiting, preparing, and retaining students, faculty, researchers, teachers, and others in the world of physics.

EJ01: 2-2:30 p.m. Mentoring and Early-Career Scientists' Commitment to Good Work

Invited – Jeanne Nakamura, Claremont Graduate University, Claremont, CA 91711; jeanne.nakamura@cgu.edu*

In two studies, one of creativity after age 60 and one of mentoring lineages, scientists described the formative role played by their mentors, and their own goals when mentoring. The story of Niels Bohr's lasting impact on the professional formation of many leading 20th-century physicists provides a starting point in drawing out lessons for early-career scientists and those who will mentor them. Data come from individual cases, and systematic interview research conducted as part of the Good Work Project (Gardner, Damon, & Csikszentmihalyi, 2001). Particular attention is given to the mentors' part in encouraging work that is excellent, ethical, and engaging (Nakamura, Shernoff, & Hooker, 2009). In addition to the mentor, the roles of the lab as a mentor-sponsored learning environment and the student as an active contributor to his or her own development are described. Practical implications of the research are discussed.

*Sponsor: Patty Palko

EJ02: 2:30-2:40 p.m. Gestural Analysis of TA-Student Interactions in a SCALE-UP Classroom

Contributed – George DeBeck V, Oregon State University, Corvallis, OR 97330; debeckg@onid.orst.edu

Dedra Demaree, Oregon State University

In the spring term of 2010, Oregon State University began using a SCALE-UP style classroom in the instruction of the introductory calculus-based physics series. Instruction in this classroom was conducted in three two-hour sessions facilitated by the primary professor and either two graduate teaching assistants (GTAs) or a graduate teaching assistant and an undergraduate learning assistant (LA). During the course of instruction, two of the eight tables in the room were audio and video recorded. We examine the practices of the GTAs when interacting with the students, primarily through a gestural analysis lens. Specifically, we examine changes in GTA behavior as they gain experience in the SCALE-UP environment, and the differences in practice between different GTAs. GTAs are shown to utilize gestures that indicate increased confidence and a changing relation to the students as they gain experience in the classroom.

Physics Education Research and Public Policy

SYMPOSIUM on Physics Education

Location: Ballroom C
Sponsor: AAPT
Date: Tuesday, Feb. 7
Time: 3:45–5:20 p.m.

Chair: Noah Finkelstein, University of Colorado, Boulder

Policymakers formulate decisions everyday that impact curriculum, standards, funding, and many other aspects of physics education at all levels. AAPT works with partners to keep policymakers 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.

– *Howard Gobstein, Executive Vice President, Research, Innovation and STEM Education, Association of Public and Land-grant Universities*

– *Helen Quinn, Professor Emerita of the Department of Particle Physics and Astrophysics at the SLAC National Accelerator Laboratory, and Co-chair of Stanford University's K12 Initiative*

– *Pat Heller, Associate Professor of Curriculum and Instruction at University of Minnesota*

Howard Gobstein

Helen Quinn

Pat Heller

PST2: Poster Session 2

Location: Ballroom A
Date: Tuesday, Feb. 7
Time: 7:30–9 p.m.

Odd number poster authors will be present 7:30–8:15 p.m.
Even number poster authors will be present 8:15–9 p.m.
(Posters should be set up by 9 a.m. Tuesday and taken down by 10 p.m. Tuesday)

Teacher Training Enhancement

PST2D01: 7:30-8:15 p.m. ATE Workshops 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 Workshop for Physics Faculty project is into its second year and has finished its sixth workshop/conference. In this poster, we will display information about the project, information about these workshops/conferences, and information about future workshops/conferences. Information concerning development of laboratory activities will also be displayed.

*Funded in part by an ATE NSF DUE grant.

PST2D02: 8:15-9 p.m. Evaluation of Physics by Inquiry Programs for K-12 Teachers*

Poster – Robert J. Endorf, University of Cincinnati, Cincinnati, OH 45221-0011; robert.endorf@uc.edu

Don Axe, Amy Girkin, Kathleen M. Koenig, Jeffery Radloff, University of Cincinnati

We present data from our Physics by Inquiry[1] professional development programs for K-12 teachers conducted at the University of Cincinnati. Each summer since 1996 a four-week 12 quarter-credit-hour graduate course in Physics by Inquiry has been held for teachers in grades 5-12, and a separate two-week 6 quarter-credit-hour course has been held for teachers in grades K-5 in all but three of those summers. A total of 544 teachers have completed one of the programs. Our evaluation of the programs is based on pre-tests, post-tests, journals, and surveys completed by the participants. These instruments demonstrate that the teachers completing the programs have achieved large gains in science content knowledge, improved their science process skills, and have increased 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).

PST2D03: 7:30-8:15 p.m. Formation of Self-Assembled Monolayers on Gold-Coated Substrates

Poster – Valentina Sountsova, Bancroft School, Worcester, MA 01605; vsountsova@bancroftschool.org

David Bennett, Newton North High School

Hatice Altug, Boston University

Self-assembled thiol monolayers (SAMs) are an important component of resonant biosensors. SAMs serve as a foundation link in a virus-capturing chain: SAM-protein-antibody. We investigated the effects of thiol concentration and incubation time on formation of SAMs on gold-coated glass or silicon substrates. It was shown that successful SAM formation on gold could be achieved using thiol concentration as low as 0.1 mM and incubation time as low as six hours. This research project was completed during the 2011 Research Experiences for Teachers in Biophotonics program. This six-week program took place at Boston University and was sponsored by NSF. While working on their research projects in BU biophotonics labs, the teachers also wrote and shared lesson plans for their classes, created presentations and posters, and discussed their work in individual blogs and websites.

PST2D04: 8:15-9 p.m. Implementation of New Science Core Standards by In-service Teachers

Poster – Jerome Mescher, Hilliard City Schools, Hilliard, OH 43026; Jerome_Mescher@hboe.org*

Jennifer L. Esswein, Bruce R. Patton, The Ohio State University

The implementation of new science standards is a difficult and complex process. Recently, the state of Ohio has put in place new Science Core Standards that reflect a much more inquiry-based approach. We have worked with a cohort of teachers to familiarize them with the new standards and to help them develop teaching approaches that will be able to implement the new standards successfully. The results of this professional development program and the successes and difficulties encountered will be discussed. Best practices that help teachers to understand and develop inquiry-based lessons will be summarized.

*Sponsor: Bruce R. Patton

PST2D05: 7:30-8:15 p.m. Measurements and Modeling for Teaching/Learning Electromagnetism and Superconductivity

Poster – Alberto Stefanel, Research Unit in Physics Education, DCFA of the University of Udine, ITALY; alberto.stefanel@uniud.it

Marisa Michilini, Lorenzo Santi, Research Unit in Physics Education, DCFA of the University of Udine

In the context of the European project MOSEM2, which has among its main objectives the development of proposals and teaching materials on electromagnetism and superconductivity centered on online experiments and modeling, the contribution of the Italian community, coordinated by the University of Udine, focused on four main areas of research: A) development of didactic proposals based on an innovative USB-probe of the resistivity as a function of temperature of superconductors, metals and semiconductors and Hall measurements; B) online measurements and modeling with commercial systems on electromagnetism; C) teacher training and an educational aim to introduce online measurement and modeling in the curriculum; D) experimentation of the MOSEM2 proposals about superconductivity with students in pilot contexts. The several experiments carried out with the students revealed the strong impact of the phenomenology of superconductivity in activating motivation for the construction of interpretative models, about the electric and magnetic properties of superconductors.

PST2D06: 8:15-9 p.m. Perspective Primary Teachers and Electromagnetic Phenomena

Poster – Stefano Vercellati, Research Unit in Physics Education, DCFA Department, University of Udine, ITALY; stefano.vercellati@uniud.it

Marisa Michelini, Research Unit in Physics Education, DCFA Department, University of Udine, Italy

Research literature showing how primary pupils face such complex topics as electromagnetism promotes the growth of the scientific approach and the development of formal thinking. In particular, a design research project was carried out in the framework of Model of Educational Reconstruction to produce a Teaching/Learning Proposal (TLP) on electromagnetism in a vertical perspective starting with primary grades. Now, to actuate this proposal in a classroom, an inquiry-based Formative Intervention Module (FIM) for 120 Prospective Primary Teachers (PPT) was implemented having as theoretical background the Pedagogical Content Knowledge. The FIM was based on interactive demonstrations and step-by-step discussions of conceptual knots that emerges from PPT investigation of the phenomena and the results coming from TLP. The analysis of this data and the PPT discussions during the cooperative learning activities offered an interesting spectra of the formation needs and produces indications on the model for primary teachers formation.

PST2D07: 7:30-8:15 p.m. Physics Teacher Preparation at Appalachian State University

Poster – Patricia E. Allen, Appalachian State University, Boone, NC 28679; allenpe@appstate.edu

Students in the Physics, Secondary Education program at Appalachian State spend approximately four years obtaining their degree in physics, while completing state requirements for teaching licensure. In addition to a required methods course for all science education majors, physics education majors take a practicum course that focuses on the theory and practice of teaching physics. Together with a series of "field experiences," these majors are well equipped to student teach, satisfy N.C. licensure requirements, and obtain employment. This presentation will highlight the practicum course, the field experiences, and the various assessment strategies used for the one to two students who complete the program each year.

PST2D08: 8:15-9 p.m. Physics Teachers' Attitudes and Abilities Improvement Effects Through Lab Workshops

Poster – Sergio Flores, University of Juarez, Juarez, 32310 Mexico; seflores@uacj.mx

Luis Leobardo Alfaro, Sergio Miguel Terrazas, University of Juarez

Rafael Gutierrez, University of Texas at El Paso

Otilio Mederos, Universidad Autonoma de Coahuila

During the last 10 years physics teachers' instructional abilities workshops have become fundamental at the University of Juarez. The main goal of this pedagogical enterprise is to improve teaching ability to foster a significant understanding of fundamental physics concepts. We present results from a teachers' didactical proposal developed during a 20-hour workshop named Analysis and Design of Learning Situations in the Physics Lab. The basis of a functional understanding was the design, implementation, and supervision of teachers' learning activities in the physics lab. This instructional design allowed teaching to persuade students' physics-based intellectual abilities development through new labs. The designed labs represent learning sequences where the students: predict, mistake, and help each other to correct the errors. The steps to collect data are: 1) students' previous knowledge, 2) a conceptual basis, 3) an experimental basis, and 4) students' acquired learning. Despite teachers' enthusiasm, most of them did not finish the design of their lab activities. Some of them had traditional teaching-based difficulties not only to write lab questions, but also to accept the new pedagogical basis of this proposal.

PST2D09: 7:30-8:15 p.m. Preparation of Prospective Primary School Teachers to PCK on the Concept of Energy

Poster – Alberto Stefanel, Research Unit in Physics Education, DCFA of the University of Udine, ITALY; alberto.stefanel@uniud.it

Marisa Michelini, Research Unit in Physics Education, DCFA of the University of Udine

The training of primary school teachers should provide for the development of content (content knowledge) as well as educational content related to specific subject disciplines (PCK). At the University of Udine a formative module for prospective primary teachers was implemented in a course in Physics Education and a related Educational Laboratory. In the first course was discussed an approach to CK about energy based on work-kinetic energy theorem, the energy conservation principle, the study of non-conservative forces and the introduction of heat, in operative way, first law of TD. A CK-questionnaire was proposed as post-test. In the second course, a laboratory activity was planned in four hours based on a PCK strategy. The outcome showed that trainees have developed a functional understanding of the concept of energy, competence about student learning problems, need of a project activity about designing active learning on energy.

PST2D10: 8:15-9 p.m. Prospective Primary Teachers Face Relative Motion and PCK Analysis

Poster – Stefano Vercellati, Research Unit in Physics Education, DCFA Department, University of Udine, ITALY; stefano.vercellati@uniud.it

Marisa Michelini, Lorenzo G. Santi, Alberto Stefanel, Research Unit in Physics Education, DCFA Department, University of Udine

The first observations of the world done by children are related with motion of objects and most of their perceptual aspects are activated during primary school; is therefore necessary begin to face the physic interpretation of motions already in primary school. In particular, with the aims to give to Prospective Primary Teachers (PPT) an awareness of which are the conceptual knots that characterize the specific thematic and which are the ways to address them, a specific Formative Intervention Module was design for 120 Prospective Primary Teachers (PPT) having as theoretical background the Pedagogical Content Knowledge (PCK). In particular was implemented a PCK questionnaire that allowed PPT to address explicitly the conceptual knots on relative motion and develop the skills needed to reinterpret the subjects that they had to teach starting from the pupils need. Data coming from the questionnaire will be presented and discuss in this work.

PST2D11: 7:30-8:15 p.m. Science and Math Links: Research-based Teaching Institute

Poster – Peter Sheldon, Randolph College, Lynchburg, VA 24503; psheldon@randolphcollege.edu

Tatiana Gilstrap, Peggy Schimmoeller, Meredith Humphreys, Randolph College

We are studying the influence of hands-on and inquiry based lessons on student and teacher attitudes toward science, with the goal of increasing engagement, keeping children interested in science, and increasing student achievement. We are creating resources including lesson plans, associated content, and video for lessons in the K-8 classroom. We have held week-long teacher institutes in 2010 and 2011 (and are offering one in 2012) for 60 local teachers to help them to implement these types of lessons in the classroom. We collect data through surveys, student performance measures and classroom observation. This ongoing research project, started in 2000, has a website resource The new Science Teacher (http://tnst.randolphcollege.edu) that we continue to enhance and add to in the form of resources for teachers and results from research.

PST2D12: 8:15-9 p.m. Science Teacher Recruitment at California State University, Chico*

Poster – David T. Kagan, CSU Chico, Chico, CA 95969; dkagan@csuchico.edu

We all know the dreadful statistics regarding the lack of fully prepared science teachers in our nation's public schools. At CSU Chico we are trying to establish a culture that encourages students to consider careers in science teaching. We offer scholarships and other financial assistance that can total over $55,000 per student. This includes everything NSF Noyce Scholarships of up to $12,000 per year to simply paying for textbooks for future science teachers. We have created a Department of Science Education within the College of Natural Sciences as well as a Center for Mathematics and Science Education and we have established a National Science Teachers Association Student Chapter.

*Funded by the Mathematics and Science Teacher Initiative of the Chancellor's Office of the California State University.

Technologies

PST2E01: 7:30-8:15 p.m. A Comparison of Online and On-Ground Student Performance in Calculus-based Physics I

Poster – Andria C. Schwortz, Quinsigamond Community College, Worcester, MA 01606; aschwortz@gmail.com

The validity and rigor of online courses is an open question in higher education, often having significant consequences for students intending to transfer from a two-year to a four-year school. Quinsigamond Community College, located in Worcester, MA, is now offering an online section of freshman calculus-based mechanics (General Physics I, PHY 105) along-side the traditional on-ground format. Student outcomes from online and on-ground sections taught during spring 2011 are presented. The sample size of the two sections consisted of approximately 20 students online and 25 on-ground, with the students commingled into two lab sections of approximately equal size. Preliminary findings reveal the results of self-selection into the two modalities (via open-ended surveys), and appear to show that online instruction can be as effective as on-ground instruction for those students willing to dedicate the required effort to the course. Support for this project was provided by Quinsigamond Community College.

PST2E02: 8:15-9 p.m. An Inside Look: Practical Strategies for Personal Response Systems*

Poster – Stephanie V. Chasteen, University of Colorado Boulder, Boulder, CO 80301; stephanie.chasteen@colorado.edu

Katherine K. Perkins, University of Colorado Boulder

I never would have understood how clickers could be used to transform classroom teaching if I hadn't watched them in the hands of experienced instructors. Not every teacher has that opportunity. This poster will give you an overview of some of the resources we have created on clickers: Get a glimpse inside our classes at the University of Colorado with short videos, grab a copy of our instructor handbook, and come discuss any challenges you've had in implementing this powerful technique. I'll share ideas and strategies for success with clickers, from writing questions to facilitating discussion. In many ways, clickers help us support student achievement of higher order thinking skills, which are the hallmark of deeper learning.

*All clicker videos and resources are at http://STEMclickers.colorado.edu, and the University of Colorado's clicker question collection is at http://www.colorado.edu/physics/EducationIssues/cts/. This work was funded by CU's Science Education Initiative and the National Science Foundation Grant No. 0737118.

PST2E03: 7:30-8:15 p.m. Progress in the Online Integrated Learning Environment for Mechanics

Poster – Daniel T. Seaton, Massachusetts Institute of Technology, Cambridge, MA 02139; dseaton@mit.edu

Gerd Kortemeyer, Michigan State University

Saif Rayyan,Yoav Bergner, David E. Pritchard, MIT

We continue the ongoing development of our Integrated Learning Environment for Mechanics (ILEM) within the LON-CAPA open source online course management system. ILEM integrates instruction (via a Wiki-text) and assessment. New problems have been added, the majority of which are research-based or involving two concepts and conceptual questions are currently being added to the central collection of multi-level research-based homework sets organized by topic. Our Modeling Applied to Problem Solving (MAPS) pedagogy[1] is optional within a standard mechanics syllabus. Unique tools for instructors and students are also being developed that streamline access to ~ 10,000 resources from across the LON-CAPA network. We focus on the current state of our educational content, as well as the tools used to disseminate that content. Results from applying this course at MIT and at Whatcom Community College (Seattle) will be discussed. Users and collaborators are invited to use ILEM in whole or in part. We acknowledge support by NSF DUE-1044294.

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.

PST2E04: 8:15-9 p.m. Video Analysis of a Hula Hoop Rotating About a Person's Arm

Poster – Nikki Sanford, High Point University, High Point, NC 9035; sanfon09@highpoint.edu*

Matthew Sanford

Aaron Titus, Mary Funke, High Point University

The motion of a point on a hula hoop rotating about a person's arm was studied using video analysis. The x-position versus time graph of the motion was found to be a sum of two sinusoidal functions of slightly different frequencies, i.e. a beat pattern. The two frequencies in the curve fit were related to the rotational frequency of the arm and the ratio of radii of the hoop and the arm. The measured frequencies can be predicted using a theoretical model of the hoop rotating in uniform circular motion about its center with the center of the hoop rotating in uniform circular motion about the arm. The video analysis, the theoretical model, and a computational model will be presented.

*Sponsor: Aaron Titus

Labs/Apparatus

PST2F01: 7:30-8:15 p.m. A Low-Cost Electrometer for Measuring Nanoamperes and Conductivity in Glass

Poster – William R. Heffner, IMI-NFG, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

Nicholas Ward, Oakwood University

Glassy materials exhibit very low conductivities and are usually considered insulators. Yet they have a very interesting and considerable temperature dependence of conductivity, especially near the glass transition. Yet laboratory methods to explore this phenomenon are generally not accessible to the undergraduate engineering student, let alone the high school classroom. We present here a low-cost, home-built electrometer capable of nano-amp current detection and suitable for the undergraduate laboratory. We use it to measure the conductivity in sugar glass, a.k.a. hard candy, and explore the glass transition. This method is based on conductivity vs. temperature where inflection points in sugar glass provide a clear signal of the glass transition. The method utilizes a simple, high-impedance current amplifier built around a low-cost (<$5) OP AMP IC. The electrometer can also be used to measure the photocurrent generated in a silicon diode.

PST2F02: 8:15-9 p.m. An Optics Investigation Using a Beaker as a Cylindrical Lens

Poster – Mark F. Masters, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Jacob Millspaw, Clint Reynolds, IPFW Department of Physics

In optics class we often derive refraction at spherical surfaces (which is ultimately the same as for cylindrical surfaces). We then move on to apply the thin lens approximation and come up with the thin lens equation. However, students generally are unwilling to apply the expressions we have derived in general situations, preferring to misapply the convenient thin lens equation and lens makers equation. For this reason we provided the students with an investigation in which the students were required to use the more general expressions for curved refracting surfaces. The investigation and results will be presented.

PST2F04: 8:15-9 p.m. Development of a Web-enabled Renewable Energy Lab

Poster – Steven Vuong, Hartnell College, Salinas, CA 93906; steven.vuongs@gmail.com

Brooke Haag, Tito Polo, Hartnell College

Dan O'Leary University of California, Santa Cruz

In the summer of 2011 as an intern, I was assigned tasks of web and instructional support for the Course Curriculum and Laboratory Improvement (CCLI) grant project at Hartnell College. I learned and implemented various software tools including Google Sketch Up, Picasa, Dropbox, and Google Documents. In addition, I composed single sheet summaries of all the solar panel hardware. I assisted in the development of the solar lab module activities, instruction of the lab, and assessment of the learning outcomes. In this poster, I will present assessment results and prospects for future project improvement.

PST2F05: 7:30-8:15 p.m. Fan Carts Blow

Poster – Jacob Millspaw, Indiana University Purdue University Fort Wayne Fort Wayne, IN 46805; millspaj@ipfw.edu

Fan carts are prevalent in mechanics-based physics labs exploring motion, forces and energy. Often the carts are loaded with masses, put onto inclines or the fan force direction is changed relative to the direction of motion. It is assumed that the fan supplies a constant force that students measure under these circumstances. We have found that the fan carts do not provide a constant force but a force that depends on the velocity of the cart which may lead to inconsistent results in lab investigations.

PST2F06: 8:15-9 p.m. Measurements and Analysis of the Compound Double Pendulum

Poster – Joel C. Berlinghieri, The Citadel, Charleston, SC 29409; berlinghieri@citadel.edu

Patrick R. Briggs, Erik Rooman, The Citadel

A compound double pendulum that is free to rotate at any angle in both the primary (top stationary) and secondary pivot points has been studied both experimentally and analytically. The apparatus uses a PASCO rotation sensor at each pivot. The two-rotation sensors are connected to a computer using Bluetooth wireless links. The angular position, angular velocity, and angular acceleration were recorded for both pivots with each pivot free to make complete 360 degree rotations. The primary pivot point was also monitored with a three-axis linear acceleration sensor. Repetitive measurements were recorded for a range of initial conditions and compared to an analysis using Mathematica. Chaotic and non-chaotic states were studied.

PST2F07: 7:30-8:15 p.m. Measurements of Charged Tapes by MBL Charge Sensor

Poster – Jung Bog Kim, Korea National University of Education, Chung-buk, Korea; jbkim@knue.ac.kr

Min Ju Kim, Korea National University of Education

Charges of tapes charged by various triboelectric conditions are measured relatively by using an MBL sensor. We figured out some results that are depending on initial charges when we pull off the tape. Initial charges play roles of not only electric force on charges that may be separated but also inducing polarization of the tape material. Amount of separated charges can be decided by these effects. We also measured a time constant of discharge depending on moisture.

PST2F08: 8:15-9 p.m. Physical Situations Modeling Trough a First Finite Differences Analysis

Poster – Juan Luna, University of Juarez, Juarez, 32310 Mexico; seflores@uacj.mx

Sergio Flores, Manuel Antonio Ramos, Oscar Ruiz, Maria Concepcion Salazar, University of Juarez

The development of calculus fundamental principles to generate mathematical models to describe physical phenomena and their corresponding change measurements is a basic variation thinking factor, and the Derivative Concept didactical platform. At the University of Juarez we implemented a proposal to help the understanding of previous meanings to calculus such as: 1) algebraic, 2) graphing, and 3) numerical. We present physical situation experiments such as: CO_2 sublimation, grains of sand flux, or the displacement of objects on a ramp. In the same way, the analysis of the first finite differences trough uses the DataStudio software to determine the kind of behavior: linear, polynomial, or exponential. This proposal helps students to find a modeling function of a data set by using the algebraic representation and their corresponding registers only. Finally, we show the first results based on these didactical ideas in a Differential Calculus course during a previous moment to the derivative.

PST2F09: 7:30-8:15 p.m. Reproducible Quantized Conductance: A Lab Experiment on the Wave Nature of Matter

Poster – Robert Tolley, Miami University, Oxford, OH 45056; tolleyrd@muohio.edu

Antony Silvidi, Chris Burnett, Khalid F. Eid, Miami University

We demonstrate clear quantized conductance steps in mechanical break junctions (MBJ) based on a gold wire, a springy-steel bending beam, a micrometer, a 1.5V battery, and a Teflon disc that we rotate manually. As the wire is stretched (in steps of less than 1 Angstrom) to the point when it is about to break at a weak point, its resistance increases gradually and eventually follows a stair-case-like shape, which is a hallmark of quantized conductance. The resistance steps are observed at values of 25.8 k?/2n, where n is an integer. The resistance steps are clearer and more distinct for smaller n, in agreement with the Correspondence Principle. The quantization occurs when the wire is thin enough that its diameter is comparable to the de Broglie wave length of the current-carrying electrons and is a direct consequence of confinement. This experiment is designed for sophomore/junior level undergraduate labs on contemporary physics.

PST2F10: 8:15-9 p.m. Undergraduate Physics Labs: The Art of Experimentation

Poster – Irene Guerinot, Maryville College, Maryville, TN 37804; irene.guerinot@maryvillecollege.edu

Arielle Nivens, Marley Kalis, Travis Wilson, Maryville College

In the study of physics, students have always been exposed to laboratory work. For the vast majority of students who enroll in our Introductory Physics courses, this is the first (and most likely last) exposure with the subject. Most students traditionally have difficulty learning physics, because they deem the material abstract or irrelevant, have become disconnected from the data collection/analysis process because of emphasis on sensor-driven instrumentation, and because curricula have been developed by experts, without input from students regarding concepts that confuse them. The input of students is important in identifying misconceptions as well as effective pedagogy. In our institution three students partnered with faculty to redesign our Introductory Physics Lab Exercises through real-life examples and outdoor activities, a pedagogical model that has been established with success in Europe, but used less extensively in the U.S. In this poster, we will describe our work and discuss results and implications.

PST2F11: 7:30-8:15 p.m. Using Electric Motors to Explore Conservation of Energy Concepts.

Poster – Mark F. Masters, IPFW Department of Physics, Fort Wayne, IN 46805; masters@ipfw.edu

Jacob Millspaw, Jonathan Howard, Finn Buldt, IPFW Department of Physics

In introductory mechanics laboratories there are many simple investigations that are related to conservation of energy. Often, these investigations are based upon a simple idea of moving an object up an incline, or rolling objects down an incline, determining initial and final velocities and change in gravitational potential energy. However, an electric motor can be used to make similar measurements at a constant speed by continuously monitoring the current and voltage as a function of time. This method allows more complex and interesting investigations.

Pre-college/Informal and Outreach

PST2G01: 7:30-8:15 p.m. Gifted Students' Differentiated Experiences in Science Classes

Poster – Minjung Park, Seoul National University, Seoul 151-742 Republic of Korea; mj1017@snu.ac.kr

Dongryul Jeon, Seoul National University

In order to investigate the differentiation for gifted students, we studied how the differentiation is applied in science classes at regular schools, private educational institutes, and education centers for gifted students. The analysis of the questionnaire showed that only the students of gifted education centers could use various specialty publications. When the students of the regular schools and the private education institutes completed curricular activities early, they spent extra time performing tasks unrelated to the contents that were taught or reviewing the lessons or solving problems. This was comparable to the gifted students who developed their own interests through independent study in science classes. Also, efforts to group students according to their interests were predominant at gifted education centers. Among the items in our questionnaire, the rate of choice of curricular activities by students and the teachers' preparation for advanced learners were the lowest.

PST2G02: 8:15-9 p.m. Implementing STEAM Instruction for Talented/Gifted Students on Light

Poster – Hyeon-Suk Choi, Korea National University of Education Chung-Buk, 363-791, KOREA; eovnddl@hotmail.com

Jung Bog Kim

How can we bring the excitement of the physics of light to classes for the gifted/talented? For 2011 summer, Seoul Metropolitan Office of Education's class for gifted/talented in Korea has offered a physics course for gifted students in the grade seven. Students learn everything from the discovery of light in art pictures to a camera's principle, and engage in hands-on activities such as making shadows, drawing pictures using mirrors and simulating a camera obscura, camera lucida. We will also present sample lessons for STEAM instruction on light.

PST2G03: 7:30-8:15 p.m. Planetary Science Lessons from Montclair's GK-12 Fellows in the Middle

Poster – Mary L. West, Montclair State University, Montclair, NJ 07043; westm@mail.montclair.edu

Interdisciplinary math/science lessons were developed and used through partnerships of Montclair State University graduate students and middle school teachers in New Jersey. Some lessons were based on field trips to Newark's Dreyfuss Planetarium and the Buehler Challenger Center. Original lessons include Comet Bingo, What if Planets Were Cubes?, Density Models for Planets, Driving on Mars, Solar System in a Can (using proportions in a big way), Solar System High Jump Olympics 2857, Stories and Constellations, Craters on Earth, Planetarium Fieldtrip Notebook, Atmospheres and Percentages for Life, and Speeds in the Universe. Adapted lessons include Your Ages on Other Planets, Geomorphic Landforms on Earth and Mars (Viking Orbiter Photos), Modeling Planetary Distances, Gravity on Earth and Other Planets, and Venus Topography Box.

PST2G04: 8:15-9 p.m. Understanding Physics Through the Machines of Leonardo Da Vinci

Poster – Pamela A. Maher, University of Nevada Las Vegas, Las Vegas, NV 89107; maherp@unlv.nevada.edu

Allan M. Tucka, College of Southern Nevada

Janelle M. Bailey, University of Nevada Las Vegas

"Understanding Physics Through the Machines of Leonardo Da Vinci" is a Nevada NASA Space Grant Consortium Informal Education grant that is currently providing research opportunities for undergraduate students at the College of Southern Nevada, a two-year institution in Las Vegas. Students enrolled in calculus-based physics, civil engineering-statics, and mechanical engineering-dynamics build a small machine from a kit based on the Codas of Leonardo Da Vinci in his book on machine inventions. They then analyze the concept that this model demonstrates and use equipment from the College of Southern Nevada lab that further demonstrates this principle. Using the machine and drawing analogs from the laboratory equipment enables the students to further understand these concepts and explain them to a lay audience. Students design and prepare a handout that explains the models and the physical science concept being demonstrated. The handouts also identify the Nevada State Department of Education Standard being taught. These pre-engineering and physics students gain experience in interpreting concepts in their field to children and the general public using models to engage their audience.

Upper Division and Graduate

PST2H01: 7:30-8:15 p.m. Implementation of Learning Assistants in Three West Virginia Institutions

Poster – Paul M. Miller, West Virginia University, Morgantown, WV 26506-6315; paul.miller@mail.wvu.edu

Jeffrey S. Carver, Aniketa Shinde, Brenda Wilson, West Virginia State University

Tina J. Cartwright, Marshall University

Brian Hallar, West Virginia Higher Education Policy Commission

In the fall of 2011, West Virginia University began a learning assistants (LA) program in physics. This program was one of three initiated statewide, with programs in biology begun at West Virginia State University and at Marshall University. This effort was undertaken as a workforce development component of the NSF Research Infrastructure Improvement grant awarded to the West Virginia Higher Education Policy Commission and is believed to be the only statewide implementation of its kind. This poster describes the challenges that had to be overcome to implement an LA program throughout three West Virginia institutions of higher education, characterizes the three settings and the baseline data, and presents preliminary results of the implementation. (This project is supported by the National Science Foundation under Grant No. EPS-1003907.)

PST2H02: 8:15-9 p.m. Open Courseware in Distance Education Upper Division Physics

Poster – Farook Al-Shamali, Athabasca University, Athabasca, AB T9S 3A3 Canada; farooka@athabascau.ca

Martin Connors, Athabasca University

After over 15 years of success with freshman physics course offerings, Athabasca University, Canada's main distance education university, has introduced upper-division physics courses. These are based mostly on MIT Open Courseware and in turn are available as open resources on ocw.athabascau.ca. PHYS 302 Vibrations and Waves uses a subset of MIT 8.03 lectures by Walter Lewin, and also material from Project Cassiopaiea, to cover topics ranging from simple vibrations to quantum and electromagnetic waves (without requiring prerequisites in either field). PHYS 405 Electromagnetism is mainly a guide to self-study with the popular Griffiths textbook. We will present some other examples of open materials that could be used in upper-division physics and mathematics courses, including quantum mechanics and fourier transform courses which are likely to be developed soon.

PST2H03: 7:30-8:15 p.m. Planar Multipole Ion Traps for Quantum Information Proocessing

Poster – Andrew Farr, The Citadel, Charleston, SC 29409; berlinghieri@citadel.edu

Ryan Boodee, Evan Aguirre, Robert Clark, Russell Hilleke, Joel C. Berlinghieri, The Citadel

A crystal of laser-cooled ions can serve as a setting for the quantum simulation of numerous condensed-matter systems. However, constructing an array of ions in a radiofrequency trap that is both regularly spaced and motionless is confounded by the typical quadratic curvature of the trap and concomitant micromotion. Multipole ion traps use additional electrodes to "flatten" the potential, offering a way of reducing these problems. We present here the design and construction of planar multipole ion traps, which are amenable to microfabrication and to the inclusion of non-optical control fields, thereby facilitating scalable quantum simulation.

Other

PST2I01: 7:30-8:15 p.m. Modern Superstition: A Challenge for Science Teachers

Poster – Sadri Hassani, Illinois State University, Normal, IL 61790-4560; hassani@phy.ilstu.edu

Modern superstition has inundated the public in the past several decades. It differs from its traditional counterpart in that modern superstition claims to be scientifically based. Science educators, especially physics teachers, are best suited to rebuke such claims. However, the popularity and the clout of celebrity and media, the powerful advocates of modern superstition, have made it next to impossible to counter it in the public arena. Behind the relatively protected walls of our schools and classrooms, we can do much to undo the damage done by modern superstition and educate the future citizenry about its pseudoscientific and antiscientific nature. This poster illustrates examples of how we can inject into our teaching some ideas that not only counter modern superstition but make the physics topics more interesting.

Post Deadline

PST2J01: 7:30-8:15 p.m. Physics Videos .net

Poster – James J. Lincoln, UCLA & Tarbut V' Torah HS, Irvine, CA 92603; LincolnPhysics@gmail.com

For the past two summers high school teacher James Lincoln, MS, MEd, and UCLA's Demonstration Coordinator Martin Simon, PhD, have been producing videos for UCLA's online enrichment program for the department's Physics 10 class. This production was funded by a intradepartmental physics education research grant. These videos have proven very helpful to other teachers at neighboring institutions and we would like to take this chance to raise awareness of this valuable tool that many teachers have used both in their classes and for their own professional development. The video collection is free for anyone to use and is organized by subject.

PST2J02: 8:15-9 p.m. The Effects of Gravity on Bubbles: A Small Community College goes to NASA

Poster – Cathleen J. Cox, Lake Tahoe Community College, Tahoe, CA 96150; cox@ltcc.edu

Melissa Thaw, Jeff Guarino, Jared Szi, Andrew Burton, Lake Tahoe Community College

Students at Lake Tahoe Community College participated in NASA's reduced gravity education flight program which provided the opportunity for students to conceive of and design an experiment, submit a proposal to NASA, engineer, build and test the apparatus, submit a test equipment data package and pass a test readiness review with NASA scientists and engineers, conduct the experiment aboard NASA's zero-gravity aircraft, and analyze the results. The students mathematically modeled the shape of bubbles in microgravity and hyper-gravity. They designed a 10-inch square aluminum and polycarbonate frame. Bubbles were blown through brass nozzles, flexible tubing, and inflated with a bicycle pump. Cameras collected video footage of the bubbles for analysis. The shape of the bubbles was analyzed in two dimensions. Although the team was not able to collect a statistically significant amount of data, analysis showed that 100% of bubbles in normal gravity were circular, 62.5 % of bubbles in microgravity were elliptical and 87.5 % of bubbles in hyper-gravity were elliptical.

PST2J03: 7:30-8:15 p.m. Attracting and Training Future Teachers with Project-based Instruction

Poster – Vera E. Margoniner, California State University, Sacramento, CA 95819-6041; vera.margoniner@gmail.com

Arthur J. Sisneros, Glenford Kennedy, California State University, Sacramento

We present the results of an innovative learning assistant program that employs STEM majors to facilitate project-based instruction in large introduction to astronomy courses at Sacramento State. Our main goal is to turn STEM-oriented students on to the excitement of teaching, increase the number of physics majors, and most importantly increase the short supply of highly qualified physics teachers. Another synergistic goal is to provide the general education students with a more authentic scientific inquiry experience than is typical in a general education class. The pilot project was run in fall 2011 with five LAs working with an 80-student class called Introduction to Astrobiology and the results are very encouraging. The LAs quickly took ownership of the project. They kept a blog documenting the experience, and even took the initiative of creating medals that were awarded to the best three projects at an end of semester projects celebration. See our webpage at http://webpages.csus.edu/~vemargon/LA/

PST2J04: 8:15-9 p.m. Students' Use of Resources to Understand Solar Cells

Poster – Alan J. Richards, Rutgers University, Piscataway, NJ 08854; richard6@physics.rutgers.edu

Eugenia Etkina, Rutgers University

We use the framework of conceptual and epistemological resources to investigate how students construct understanding of a complex modern physics topic that requires mastery of multiple concepts. We interviewed experts and novices about their understanding of the physics of solar cells, and examined their responses for evidence of resources being activated. Based on the patterns in the interviews, we can hypothesize what ideas students draw on when they are trying to understand the complex physics involved in the functioning of solar cells.

PST2J05: 7:30-8:15 p.m. Photoelectric Effect, Theory and Practice

Poster – Mikhail M. Agrest, College of Charleston, Charleston, SC 29414; agrestm@cofc.edu

In theory, there is no discrepancy between theory and practice, but in practice, there is always some discrepancy. How does it happen, and why? Many students will wonder why a heavy book falls faster than a light sheet of paper. Does it violate the universal law of gravity? Some students would be wondering why the stopping energy in the photoelectric effect "depends" on the brightness of light. Does it violate the concept of the photoelectric effect? How to convince them that Einstein was right? Introductory Conceptual Physics is about introducing concepts. As models are simplified, descriptions of the processes they have are a range of applications. It is important to give students a sense of it, but sometimes providing them with a complex situation distracts students from learning the concept. Influence of the instruments, sensitivity, and dispersion of the spectra of light used in the Photoelectric Effect lab of an introductory physics class will be discussed.

PST2J06: 8:15-9 p.m. A Physics Course for Theology Students*

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

A typical first-semester, algebra-based physics or physical science course presents little attraction or relevance to mainstream students of religion, philosophy, or theology, excluding perhaps topics in energy and thermodynamics. A 2010 survey has shown the essential absence of any physical science expectations or opportunities within M.Div. programs—the source of most North-American ministers, who teach a large fraction of the population about the important principles in life. In consultation with faculty and students in theology and religion programs, we are constructing a curriculum with direct, quantitative application to major theological questions. Major topics of this one-semester (or less), fundamental course are: history of physics and religion, principles and experiments, scientific notation (large and very-large numbers), dimensions (x,y,z,t) and equations, probability and statistics, major principles of physics (conservation laws, quantum theory, statistical mechanics), putting God into physics, applications. An early example application will be done to convince skeptical students.

*Supported in part by a Teagle Foundation grant to Samford University and the Birmingham Area Consortium for Higher Education

PST2J07: 7:30-8:15 p.m. Using the Physics of Music to Teach about the Physics of the Early Universe

Poster – Jatila van der Veen, University of California, Santa Barbara, CA 93106-4170, jatila@physics.ucsb.edu

Ryan McGee, Philip Lubin, Matthew Wright, JoAnn Kuchera-Morin, UC Santa Barbara

Understanding the details of the power spectrum of temperature fluctuations in the Cosmic Microwave Background (CMB) has been the focus of cosmology research for the past several decades. Because the CMB is the most ancient light we can observe, understanding how the CMB encodes information about the origin and evolution of the universe should be an important component of physics and astronomy education. In this paper we present a new simulation which utilizes the technique of sonification to unpack the conceptual basis of CMB research using the physics of music. We discuss the development of our software, and how the relative densities of baryons, dark matter, dark energy and curvature of spacetime are encoded in the first three harmonics of the power spectrum of CMB temperature fluctuations, taken over all observable space, at one time—approximately 380,000 years after the Big Bang.

*Support provided by the US Planck Mission Collaboration, Jet Propulsion Laboratory, and NASA

PST2J08: 8:15-9 p.m. Relativity on Rotated Graph Paper: The Uniformly Accelerated Light Clock

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

Visual calculations for special relativity can be done using spacetime diagrams drawn on graph paper that has been rotated by 45 degrees. The rotated lines represent lightlike directions in Minkowski spacetime, and the boxes in the grid (called light-clock diamonds) represent ticks of an inertial observer's lightclock. Many quantitative results can be read off a spacetime diagram by counting boxes, using a minimal amount of algebra. After a brief review of our method (more fully described in the preprint referenced below)*, we consider the lightclock of a uniformly accelerated observer.

*http://arxiv.org/abs/1111.7254 has a preprint that describes the method.

PST2J09: 7:30-8:15 p.m. Inquiry Pathway: Extending the RITES Sound Investigation

Poster – Dan Liu, University of Rhode Island, Kingston, RI 02881; dan_liu@my.uri.edu

Jay Fogleman, Education Department, University of Rhode Island

A sound investigation developed within the RITES partnership addresses state standards, but leaves little latitude for students to explore a subject for which there is generally high interest. We have developed an extended Sound Investigation that guides high school students to learn the superposition principle and explore their own activities by using the software "Audacity." Students begin with the strongly guided RITES Sound investigation, and then transition to our extended investigations that are designed to support them using more authentic methods and tools. Students begin by using the sound analysis software Audacity to explore the harmonic nature sound. Students then investigate arbitrary sounds as superpositions of harmonic waves and compose by changing one variable each time. The analysis methods in the investigation include induction and synthesis during the interactive activities. The materials include supports for both enrichment and remediation to meet the needs of all students.

PST2J10: 8:15-9 p.m. Can Negative Probabilities be Useful?

Poster – Acacio de Barros, SFSU, San Francisco, CA 94025; barros@sfsu.edu

In this poster we propose that the use of negative probabilities in quantum mechanics might be useful to teach different interpretations of probabilities. This may be particularly useful for students of quantum mechanics, as negative probabilities show up in quantum systems that are highly correlated.

PST2J11: 7:30-8:15 p.m. The Effect of PhET Simulations on Algebra-based Physics

Poster – Randy Laforteza, California State University, Sacramento, Sacramento, CA 95819-6041; gtlaforteza@gmail.com

Arthur J. Sisneros, Vera E. Margoniner California State University, Sacramento

We report on preliminary results from our first semester implementing the usage of PhET computer simulations in an algebra-based physics class at Sacramento State. We developed a series of worksheets designed to encourage students to make predictions before experimenting with the simulations. Students then compare the results of the "experiment" with their predictions and are encouraged to revisit their original preconceived models. We measure learning gains objectively by comparing pre and post-instruction Force-Motion Concept Evaluation (FMCE) results, and qualitatively by interviewing students.

PST2J12: 8:15-9:00 p.m. The Effect of Math Skills in Algebra-based Physics

Poster – Arthur J. Sisneros, California State University, Sacramento, Sacramento, CA 95819; ajs433@saclink.csus.edu

Randy Laforteza,Vera Margoniner, California State University, Sacramento

The effect of math skills on overall success in an introductory, non-calculus physics course is studied by comparing the results from a math diagnostic test to the final grades of students in the physics 5A course at CSU Sacramento during the spring 2010, fall 2010, and spring 2011 semesters. The data suggests a correlation between initial math skills and final grades. Students with poor initial math skills in the fall 2010 and spring 2011 semesters were also offered a set of tutorial sessions in an effort to help improve their final grades. These students performed significantly higher than students of the same math skill that did not take the tutorial sessions.

Session FA: New Results in Astronomy Education Research

Location: Room 106
Sponsor: Committee on Space Science and Astronomy
Co-Sponsor: Committee on Research in Physics Education
Date: Wednesday, Feb. 7
Time: 8–9 a.m.

Presider: Eric Hintz

Astronomy Education research continues to grow and develop. This session concerns astronomy education research and astronomy teachers and the latest methods and techniques to teach astronomy effectively.

FA01: 8-8:30 a.m. Item Response Theory in Astronomy Eduation Research

Invited – Colin S. Wallace, Center for Astronomy Education (CAE), Steward Observatory, University of Arizona, Tucson, AZ 85721; cswallace@email.arizona.edu

Janelle M. Bailey, University of Nevada at Las Vegas

Wayne M. Schlingman,Center for Astronomy Education (CAE), Steward Observatory, University of Arizona

Item response theory (IRT) is a family of models that are increasingly being used by astronomy education researchers to analyze students' responses to concept inventories, surveys, and other assessments of student knowledge and ability. When IRT models fit the data, they offer researchers a way to measure students' abilities independent of the items used to probe those abilities, and they offer researchers a way to measure item properties (such as difficulty and discrimination) independent of the students who responded to those items. In this talk, we discuss the basics of IRT and demonstrate how it has been used in studies using the Star Properties Concept Inventory, the Light and Spectroscopy Concept Inventory, and a suite of conceptual cosmology surveys. These studies demonstrate how IRT is useful for both multiple-choice and open-ended tests, and for dichotomous and polytomous item scoring. This material is based in part upon work supported by the National Science Foundation under Grant Nos. 0833364 and 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.

FA02: 8:30-9 a.m. Do Astronomy REU Programs Matter for Females?

Invited – Stephanie J. Slater, CAPER Center for Astronomy & Physics Education Research, Laramie, WY 82070; stephanie@caperteam.com

REU is tacitly intended to increase retention and provide "an important educational experience" for undergraduates, particularly women, minorities and underrepresented groups. This longitudinal, two-stage study considered the educational experience for 51 women in the field of astronomy. Results indicate that the REU provided a limited impact in terms of participants' knowledge of professional astronomy. The REU did not provide a substantive educational experience related to the nature of scientific work, the scientific process, the culture of academia, participants' conceptions about themselves as situated in science, or other aspects of the "self," were limited. Instead, the data suggests that there were pre-existing and remarkably strong conceptions in these areas, and that the REU did not function to alter those states. Findings related to identify formation and transformation motivate an ongoing research agenda of long-term mentoring relationships for women in the sciences, at a variety of stages and across multiple disciplines.

Wednesday, Feb. 8 Highlights

REGISTRATION 8 a.m.-3 p.m. North Lobby
Yoga 7–8 a.m. 104A
SOFIA Tour 8 a.m.–3 p.m. Pre-Registered
Summer Meeting 2012 – Philadelphia Kick-off
10–10:30 a.m. Registration area

PLENARY 10:30–11:30 a.m. Ballroom C
Richard Muller —"Real World Problems: Physics for Future Presidents"

CRACKERBARREL 11:30 a.m.–12:30 p.m. 204
Teaching Physics with "Real World" Problems

SEES Program – Elementary Students
9 a.m.–12 p.m. Ballroom A

AAPT PRESIDENTIAL CEREMONY Ballroom C
12:30–1 p.m.

GREAT BOOK GIVEAWAY Registration area
3–3:30 p.m.

Session FB: Implementing Matter and Interactions and Six Ideas that Shaped Physics

Location: Room 103
Sponsor: Committee on Physics in Undergraduate Education
Co-Sponsor: Committee on the Interests of Senior Physicists
Date: Wednesday, Feb. 7
Time: 8–9:40 a.m.

Presider: Gerald Feldman

Matter and Interactions, *by Ruth Chabay and Bruce Sherwood, and* Six Ideas that Shaped Physics, *by Thomas Moore, are two innovative introductory calculus-based physics textbooks that have been adopted at numerous sites. Topics in this session include successes and challenges, suggestions for future adopters, assessment, and associated laboratory activities.*

FB01: 8-8:30 a.m. Matter & Interactions

Invited – Ruth Chabay, NC State University, Raleigh, NC 27695-8202; rwchabay@ncsu.edu

Bruce Sherwood, NC State University

The revolutionary developments in physics during the past century changed the way physicists think not only about "modern physics," but also about classical concepts and models. The 20th century emphasis on parsimony—a small number of fundamental principles (conservation laws), a small number of constituents of matter (quarks, leptons), and a small number of fundamental interactions—makes it possible to understand apparently dissimilar phenomena, whether classical or nonclassical, in a simple and unified way. An emphasis on the process of constructing and using models, including computational models, offers additional tools for exploring fundamental principles, and makes explicit the idealizations, approximations, and assumptions involved in constructing a physical model. We will illustrate the power of the modern perspective with case studies drawn from the Matter & Interactions curriculum. See http://matterandinteractions.org.

FB02: 8:30-9 a.m. Six Ideas: Past, Present, and Future

Invited – Thomas A. Moore, Pomona College, Claremont, CA 91711; tmoore@pomona.edu

Six Ideas That Shaped Physics is a six-volume textbook for the calculus-based introductory physics course that emphasizes a thoroughly contemporary approach to physics while supporting active learning in the classroom. The approach is also carefully designed to help students develop robust physical modeling skills and avoid well-known conceptual traps. In this talk, I will summarize the most important features of the *Six Ideas* textbooks and the online tools that support it, with special emphasis on the exciting changes we are planning for the next edition (due for release in 2014).

FB03: 9-9:10 a.m. Matter & Interactions at Purdue

Contributed – Mark P. Haugan, Purdue University, West Lafayette, IN 47907; haugan@purdue.edu

Purdue University began using the Matter & Interactions curriculum[1] to teach the calculus-based introductory physics courses taken by science and engineering students in the fall semester of 2006. This new curriculum provides a remarkably coherent introduction to mechanics, thermal physics, and electricity and magnetism by emphasizing a small number of fundamental physics principles and the process of using these principles to construct models of physical systems that predict and explain their behaviors. I reflect on events that led to our adoption of this new curriculum and on our experience implementing and assessing it in courses taken by more than 2000 students each year. The courses' success inspires work to enhance the coherence of our third-semester modern physics course by continuing the M&I focus on fundamental principles and physical modeling.

1. R. Chabay and B. Sherwood, *Matter & Interactions*, 3rd ed. (Wiley & Sons, 2010).

FB04: 9:10-9:20 a.m. Implementing Matter and Interactions at CSU Long Beach

Contributed – Galen T. Pickett, California State University Long Beach, Long Beach, CA 90840; Galen.Pickett@csulb.edu

We describe the implementation of the Matter and Interactions curriculum at Cal State Long Beach. While our gains on the Force Concept Inventory and the Basic Electricity and Magnetism Assessment are systematically lower than those achieved in comparable courses, we have had interesting success on the Colorado Learning Attitudes About Science Survey. As a part of being a comprehensive funded site of the Physics Teacher Education Coalition, significant reforms of our courses have been implemented, and we report on the effect of those reforms on our assessment data.

FB05: 9:20-9:30 a.m. Implementing Reformed Curricula in Large Introductory Physics Course at Georgia Tech

Contributed – Michael F. Schatz, Georgia Institute of Technology, Atlanta, GA 30332; michael.schatz@physics.gatech.edu

Marcos D. Caballero, University of Colorado Boulder

Edwin F. Greco, Marcus J. Marr, Richard Catrambone, Georgia Institute of Technology

The reform curriculum, Matter and Interactions (M&I), was first introduced into Georgia Tech engineering physics courses in summer 2006; today the curriculum is taught to more than 1000 students each semester. We will discuss some key issues associated with implementing a new curriculum in large-enrollment introductory courses. We will also describe efforts to measure the new curriculum's impact using both standardized assessment tools (concept inventories) and in-depth student interviews (think-aloud protocol studies). Finally, we will discuss work to enhance students' understanding of numerical computation and visualization introduced in the M&I curriculum.

FB06: 9:30-9:40 a.m. Integrating "Six Ideas..." into the Curriculum at Marquette University

Contributed – Benjamin L. Brown, Marquette University, Milwaukee, WI 53233; ben.brown@mu.edu

Andrew Kunz, Melissa Vigil, Marquette University

We are in our third year of implementing the *Six Ideas that Shaped Physics* textbooks into both the engineering physics courses and into our course for prospective chemistry and physics majors. With about 350 students in the engineering course (four lecture classes of about 90 students each), and with 20 students in the majors course, each class has presented distinct challenges. In the engineering course, we initially include three written assignments per week with the opportunity for students to rework the problems. This year, we have introduced computerized homework sets with the help of with McGraw Hill. The course for majors is a studio style course. Results for the Force Concept Inventory[1] standardized test gains with the computer homework will be detailed. Overall, we are satisfied with the learning gains and the level of student satisfaction in both courses.

1. David Hestenes, Malcolm Wells, & Gregg Swackhamer, "Force Concept Inventory," *Phys Teach.* **30** 141-151 (1992).

Session FC: Computational and Online Tools for Teaching Physics

Location: Room 200C
Sponsor: Committee on Educational Technologies
Date: Wednesday, Feb. 7
Time: 8–9 a.m.

Presider: Cathy Ezrailson

FC01: 8-8:10 a.m. Accurate Scientific Visualization in Research and Physics Teaching

Contributed – Tim Wendler, BYU, Provo, UT 84604; timoth500@yahoo.com

Accurate visualization is key in the expression and comprehension of physical principles. Many 3D animation software packages come with built-in numerical methods for a variety of fundamental classical systems. Scripting languages give access to low-level computational functionality, thereby revealing a virtual physics laboratory for teaching and research. Specific examples will be presented: Galilean relativistic hair, energy conservation in complex systems, scattering from a central force, and energy transfer in bi-molecular reactions.

FC02: 8:10-8:20 a.m. Investigating Student Interactions with a Synthetic Tutoring System*

Contributed – Christopher M. Nakamura, Kansas State University, Manhattan, KS 66506; cnakamur@phys.ksu.edu

Sytil K. Murphy, Shepherd University

Michael Christel, Scott Stevens, Carnegie Mellon University

Dean A. Zollman, Kansas State University

Online learning environments represent a potentially important educational resource, particularly for students with insufficient access to teachers, or who are accustomed to getting information online. Understanding how students progress through online learning materials is important for successful design. Objective questions are easily assessed by computer, but free-response questions also provide insight into conceptual understanding. We have developed an online learning environment that allows students to get prerecorded video answers to natural language questions and requires them to answer free-response conceptual questions. Preliminary analysis suggests grouping responses to a question based on similarities in the ideas expressed can provide an automated analysis scheme that is useful for classifying future responses. Grouping may also provide a useful framework for understanding different ways students think about the question. A natural extension of this analysis is to investigate conceptual connections and statistical correlations between groupings that emerge from students' responses across multiple questions.

*This work is supported by the U.S. National Science Foundation under grant numbers REC-0632587 and REC-0632657.

FC03: 8:20-8:30 a.m. Creating an Online Virtual World to Teach Physics*

Contributed – Ricardo J. Rademacher, Futur-E-Scape, LLC 503 McAlpin Ave. Cincinnati, OH 45220; ricardo@rademacher.com

For the last 10 years, Dr. Rademacher has pursued the creation of a three-dimensional online virtual world dedicated to teaching physics. In this presentation, three different virtual world implementations will be presented and the future for this project will also be discussed. The first implementation presented will be the Virtual Online Laboratory (VOL) as a testbed in translating offline physics labs to the three dimensional online world. Next, the Massively Multi-User Synchronous Collaborative Learning Environment (MMUSCLE) is presented as the next logical step with the addition of stronger social elements and introduces the use of video game development techniques and software. Finally, Physics Adventures in Space Time (PAST) is presented as the latest version, which incorporates all of the above but adds role-playing game elements to help move the pedagogy along.

*For more information on this project, please visit http://www.thevniversity.com

FC04: 8:30-8:40 a.m. Problem-Solving Strategies in an Online Homework Environment

Contributed – Daniel T. Seaton, Massachusetts Institute of Technology, Cambridge, MA 02139; dseaton@mit.edu

Raluca Teodorescu, Carolin N. Cardamone, Saif Rayyan, David E. Pritchard, Massachusetts Institute of Technology

Data collected by online homework systems allow for unique insights into student problem-solving patterns. We apply data-mining techniques to investigate student interactions with online homework problems in our Integrated Learning Environment for Mechanics, built in the LON-CAPA open-source learning system. Problem-solving behaviors are analyzed using three different measures: time-per-problem, LON-CAPA difficulty, and item difficulty measured by item response theory. We build on our recent analysis of student-chosen, multi-level homework, providing further insight into student performance, problem efficacy, and overall student motivation. Particular attention is given to time-based measures of student interactions with online homework. Work supported by NSF Grant #PHY-0757931.

FC05: 8:40-8:50 a.m. An Interactive Tool to Draw Spacetime Diagrams

Contributed – Roberto B. Salgado, Bowdoin College, College Station Brunswick, ME 04011; rsalgado@bowdoin.edu

We present an interactive program written in VPython that allows a student to interactively draw a spacetime diagram. The key feature of the program is that tickmarks along worldlines are marked by the light rays of a ticking light clock. The rays trace out diamonds with lightlike sides enclosing a fixed magnitude of area, which represent ticks of the clock. This provides visualizations of calculations in relativity that are usually treated algebraically.

FC06: 8:50-9 a.m. Physics Educators as Designers of Simulation Using EJS Part 2*

Contributed – Loo Kang Lawrence Wee, Ministry of Education, Singapore Ministry of Education (MOE) Building, SG 138675 Singapore; weelookang@gmail.com

To deepen do-it-yourself (DIY) technology in the physics classroom, we seek to highlight the Open Source Physics (OSP) community of educators that engage, enable and empower teachers as learners so that we create DIY technology tools-simulation for inquiry learning. We learn through Web 2 online collaborative means to develop simulations together with reputable physicists through the open source digital library. By examining the open source codes of the simulation through the Easy Java Simulation (EJS) toolkit, we are able make sense of the physics from the computational models created by practicing physicists. We will share newer (2010-present) simulations that we have remixed from existing library of simulations models into suitable learning environments for inquiry of physics. We hope other teachers would find these simulations useful and remix them that suit their own context and contribute back to benefit all humankind, becoming citizens for the world.

*Extension of Wee, L. K. (2010, 20 July). Physics Educators as Designers of Simulation using Easy Java Simulation (EJS). Paper presented at the AAPT National Meeting 2010 Summer, Portland, Oregon. Video and paper can be found here http://weelookang.blogspot.com/2010/07/physics-educators-as-designers-of.html

Session FD: Introductory Physics Courses

Location: Room 202AB
Sponsor: Committee on Physics in Undergraduate Education
Date: Wednesday, Feb. 7
Time: 8:30–10 a.m.

Presider: Tiberiu Dragoiu

FD01: 8:30-8:40 a.m. Letting Students Be the Simulation: Example of the Monty Hall Problem

Contributed – Gerald Feldman, George Washington University, Washington, DC 20052; feldman@gwu.edu

Statistical processes can be simulated to help students understand the results. These simulations are usually computer codes that the students execute, where the computer runs a large number of trials for the statistical process. We have employed a different scheme in which the students actually become the simulation, using examples of coin flipping and the Monty Hall (MH) problem. First, students are asked to make predictions about the best strategy for winning. Then they engage in a real-time classroom activity where they run the trials themselves by flipping coins or playing the MH game. Students get a feel for the accumulation of statistics as they collect their own data over several trials, and they observe the results converging to a particular answer when a large statistical sample is obtained by combining the class data. For the MH problem, students are often surprised at the counter-intuitive result that their own simulation of the process reveals.

FD02: 8:40-8:50 a.m. Nuclear Physics in First Year College Physics – A Pedagogical Natural

Contributed – Donald F. Holcomb, Cornell University, Ithaca, NY 14853; dfh1@cornell.edu

Nuclear physics provides a natural opportunity to bring 20th century physics into the first-year physics syllabus. (1) Nuclear reactions are important players in 21st century applications of physics. Medical diagnosis and treatment, as well as energy generations, are natural examples. (2) The necessary background for a phenomenological treatment of nuclear physics is quite limited, and will be brought by a large fraction of students. (3) Nuclear physics provides beautiful opportunities for the use of MODELS in physics—the "close-packed spheres" model for calculating the size of nuclei as a function of the number of nucleons, as well as energy flow equations, provide nice examples. In summary: We have an opportunity to do a piece of 20th century science that has a strong motivational base for a substantial fraction of students, can be treated with tractable models, and can have a certain freshness.

FD03: 8:50-9 a.m. Remedying Typical Texts? Discussions of Maxwell-Ampere's and Faraday's Laws

Contributed – Stephen Eric Hill, University of Redlands, Redlands, CA 92373; eric_hill@redlands.edu

When introducing any theory to students, we help them develop a facility with the math and an understanding of the concepts. Unfortunately, most introductory texts likely hinder student's understanding of Electricity and Magnetism by discussing Faraday's Law and the Maxwell-Ampere Law in a way that is inconsistent with the students' hitherto-developed understanding of causality and, for many texts, actually contradicts the principle of causality. I'll speak to this point and provide an accurate and consistent discussion of these laws which should help rather than hinder their understanding of Electricity and Magnetism.

FD04: 9-9:10 a.m. Students-generated Multiple-Choice Questions for Peer Instruction

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

In the introductory physics course for all science majors at Ryerson University, active learning has been promoted by the adoption of Peer Instruction aided by clickers since 2007. Peer Instruction has had a significant positive effect on students? performance. In addition to the existing Peer Instruction, recently we have introduced a new activity where the students collaborate in small groups to create their own multiple choice format questions. The students are presented with open-ended questions, working in small groups to produce plausible answer options for a multiple choice format. The entire class then discusses the options presented by the groups. The questions created as a result of such small-group collaborative activities are used for Peer Instruction and evaluations. We will present examples of student-generated questions.

FD05: 9:10-9:20 a.m. Using Modeling Discourse Management In Introductory Physics Classes

Contributed – John W. Griffith, Red Mountain Campus, Mesa Community College, Mesa, AZ 85207; john.griffith@mcmail.maricopa.edu

Three years ago, I began to incorporate a classroom management technique called Modeling Discourse Management[1] (MDM), a student-centered engagement method, into my introductory physics courses. This was quite a change for my classes given that my primary delivery method prior to this was classroom lecture. In this talk, strengths and successes of the incorporation of MDM into my classes, student feedback about MDM, a brief description of switching from lecture to MDM, and a sample activity or two will be presented.

1. D. M. Desbien, Modeling Discourse Management Compared to Other Classroom Management Styles in University Physics. Unpublished doctoral dissertation, Arizona State University (2002).

FD06: 9:20-9:30 a.m. Dynamics Concepts Learning Effects Through in-classroom and in-lab Instruction Comparison

Contributed – Sergio Flores, University of Juarez, Ciudad Juarez, Chihuahua 32310 Mexico; seflores@uacj.mx

Maria Dolores Gonzalez, New Mexico State University

Juan Ernesto Chavez, Juan Luna, Jose Valente Barron University, of Juarez

Physics II course is based on dynamics content and is mandatory for all majors in the University of Juarez. Many investigations related to a conceptual learning of these topics have found important understanding problems. In this course students have to develop a functional understanding of topics as velocity, acceleration, and Newton's second law. Some students show a lack of relation between the vector properties of these variables and the equation that relates these variables with the corresponding modeling process. We present results about the learning effects and conceptual versatility students develop through a lab environment. Research data were collected from two Physics II groups, one of the groups under a traditional instruction (in-classroom lecture) and the other one under an in-lab curriculum throughout the fall 2011 semester. The assessment elements during the cognitive process were similar for both groups. One of the micro-curriculum differences of the in-lab group was the use of equipment and material during all sessions. Observations show that about 50% of students from the traditional instruction dropped the class, and 90% of the in-lab instruction students stay in class by the middle of the semester.

FD07: 9:30-9:40 a.m. Investigating Student Ability to Apply Basic Electrostatics Concepts to Conductors*

Contributed – Ryan L. C. Hazelton, 200 NE 65th St Seattle, WA 98115; rlhazelton@gmail.com

Paula R. L. Heron, University of Washington

MacKenzie R. Stetzer, University of Maine

In teaching electrostatics and electric circuits, it is necessary to introduce abstract ideas such as electric fields and electric potential before discussions of circuits can take place. We have found that students in introductory courses can build a functional understanding of some aspects of electric fields and potential, but their understanding of these concepts appears to falter when applied to systems involving conductors. Examples of our preliminary findings will be presented.

*This work has been supported in part by the National Science Foundation under Grant No. DUE-0618185.

FD08: 9:40-9:50 a.m. Acronyms to Encourage Physics Education

Contributed – Shannon A. Schunicht, Texas A&M University, College Station, TX 77845.3005; sschunicht@gmail.com

When instructing classes, physics formulas are continually espoused with applications, historical highlights, and derivations always in the same fashion. Students have other classes, assignments, et.al. For this reason, the study of physics takes second place, if not being discarded altogether. This author came back to school after suffering a severe head injury to make some pragmatic findings to compensate for the residual memory deficits. The most valuable was having each vowel represent a mathematical operation. Using this technique, any formula may be algebraically manipulated into a word for recollected ease, ADDITIONAL LETTERS may be added to enhance a letter combinations intelligibility, but need be CONSONANTS only. Examples include: exCePT i buiLD rabbiTS 4 caTS oN 2 HaTS. Everyone remembers DR. Seuss? This acronym is for the quadratic equation! Sample cards will be distributed, as well as formulas tackled that are submitted.

Session FE: Upper Division Physics

Location: Room 104B
Sponsor: Committee on Graduate Physics Education
Date: Wednesday, Feb. 8
Time: 8–9:20 a.m.

Presider: Joe Kozminski

FE01: 8-8:10 a.m. Quantum Information for Undergraduates

Contributed – Jean-Francois S. Van Huele, Brigham Young University, Provo, UT 84602-4681; vanhuele@byu.edu

Quantum Information (QI) is rapidly becoming a mature discipline, but it has yet to find its way into the undergraduate physics curriculum. Should it? And if so, how do we make this happen? To address these two questions interactively, we will need information on QI content and QI resources, which this talk will provide, but also criteria for curricular priorities and suggestions for pedagogical strategies, which the audience will help provide.

FE02: 8:10-8:20 a.m. Teaching Ferromagnetism and Magnetic Domains with a Homemade Kerr Microscope

Contributed – Hector C. Mireles, Cal Poly Pomona, Pomona, CA 91768; hcmireles@csupomona.edu

We have constructed a magneto-optical (Kerr) microscope that permits students to observe—in real time—magnetic domains responding to a controlled magnetic field. By studying the dynamics of magnetic domains, our students explore some of the fundamental aspects that govern all devices that rely on magnetic memory; hysteresis and magnetic anisotropy. The microscope is incorporated into our upper-division solid-state physics laboratory course, and also provides students with insight into the magneto-optical Kerr effect (MOKE). We offer some technical suggestions for laboratory developers, and outline some learning objectives that undergraduates could achieve with this instrument.

FE03: 8:20-8:30 a.m. Medical Physics

Contributed – Thomas B. Greenslade, Jr., Kenyon College, Gambier, OH 43022; Greenslade@Kenyon.edu

The majority of American men will die with Prostate Cancer. Note that I said “will die WITH” rather than “will die OF” prostate cancer. Still, a fair number of us will have to deal with the presence of prostate cancer and must seek medical treatment for it. I was diagnosed with prostate cancer a short time before my 73rd birthday. The initial diagnosis showed that it probably had not spread. Showing that this was true and then treating it led to a host of procedures that were pure physics, and are the subjects of this talk.

FE04: 8:30-8:40 a.m. More Than Coursework: Aiding the Transition from Learner to Doer

Contributed – Vern Lindberg, Rochester Institute of Technology, Rochester, NY 14623; vern.lindberg@rit.edu

Dawn Hollenbeck, L.S. Barton, Rochester Institute of Technology

Traditional course work, though of central importance for a physics major, is not the only item of importance in undergraduate training. At RIT, we teach technical and communications skills essential after graduation (either for graduate school or immediate employment) throughout the curriculum. Technical skills including LaTeX, gnuplot, LabView, and maintaining a lab notebook are used throughout the curriculum. Communication skills are honed in a Comprehensive Oral Exam (CORE) based on introductory courses including modern physics. Completion of the CORE generates a notable increase in student confidence, poise, and ability to present material orally. As part of their senior Capstone Research, students give presentations of increasing length, and produce papers in scientific form. Many of our majors learn teaching skills while serving as undergraduate TAs in our Team Physics implementation of SCALE-UP. Upon graduation, our majors report success in these non-curricular areas of their training.

FE05: 8:40-8:50 a.m. Adopting Paradigms in Physics Curricular Materials in Diverse Contexts

Contributed – Mary Bridget Kustusch, Oregon State University, Corvallis, OR 97331-6507; mary.bridget@physics.oregonstate.edu

One of the major goals of upper-division programs is and should be to foster the capacity of the next generation of physics majors to “think like physicists.” The Paradigms in Physics Project provides tools and support for faculty from many institutions as they shift their practices at the lecture, activity, course, and even program level. This presentation will compare some of the ways in which Paradigms-influenced curricular materials have been implemented in different environments and by different instructors. The presenter will reflect on her own experiences as a new postdoc becoming a part of the Paradigms team and discuss the implications for dissemination and faculty change.

FE06: 8:50-9 a.m. Investigating Student Understanding of Diode Circuits*

Contributed – MacKenzie R. Stetzer, University of Maine, Orono, ME 04469-5709; mackenzie.stetzer@maine.edu

Christos P. Papanikolaou, University of Athens

David P. Smith, University of Washington

As part of an ongoing, in-depth investigation of student understanding of analog electronics, we have been examining student learning in upper-division laboratory courses on the subject. This investigation, which began at the University of Washington, has now been extended to multiple institutions. In this talk, I will highlight the role of written questions on basic diode circuits in probing student understanding of both fundamental electric circuits concepts (typically covered in introductory physics courses) and canonical topics in analog electronics. 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 the National Science Foundation under Grant No. DUE-0618185.

FE07: 9-9:10 a.m. Investigating Departmental Expectations for Physics Undergraduate Students

Contributed– Renee Michelle Goertzen, Florida International University, Miami, FL 33199; rgoertze@fiu.edu

Eric Brewe, David T. Brookes, Laird Kramer, Florida International University

We are investigating the goals physics faculty at our institution hold for the students majoring in physics. We present preliminary results of interviews with physics faculty that explore what attitudes, abilities, and characteristics they expect students to have developed by the time they graduate with a Bachelor's degree from our institution. The goal of the work is to build a deeper understanding of the expectations physics faculty hold for their students, which will allow us to better assess whether students meet these expectations, and whether the physics program provides sufficient opportunities for students to develop these desired attitudes and abilities. This increased understanding should also facilitate comparison of how the goals of physics professors and of the physics education research community.

FE08: 9:10-9:20 a.m. Integration: Has Its Time Finally Come?

Contributed – Norman J. Chonacky, Yale University, New Haven, CT 06520-8284; norman.chonacky@yale.edu

During the past four decades, computation has increasingly become a vital component of science and engineering toolboxes. Important computational advances have come in numerical modeling and simulation. More recently various development efforts have produced technologies making it easier to produce sophisticated and user-friendly software, whose applications yielded exemplary educational materials for undergraduate physics. Yet thus far these materials have not made significant headway into physics courses. A recent study confirmed this national failure to integrate and pointed to possible reasons for this despite the existence of high-quality computational resources.[1] This talk reports recent progress in efforts by the Partnership for Integration of Computation into Undergraduate Physics (PICUP) to provide a framework for, and sample materials aimed at, lowering faculty barriers to computational integration.

1. N.Chonacky & D.Winch, "Integrating computation into the undergraduate curriculum: A vision and guidelines for future development," *Am. J. Phys.* **76** (4&5) 327-333, (April/May 2008).

Session FF: Pseudoscience

Location: Room 204
Sponsor: Committee on Science Education for the Public
Date: Wednesday, Feb. 8
Time: 8–9:50 a.m.

Presider: Bill Reitz

Claims pretending to be scientific are numerous and varied. This session will look at some of those claims and how they can affect our teaching the nature of science.

FF01: 8:00-8:30 a.m. Pseudoscience from a Journalist's Perspective

Invited – Martin H. Hackworth, Idaho State University, Pocatello, ID 83204; martin.hackworth@gmail.com

The difficulty in discerning between pseudoscience and science from the twin perspectives of both science and journalism. The author is a Senior Lecturer in Physics at Idaho State University and a multiple winning journalist.

FF02: 8:30-9 a.m. Send Your Students to the Internet to Practice Distinguishing Good Science from Pseudoscience!

Invited – Douglas K. Duncan, University of Colorado, Boulder, CO 80309; dduncan@colorado.edu

Leilani Arthurs, University of Nebraska

Student attitudes about learning science were compared at the end of two astronomy courses, one with a traditional curriculum and one whose curriculum explicitly addressed the nature of science and metacognition (i.e. thinking about one's own thinking). The augmented curriculum gave students practice at evaluating examples of science and pseudoscience found on the Internet or YouTube. Attitudes at term end were assessed using the Epistemological Beliefs Assessment for Physical Science (EBAPS) survey, extensive interviews and written responses. A majority of students in the transformed course stated that anyone can learn science, whereas a majority of students in the traditional course thought that only individuals with innate abilities can learn science and think scientifically. Students in the transformed course reported much more confidence in their ability to evaluate the scientific validity of information found on the Internet, and they valued making sense of science more than students from the traditional course.

FF03: 9-9:30 a.m. Valid vs. Bogus Methods in Paranormal Investigation

Invited – James Underdown, Center for Inquiry/ Independent Investigations Group, 4773 Hollywood Blvd., Los Angeles, CA 90027; jimu@cfiwest.org

The widespread belief in paranormal phenomena such as ghosts, telepathy, performance-enhancing bracelets, etc. is often bolstered by pseudoscientific jargon and bad science. To make matters worse, TV shows and websites featuring ghost-hunters and paranormal claimants add to the misunderstanding of what really causes people to have weird experiences. James Underdown is the founder and chair of the Independent Investigations Group (IIG), the world's largest paranormal investigations team.The IIG offers a $50,000 prize to anyone who can prove paranormal ability under scientific testing conditions. For over 11 years, Underdown and the IIG team have been testing people who have made claims from telepathy, to dowsing, to telekinesis. No one has passed even a preliminary test of such ability. In this presentation, Underdown will look at some of the testing techniques his group uses to check the validity of paranormal claims, and will report on the state of the paranormal arts.

FF04: 9:30-9:40 a.m. Bogus Astronomy: Examples for Teaching Scientific Reasoning

Contributed – Timothy A. Heumier, Azusa Pacific University, Azusa, CA 91702; theumier@apu.edu

In my Introduction to Astronomy class, I periodically show items garnered from the Internet that are BOGUS! I start by presenting an item, and then ask what they think of it. Sometimes they catch on quickly, sometimes it takes awhile. As we analyze the claims, we make use of facts and principles we have learned in astronomy to detect these frauds. I will demonstrate four such bogus items, including the famous "Mars as big as the Moon", "Moon at the North Pole", "New near-earth asteroid Hatchett-McRay" and the ever popular "NASA finds the missing day." In all cases, I discuss why some people might be inclined to fall for the fraud, and how my students can learn to avoid falling prey.

FF05: 9:40-9:50 a.m. Searching for ET: The Science and Pseudoscience of Aliens

Contributed – Barbra Maher, Red Rocks Community College, Lakewood, CO 80127; barbra.maher@rrcc.edu

Aliens and UFOs abound in popular culture, providing an exciting approach to the issue of science versus pseudoscience. Extraterrestrial life is a topic that can easily capture the student's imagination and attention. Recent advancements in astrobiology have changed the outlook of some on the probability of life beyond Earth, but it is still a controversial idea for many. In several courses at Red Rocks Community College, this topic is used to explore the differences between science and pseudoscience. Students are introduced to the topic using a variety of media including video, science fiction, apps, and databases. Students then complete assignments ranging from researching popular UFO cases, exploring the limits of the Drake equation, learning about extremophiles, researching the efforts of SETI, and probing the latest exoplanet discoveries. Learning outcomes include knowledge and application of the scientific method, and understanding the various scientific approaches to the search for extraterrestrial life.

Session FG: Interactive Lecture Demonstrations: Physics Suite Materials that Enhance Learning in Lecture

Location: Room 203AB
Sponsor: Committee on Research in Physics Education
Date: Wednesday, Feb. 8
Time: 9–10 a.m.

Presider: Priscilla Laws

FG01: 9-9:30 a.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).

FG02: 9:30-10 a.m. Interactive Lecture Demonstrations: Effectiveness in Teaching Concepts

Invited – Ronald K. Thornton, Center for Science and Math Teaching, 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).

Session FH: *Panel:* Two-Year College Guidelines

Location: Room 203C
Sponsor: Committee on Two-Year Colleges
Date: Wednesday, Feb. 8
Time: 8–10 a.m.

Presider: John Griffith

The two-year college community has been working to revise the AAPT booklet "Guidelines for Two-Year College Physics Programs." This panel discussion will update the community on the status of the revision.

Panelists:

– William P. Hogan, Joliet Junior College
– Paul Williams, Austin Community College
– Thomas O'Kuma, Lee College
– Dennis Gilbert, Lane Community College

Session FI: Reforming the Introductory Physics Course for Life Science Majors VI

Location: Room 200AB
Sponsor: Committee on Physics in Undergraduate Education
Date: Wednesday, Feb. 8
Time: 8–10 a.m.

Presider: Juan Burciaga

This session concerns identifying and characterizing physics aspects of biology-related disciplines (bioengineering, biophysics, etc.) to better answer "What physics should be in the IPLS?" There will be a mini-poster session following the invited talks. (The IPLS list-serve is ipls@mail.aapt.org, a wiki on the topic is at www.phys.gwu.edu/iplswiki/index.php/Main_Page)

FI01: 8-8:30 a.m. Toward Better Serving Life Science Students in Introductory Physics

Invited – Charles J. De Leone, California State University, San Marcos, CA 92096-0001; cdeleone@csusm.edu

Insight from physics education research and increased emphasis on quantitative and computational methods in biology has called into question both the content and delivery of the traditional introductory physics course for life scientists. In response to this situation, physics educators have begun to search for better ways to satisfy the needs of future life scientists. This talk aims to explore the space of course modifications that might better serve life science students. Context for this discussion will be the introductory physics course for biologists at California State University, San Marcos. Attention will be paid to the initial design of this course, how it has evolved in the eight years since it was first piloted, and the feedback received from science colleagues outside of physics.

FI02: 8:30-9 a.m. Accelerated Integrated Science Sequence: An Experiment in Interdisciplinary Science Education

Invited – Scot A. Gould, W.M. Keck Science Department, Claremont McKenna, Pitzer, Scripps Colleges, Claremont, CA 91711-5916; sgould@kecksci.claremont.edu

Accelerated Integrated Science Sequence (AISS) is the centerpiece of an effort by our department to attract science majors to colleges that have traditionally not emphasized the natural sciences. AISS is a year-long, double course with an integrated laboratory component. It covers the material found in the conventional introductory biology, chemistry, and physics courses. Faculty members from the three disciplines team-teach the course simultaneously. The material is organized in the following areas: randomness, structure of materials, energy states of systems and dynamical processes. Fundamental physics principles are introduced through examples from biology and chemistry. Outcomes in biology and chemistry are explained using physical concepts. While the percentage of college applicants who indicate their intention to major in the sciences has not increased, the yield of the accepted students with interest in the sciences now exceeds the average acceptance yield of the colleges.

FI03: 9-9:30 a.m. Where Will Physics Be in the New 2015 MCAT?

Invited – Richard S. Lewis, Pomona College, Claremont, CA 91711; rlewis@pomona.edu

The Medical College Admission Test (MCAT) has been undergoing a three-year, comprehensive review. As the review process is nearing an end, preliminary recommendations for the revision are starting to be communicated, and a new test is expected to be introduced in the spring of 2015. Students who plan to prepare for a career in medicine generally make up a sizeable portion of students taking physics for the life sciences, and a significant part of the current MCAT has been testing knowledge and use of concepts in physics. Therefore, it may be instructive to consider the preliminary recommendations and discuss the implications for teaching physics for the life sciences.

FI05: 9:30-10 a.m. Teaching Physics Effectively to Life Sciences Students

Poster – Philip R. Kesten, Santa Clara University, Santa Clara, CA 95053; pkesten@scu.edu

David L. Tauck Santa Clara University

Life sciences majors comprise nearly half of all undergraduates enrolled in introductory physics courses. Showing them how physics determines many characteristics of living systems often captivates their attention and motivates them to learn. Physicists don't need to be experts in biology to introduce physics by putting it in an interesting biological or clinical context. We share several novel examples, including the effects of shear on blood flow and the use of vectors to determine the electrical axis of the heart. In addition, these students benefit from the inclusion of calculus where it makes the physics clearer and more accessible, for example, in Planck's quantization of the energy in a blackbody cavity. Finally, life sciences students are most comfortable with a conceptual approach to both problem-solving and learning in general; to teach them physics effectively demands a heavy dose of conceptual testing. We address all of these in this paper.

FI06: 9:30-10 a.m. Teaching Radioactivity in the Introductory Modern Physics Class designed for Life Science Majors

Poster – Tatiana A. Krivosheev, Clayton State University, Morrow, GA 30260; TatianaKrivosheev@mail.clayton.edu

Susie Brandstetter, Kanesha Smiley, Marissa Lowe, Clayton State University

We present our experience of using hand-on activities in teaching radioactivity, dosimetry, and biological effects of radiation in the Introductory Modern Physics class designed for Life Majors. The activities enhance the understanding of physics while boosting interest and relating to the students' previous knowledge and skills from biology and microbiology classes.

Plenary: Real World Problems: *Physics for Future Presidents*

Location: Ballroom C
Date: Wednesday, Feb. 8
Time: 10:30–11:30 a.m.

Presider: Mary Lowe

Richard A. Muller, Professor of Physics, University of California, Berkeley

Physics for Future Presidents: Inspiring the non-science student by emphasizing issues of international importance

"Physics for Future Presidents" is the informal title of the course I taught at Berkeley for 10 years. For the last two it was voted by a poll taken by the student newspaper as the "best class at Berkeley"—in all subjects. The approach of the course is immersion in high-tech issues of vital importance. These include energy, nukes, terrorism and counter-terrorism, satellites, remote sensing, climate change, and current events such as the tsunami and nuclear accident at Fukushima. The course is designed to attract students from liberal arts and business, but is sometimes taken by physics and math majors too. Enrollment grew from an initial 34 students (in 2001) to over 500, filling the largest lecture hall at Berkeley. My lectures from 2006 are available on YouTube. The textbook *Physics and Technology for Future Presidents* (under $50, Princeton University Press) is now used at over 20 universities in the United States. I'll discuss the content of the course and the pedagogy, and how to make physics phobes love the subject.

Crkrbrl 7: Crackerbarrel on Teaching Physics with "Real World" Problems

Location: Room 204
Sponsor: Science Education for the Public Committee
Date: Wednesday, Feb. 8
Time: 11:30 a.m.–12:30 p.m.

Presider: Mary Lowe

This crackerbarrel will describe and discuss how to incorporate "Big Question," real world problems in their courses. This session is part of a grant involving Project Kaleidoscope and AAPT to create and implement undergraduate curricula that better prepare students for 21st century challenges. Examples of real world problems include energy, air and water quality, nuclear power, and climate change.

AAPT Ceremony: Presidential Transfer

Location: Ballroom C
Date: Wednesday, Feb. 8
Time: 12:30–1 p.m.


David Sokoloff
2011 AAPT President


Jill Marshall
2012 AAPT President

Session GA: Unusual Uses of Video Analysis in the Classroom

Location: Room 106
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Physics in High Schools
Date: Wednesday, Feb. 8
Time: 1-1:50 p.m.

Presider: Priscilla Laws

New low-cost devices for creating 30 fps and high-speed video images, the availability of unusual YouTube videos, and the expanding capabilities of computer tools for video analysis have led to exciting new physics-based video projects.

GA01: 1-1:10 p.m. Computational Modeling and Video Analysis of a Place Kick in American Football

Contributed – Kevin Sanders, High Point University, High Point, NC 27262; sandek10@highpoint.edu*

Aaron Titus, High Point Univsersity

The motion of an American football during a place kick is not characterized by ideal projectile motion because it is significantly affected by drag and spin. In this experiment, a regulation football was kicked end-over-end (as in a field goal kick). Video was analyzed to determine the effect of drag and lift (due to backspin) on the path of the football. Results of a computational model were compared to the actual path in order to estimate the drag and lift coefficients. It was found that lift, due to the Magnus effect, was more significant than anticipated and could not be neglected in order to accurately model the motion of the football. The video, computational model, and resulting coefficients will be presented.
*Sponsor: Aaron Titus

GA02: 1:10-1:20 p.m. Video Analysis to Analyze Ciliary Beat Frequency of Paramecium

Contributed – Amanda Tindall, High Point University, High Point, NC 27262; atindalla@gmail.com*

Aaron Titus, High Point University

Paramecium, unicellular eukaryotes commonly found in freshwater habitats, survive by propelling themselves through the water in search of nutrition. Propulsion is achieved through coordinated motion of thousands of tiny hair-like structures called cilia performing a rowboat-like motion, powering them through the water as quickly as 2700 mu-m/s. Paramecium are excellent model organisms as they are easy to maintain and large enough to examine using brightfield microscopy; models constructed from the analysis of paramecium ciliary beat can be applied to higher order systems, such as human trachea cells. We captured and analyzed videos using a light microscope and open source tracking software, then determined ciliary beat frequency and compared motion to the simple harmonic oscillator, thereby developing an effective model for cilia motion. This research requires little specialized equipment and is an interesting and effective use of video analysis easily explored in both undergraduate laboratories and advanced high school programs.
*Sponsor: Aaron Titus

GA03: 1:20-1:30 P.M. Video Analysis of the Inverted Pendulum Model of Walking

Contributed – Justin C. Dunlap, Portland State University, Portland, OR 97207-0751; jdunlap@pdx.edu

Angela Steichen, Crystal Wright, Ralf Widenhorn, Portland State University

In order to analyze an otherwise complex system, a common and simple model of walking is used that treats the body's center of mass as an inverted pendulum that rotates about the foot. Using video analysis, students can visually see the pendulum-like behavior of their steps and can measure important quantities necessary for the analysis of their motion. Topics such as velocity, center of mass, simple harmonic motion, and energy conservation make this activity appropriate for the physics classroom while providing links to biomechanics and the human body. The lab is part of a series of activities designed to improve the understanding of medical instrumentation as well as the human body.

GA04: 1:30-1:40 p.m. Physics-based Video Projects at Bismarck State College

Contributed – Anthony M. Mwene, Bismarck State College, Bismarck, ND 58506; tony.musumba.mwene@bismarckstate.edu

Students at Bismarck State College (a two-year college) have been using video analysis tools in class and making videos of their activities outside class for analysis. I will present some of the interesting videos my college physics and university physics students have made and analyzed at Bismarck State College. Some of the videos were taken during class time but others were taken during out of class activities.

GA05: 1:40-1:50 p.m. How Unhappy Is the "Sad Ball"

Contributed – Tiberiu Dragoiu, Hillsborough High School, Hillsborough, NJ 08844; tdragoiu@gmail.com

The NSF founded "ATE Project for Physics Faculty" aimed at two-year college (TYC) and high school (HS) physics instructors, has provided high-quality workshops throughout the country for many years. Few of these workshops were dedicated to video-analysis. During my participation in some of these three-day intensive meetings, I learned to take and analyze high-speed video footage, up to 1000 fps. Out of many experiments and movie captures performed, I will show how I used video analysis to investigate the happy and sad (unhappy) balls.

Session GB: What Can We Learn About Learning from Research in Museums, Media, and Other Informal Environments?

Location: Room 200C
Sponsor: Committee on Research in Physics Education
Date: Wednesday, Feb. 8
Time: 1-2:30 p.m.

Presider: Stephanie Chasteen

This session aims to bridge the gap between formal and informal learning environments: What can teachers and PER learn from research outside the classroom? We welcome papers describing research and research-based strategies on motivation, identity, assessment strategies, metacognition, transfer, creating prolonged engagement, or other aspects of museums, media, after-school programs, etc.

GB01: 1-1:30 p.m. Rethinking the Roles of Informal Science Environments and Classroom Teaching

Invited – James F. Kisiel, California State University, Long Beach, CA 90840; jkisiel@csulb.edu

Where do we really learn science? As concerns build regarding the challenges of effective science teaching in the formal, K-12 learning environment, we find increased attention drawn to a larger view of science learning, learning that spans setting and time. A growing body of research is helping us to understand how people come to understand science outside of school settings, suggesting a more complex and more fluid sense of science learning. For this session, we?ll explore a broader conception of what it means to learn science in informal science environments (museums, parks, science centers, aquariums) as well as the challenges of leveraging such environments and institutional resources to support learning across both informal and formal learning contexts. Research related to teacher use of informal learning settings will set the stage for a variety of strategies for improving teachers? use of informal science learning institutions and other community sites.

GB02: 1:30-2 p.m. NOVA and Science Cafes: A Flexible Model for Public Engagement of Science

Invited – Rachel Connolly, NOVA/WGBH, One Guest St., Boston, MA 02135; rachel_connolly@wgbh.org

Science Cafés are conversations between scientists and the public that occur in casual settings. This flexible model for public engagement is growing in popularity and increasingly being adapted to reach a range of audiences—from teachers to teens. Since 2005, NOVA has been promoting and offering resources to Science Cafés nationally as part of the outreach strategy for NOVA scienceNOW. With the launch of our new online community at www.sciencecafes.org, we now have over 200 registered cafe affiliates nationally, and four international affiliates. Come and learn about cafes and how to start or grow one in your community.

GB03: 2-2:30 p.m. Authoring New Identities through Engagement in an After School Science Club, GET City

Invited – Hosun Kang, University of Washington, College of Education, Seattle, WA 98195-3600; hosunk@uw.edu

Angela Calabrese-Barton, Michigan State University

There is growing evidence that out-of-school informal science programs, such as after-school science clubs, can promote science learning (NRC, 2009). We have been studying young women's learning and participation in science as they traverse across various "science spaces," including after-school science clubs and school science classrooms, and the impact this has on their identity development (or sense of future selves in science). Findings indicate that informal learning opportunities, when they are both continuous and complementary to school science, play critical roles in shaping how and why girls identify with science, and the ways in which such identity work can transfer from out-of-school settings to in-school settings, in ways that positively impact their participation and learning there. In my talk I focus on these findings, and describe the mechanisms of transfer that support girls in leveraging out of school learning for success in school science.

Session GC: The Search for Dark Matter

Location: Room 103
Sponsor: Committee on Space Science and Astronomy
Date: Wednesday, Feb. 8
Time: 1-2 p.m.

Presider: Cathy Ezrailson

GC01: 1-1:30 p.m. The Dark Side of the Universe

Invited – Marusa Bradac, UCDavis, Davis, CA 95616; marusa@physics.ucdavis.edu

One of the greatest accomplishments in recent astrophysics is the creation of a model for the complete inventory of the Universe. All the observational data tells us with extremely high certainty that ordinary matter (every particle ever detected by every person who ever lived) makes up only one fifth of all the matter there is. The rest goes by the popular name of dark matter. Because it is dark, dark matter has been notoriously hard to detect; it doesn't emit or reflect radiation such as light or heat, and it can have only the feeblest of interactions with itself and ordinary matter. So how do we know it is there? In this talk, I will discuss how astronomers observe the invisible matter in one of the true gems on the sky: a giant cluster of galaxies 1E0657-56. It is one of the hottest and most luminous X-ray clusters known and is unique in being a major supersonic cluster merger occurring nearly in the plane of the sky, earning it the nickname "the Bullet Cluster."

GC02: 1:30-2 p.m. Direct Detection of Dark Matter

Invited – Harry N. Nelson, UCSB Physics Department, Santa Barbara, CA 93106-9530; hnn@hep.ucsb.edu*

The conclusive evidence for the existence of dark matter, a form of matter that surrounds galaxies and clusters of galaxies, all comes from astrophysical measurements. However, it is natural to ask whether the dark matter consists of a new particle that can be detected in Earth-based laboratories. An intense, worldwide effort is under way to detect hypothetical dark matter particles. I'll review those efforts, with emphasis on the near future, when the new experiment LUX will commence at the Sanford Lab.

*Sponsor: Cathy Ezrailson

Session GD: Teaching Methods for Physics Teacher Preparation II

Location: Room 203C
Sponsor: Committee on Teacher Preparation
Date: Wednesday, Feb. 8
Time: 1-2:20 p.m.

Presider: Duane Merrell

GD01: 1-1:30 p.m. Content-Intensive Masters Degree Programs for Under-prepared Inservice Teachers

Invited – Colleen Megowan-Romanowicz, Arizona State University, Tempe, AZ 85282; megowan@asu.edu

To address the critical shortage of highly qualified middle and high school teachers in the physical sciences, the Modeling Instruction Program at Arizona State University has given birth to two content-intensive Master of Natural Science (MNS) degree programs--one designed to prepare high school physics and chemistry teachers and the other designed to prepare elementary-certified teachers to teach the physical sciences and/or mathematics at the middle school level. Grounded in Modeling pedagogy, these programs deliver a suite of courses that focuses on the handful of conceptual models that form the content core of the physical sciences. The program of study for high school teachers includes courses in contemporary physics and courses that integrate physics with other disciplines. The program for middle school teachers has an Energy and Sustainability theme and features eight courses that integrate mathematics and the physical sciences. Both programs require teachers to complete classroom action research.

GD02: 1:20-1:40 p.m. An Optics Design Challenge Tying Pre-service Teachers to Physics Classrooms

Contributed – Jill Marshall, University of Texas, Austin, TX 78712-0382; marshall@mail.utexas.edu

Gretchen Edelmon, University of Texas

Incorporating design challenges into STEM classrooms has been shown to be a way to motivate students and enhance science and mathematics learning by embedding it in an authentic context. I will report on a design challenge that has been incorporated into the UTeach secondary teacher preparation program at the University of Texas. The design challenge partners pre-service teachers with students in a physics course based on Physics by Inquiry (McDermott & the University of Washington Physics Education Group, 1996). The pre-service teachers are challenged to design durable pinhole cameras that could be manufactured from readily available materials in sufficient quantities for use in their future classrooms for optics and chemistry lessons. The Physics by Inquiry students serve as customers. The cameras must be usable by students with varying visual acuity and facial dimensions to pass a resolution test. I will focus on student learning in both design and optics.

GD03: 1:40-1:50 p.m. Deepening Prospective Elementary Teachers' Pedagogical Content knowledge (PCK) of Energy

Contributed – Lorenzo G. Santi, Physics Section of DCFA - University of Udine, 33100 Italy; lorenzo.santi@uniud.it*

Marisa Michelini, Alberto Stefanel, Physics Section of DCFA - University of Udine

To assist future elementary teachers (FETs) in comprehending children ideas expressed in games, stories, questions, etc., research-based interventions were conducted on different groups of FETs in three academic years with the goal of designing and assessing a module on energy for FET formation. Major goals for this investigation were to elicit FET ideas about energy and of the anchoring concepts in the learning of the topic; to acquaint FETs with research findings on this topic; and to propose a specific research-based curricular progression. Ideas that were targeted included those of energy as fuel-like substance that is possessed by living things; as possessed only by moving objects or as product of some process and existing only during this process; as force or power, etc. In this talk, the tasks used in this investigation will be presented and the role in teacher formation of analyzing pre-college students' learning challenges will be discussed.

*Sponsor: Stamatis Vokos

GD04: 1:50-2 p.m. Learning and Teaching Through Inquiry: Helping Change the Science Classroom*

Contributed – Donna L. Messina, University of Washington, Seattle, WA 98195-1560; messina@phys.washington.edu

Paula R.L. Heron, Peter S. Shaffer, Lillian C. McDermott, University of Washington

Effective science education reform requires bringing inquiry teaching and learning to the forefront in K-12 schools. Meeting this challenge requires substantial changes in teacher preparation, professional development, and teaching practice. Physics by Inquiry[1] is a curriculum that helps teachers develop a deep understanding of topics relevant to the K-12 classroom. These research-validated, professional development materials are intended to be used in an instructional environment that provides teachers with an opportunity to learn through a process of inquiry. In addition, they serve as a model for instruction in precollege classrooms. The results of studies conducted to assess the effects of the curriculum on changes in teachers' content understanding, pedagogical content knowledge, and teaching practice will be discussed.

*This work has been supported in part by the National Science Foundation.

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

GD05: 2-2:10 p.m. Improving Future High School Physics Teachers' Preparedness

Contributed – Brian D. Thoms, Georgia State University, Atlanta, GA 30303; bthoms@gsu.edu

Sumith Doluweera, Brett Criswell, Georgia State University

A new seven-week summer course has been developed to improve the physics pedagogical content knowledge and the confidence of future physics teachers. Master of Arts in Teaching students at Georgia State University have an option to pursue broad-field certification (physics, chemistry, biology, and earth science). The students who take this option have a variety of backgrounds in physics, ranging from one year of algebra-based physics to full physics or engineering degrees and have a commensurate range in physics conceptual understanding. Since student teaching occurs in the fall and spring terms, the short summer semester is the primary opportunity for content coursework. We have developed the new course to simultaneously address the physics misconceptions of the future teachers while teaching physics pedagogical content knowledge and expose them to research-proven teaching methods in a SCALE-UP classroom. The conceptual physics knowledge and attitudes of these students have been investigated during pilot semesters. In a single seven-week summer term, normalized gains in Force Concept Inventory scores averaged 0.43 (half of students showed normalized gains over 0.50) and students also show large increases in their self-evaluations of their comfort and preparedness for teaching physics.

GD06: 2:10-2:20 p.m. Integrating Complementary Modes of Representation through Digital Video Analysis

Contributed – Richard P. Hechter, University of Manitoba, Education Building, Winnipeg, MB R3T 2N2, Canada, hechter@cc.umanitoba.ca

Pre-service physics teacher education courses are the home of transformative experiences aimed toward developing teacher identity and efficacy, and pedagogical strategies and decision-making through the context of K-12 physics concepts and curriculum. Within these courses, insight into best teaching practices that evoke meaningful learning suggests the inclusion of explicit integration of complementary modes of representation of physics phenomena, concepts, and data, be an explicit part of physics teachers' pedagogical approach. This presentation will present preliminary research that explores pre-service physics teachers' current positioning within, and projected future use of, multiple forms of representation through infused technology within the physics classroom. Specifically, pre-service teacher insight of the overlapping integration of the symbolic, numerical, graphical, and visual modes of representation through the use of Ipad technology and digital video analysis will be discussed.

Session GE: Physics of Everyday Devices

Location: Room 200AB
Sponsor: Committee on Apparatus
Date: Wednesday, Feb. 8
Time: 1-2:30 p.m.

Presider: Raymond Polomski

This session includes talks on experiments and approaches to explore the physics hidden within the black boxes of our everyday lives, particularly activities useful as classroom demonstrations or hands-on laboratory.

GE01: 1-1:30 p.m. Relating the Nature of Light and Technologies That Use It

Invited – Gary G DeLeo, Lehigh University, Bethlehem, PA 18015; lgd0@lehigh.edu

Animals evolved survival strategies based largely upon exquisite sensitivities to electromagnetic radiation. Many of our technologies, exotic and household, operate by managing light—they produce, detect, and manipulate it. There are many learning opportunities in understanding relationships between common observations of nature and technologies that surround us. For example, we can consider the relationship between a snake, fireplace, television remote control, Radio Shack "IR thermometer," and the built-in filter in a digital camera; or that between a soap bubble and non-reflective glasses. In such a manner, I will describe demonstrations and activities that explore the nature of light and its uses in technology. I describe how old devices can facilitate an understanding of newer technologies; e.g., using old-style SLR film cameras to reveal basic principles that digital cameras conceal. I will share my experiences in using these activities in outreach programs across a wide range of educational levels.

GE02: 1:30-2 p.m. A Picture is Worth a Zillion Photoelectric Events

Invited – William J. Church, Littleton High School, Bethlehem, NH 03574; williamchurch@myfairpoint.net

Most laptops are shipped with a webcam built into the screen. Traditionally used for videoconferencing and games, these cameras are an onboard real-time science sensor that can be used for physics projects at all levels. This session will discuss how the webcam works and how this measurement tool can be used in a physics classroom. The session will start with a discussion of how an image is acquired, filtered for color, digitized, and represented in memory and end with demonstrations of several classroom projects including light absorption and reflection, color analysis, and moving object tracking. Free color analysis software, accompanied by an activity focusing on the differences between color perception of humans and other species, will be available from the author.

GE03: 2-2:10 p.m. Experiments with Solar Cells and LCDs from a Dollar Calculator

Contributed – William Heffner, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

There are a variety of devices and a lot of physics inside a solar calculator including solar cells, liquid crystal displays, membrane contact switches, rechargeable batteries and the processor. Some of the least expensive, large display calculators are available for as little as one to three dollars -- low-cost enough to dissect and reuse the components in one or more physics lab periods. We will describe several electro-optic related experiments that can be done from these parts which reinforce the exploration of how they work.

GE04: 2:10-2:20 p.m. The Physics of Tires and the Automotive Center of Mass

Contributed – Chuck Edmondson, United States Naval Academy, Annapolis, MD 21402; edmond@usna.edu

The properties of automotive tires change drastically with vertical loading. For example, the lateral force generated by a tire when turning is not linearly proportional to the vertical load (normal force). Overloaded tires reduce gas mileage and can lead to tire failure. To select a tire with the proper load rating, one must know both the static load on each tire and the dynamic load when the car is accelerating. The static load can be measured by placing a scale under each tire. We can estimate the dynamic load if we know the range of expected accelerations and if we can find the location of the center of mass relative to the four tires. The longitudinal, lateral, and height of the center of mass can be calculated using the same scales from the static experiment. A simple classroom experiment is presented to demonstrate all of the essential elements.

GE05: 2:20-2:30 p.m. Make Diodes in Your Classroom – Introduce Your Students to Electronics

Contributed – Jon Scott, Normal Community H.S., Normal, IL 61761; jonmscott@gmail.com

Students often view electronic devices as mysterious black boxes. They have no concept for how they work. Diodes are one of the fundamental solid-state electronics devices. Because the diode is fundamental, it serves as a good entry point for students to understand electronics. If students understand how a diode works, they have the foundation to understand electronics. While commercially available p-n junction diodes are cheap and readily available, there is nothing like being able to make one yourself. Surprisingly easy, an activity to make diodes in a high school science lab is presented. All you need is a Bunsen burner; Nano-CEMMs, a nanotechnology research center at the University of Illinois, will supply the rest of the materials necessary.

Session GF: PER: Student Reasoning and Problem Solving

Location: Room 202AB
Sponsor: Committee on Apparatus
Date: Wednesday, Feb. 8
Time: 1-2:30 p.m.

Presider: Gary White

GF01: 1-1:10 p.m. Problem Solving Strategies with Representational Format and Context*

Contributed – Bashirah Ibrahim, Kansas State University, Manhattan, KS 66506-2601; bibrahim@phys.ksu.edu

N. Sanjay Rebello

We compare students' problem-solving strategies when completing tasks with the same representational format across two topical areas, kinematics and work. We individually interviewed a cohort of 19 engineering students completing 10 tasks over three sessions. The tasks were structured in linguistic, graphical and symbolic forms requesting either qualitative or quantitative solutions. We used a holistic approach to analyze the data focusing on whether students employed a quantitative or qualitative strategy, formulated a description or an explanation and included equations or visual representations in the problem solution. We found that the students were inconsistent in their approach for interpreting and solving problems with the same representation across the two topical areas. The mainly symbolic problem representation and level of prior knowledge influence students' strategies, their written responses and ability to recognize qualitative ways to attempt a problem.

*Supported in part by NSF grant 0816207.

GF02: 1:10-1:20 p.m. Characterizing Student Strategies for Checking Solutions to Physics Problems

Contributed – Cameron M. Teichgraeber, The Ohio State University, Columbus, OH 43210; teichgraeber.1@physics.osu.edu

Andrew F. Heckler, The Ohio State University

Formal solution evaluation strategies, such as limiting case analysis and dimensional analysis, are valuable skills for physics students to develop. As a first step in developing instructional methods to improve these skills, we investigate student strategies for checking and evaluating solutions to physics problems during the solution process and after an answer is obtained. We collected written solutions and video data from students enrolled in calculus-based introductory mechanics and electricity and magnetism. Students exhibited basic checking, such as rereading the problem statement or givens, as well as more sophisticated checking, such as viewing the problem and results in a new representation. Students also showed a willingness to initiate checking strategies even when they were unable to obtain a conclusive result.

GF03: 1:20-1:30 p.m. Computational Modeling Integrated with ASU Modeling Instruction: Implementation and Assessment

Contributed – John M. Aiken, Georgia State University, Atlanta, GA 30303; jaiken1@student.gsu.edu

Michael F. Schatz, Georgia Institute of Technology

John B. Burk, The Westminster Schools

Marcos D. Caballero, University of Colorado at Boulder

Brian D. Thoms, Georgia State University

We describe the implementation and assessment of computational modeling in a ninth-grade classroom in the context of the Arizona Modeling Instruction physics curriculum. Using a high-level programming environment (VPython), students develop computational models to predict the motion of objects under a variety of physical situations (e.g., constant net force), to simulate real-world phenomenon (e.g., car crash), and to visualize abstract quantities (e.g., acceleration). The impact of teaching computation is evaluated through a proctored assignment that asks the students to complete a provided program to represent the correct motion. The students are given an open-ended essay question that asks them to explain the steps they would use to model a physical situation. We also investigate the attitudes and prior experiences of each student using the Computation Modeling in Physics Attitudinal Student Survey (COMPASS) developed at Georgia Tech as well as a prior computational experiences survey.

GF04: 1:30-1:40 p.m. Why Are Taylor Series So Tough?

Contributed – Marcos D. Caballero, University of Colorado, Boulder, CO 80302; marcos.caballero@colorado.edu

Rachel E. Pepper, University of California, Berkeley

Steven J. Pollock, University of Colorado - Boulder

At CU-Boulder, we have begun efforts to develop student-centered instruction in upper-division classical mechanics courses for physics majors. Part of this work requires investigations of student difficulties with particular concepts, models and tasks. Student use of Taylor series (an indispensable tool for practicing physicists) offers a unique look into how students separate math from physics. We have explored the difficulties that students exhibit when invoking, using, and discussing Taylor series as they relate to physical problems. Our investigations included classroom observations, students' homework performance, and out-of-class interviews. Our work implies the need for a stronger math-physics connection when teaching students to employ Taylor series. This work was supported by the University of Colorado's Science Education Initiative.

GF05: 1:40-1:50 p.m. Study of the Effect of Problem Format on Students' Answers*

Contributed – Beth Thacker, Texas Tech University, Lubbock, TX 79409 beth.thacker@ttu.edu

We report the results of a study of the effect of problem format on students' answers. In particular, we studied their ability to explain their reasoning and demonstrate the use of a logical problem solving process based on the physics principles they have learned. The same problem written in multiple formats was administered as a quiz in the large introductory physics sections in both the algebra-based and calculus-based classes. The formats included multiple choice only, multiple choice and explain your reasoning, explain your reasoning only, ranking and explaining your reasoning, and a few others. We present the results.

*This work is supported by NIH grant 5RC1GM090897-02.

GF06: 1:50-2 p.m. Importance of Scientific Reasoning Abilities: Should this Influence Our Teaching?

Contributed – Kathleen Koenig, University of Cincinnati, Cincinnati, OH 45247; kathy.koenig@uc.edu

Carol Fabby, University of Cincinnati

Lei Bao, The Ohio State University

Student development of scientific reasoning is at least as important as certain science content knowledge. This statement is made not only in regards to national attention on promoting 21st century skills for global competitiveness, but also in reference to research that demonstrates that students with formal reasoning patterns are more proficient learners. Unfortunately, students enter higher education with wide variations in scientific reasoning abilities, and these skills are not typically targeted in the college curriculum. In this talk I share the scientific reasoning abilities, as measured by Lawson's Classroom Test of Scientific Reasoning, for a wide variety of majors and show that the typical college course does not impact these skills. This talk provides the rationale for the inclusion of learning objectives in our courses that promote the development of more formal reasoning. Examples of pedagogies and curricula shown to be effective in developing student scientific reasoning abilities will be provided.

GF07: 2-2:10 p.m. Reasoning and Content Learning in Diverse Student Populations

Contributed – Bruce R. Patton, The Ohio State University, Columbus, OH 43210; patton@physics.osu.edu

Jennifer L. Esswein, The Ohio State University

Jerome Mescher, Hilliard City Schools

Inquiry-based instruction has been shown to lead to large gains in both content knowledge as well as scientific reasoning ability. It is of great interest to understand factors that contribute to these gains. The success of diverse populations within an inquiry-based learning environment is related to a large set of variables which include initial reasoning ability, content knowledge, mathematical background, and demographic factors. The role of different factors in the group-based course is identified, such as group work, individual exercises, journaling, instructor intervention, and hands-on activities. Comparison will be made between cohorts who include high school students, pre-service teachers, in-service teachers, and GEC students.

GF08: 2:10-2:20 p.m. Students' Brain Type and Conceptions of Learning Science

Contributed – Jiyeon Park, Seoul National University, Daehakdong, Seoul 151-748 REPUBLIC OF KOREA; pjy13638@snu.ac.kr

Dongryul Jeon

We investigated whether the brain type is a good predictor of students? conceptions of and approaches to learning science. The inventory instruments used for our study were the systemizing quotient and the empathy quotient for measuring the brain type, the questionnaire on the conceptions of learning science, the questionnaire on the approaches to learning science. Our result showed that there was a highly significant positive correlation between D, which is the difference between SQ and EQ, and conceptions of and approaches to learning science. The highly significant positive correlation also appeared between C, which is the sum of SQ and EQ, and conceptions of and approaches to learning science. The EQ is as important a factor in science learning as SQ. Therefore we need to regard the brain type as one of the important student characters.

GF09: 2:20-2:30 p.m. Progress in Overcoming One-Point Slope Calculations

Contributed – Bradley S. Moser, University of New England, Biddeford, ME 04005; bmoser@une.edu

James Vesenka, University of New England

The Test of Understanding Graphs in Kinematics (TUG-K) has informed the instruction of introductory physics for nearly two decades. One of this test's early discoveries was the student tendency to calculate a one-point slope. Even if the tangent line does not originate at the origin, students will often compute the slope at a point by simply dividing a single y-value by a single x-value. In our sample of introductory physics students taught the past few years by four different instructors all utilizing Modeling-based Instruction, we found an improved success rate on TUG-K items probing the one-point slope phenomenon. Yet, student success still remained below 50% on these items. This year we have developed a greater variety of slope calculation activities and assessments for our students, in hopes of further remediating this persistent issue. We will present our post-test findings in this talk.

Session GG: Post Deadline

Location: Room 203AB
Date: Wednesday, Feb. 8
Time: 1-1:30 p.m.

Presider: Gay Stewart

GG01: 1-1:10 p.m. An Experience with Integrated Lecture and Laboratory Classes: An Early Appraisal

Contributed – Ntungwa Maasha, College of Coastal Georgia, Brunswick, GA 31520-3644; nmaasha@ccga.edu

Two years ago we began teaching the calculus-based physics course sequence in an integrated lecture-laboratory mode. In this presentation I outline and discuss what we have learned from the experience, including some of the significant advantages and drawbacks we have encountered in using this approach. I also examine what seemed to be intractable problems and our aspirations for upgrading and streamlining the approach by importing additional research based methodologies available in the physics community.

GG02: 1:10-1:20 p.m. Motion Graphs and the Kinematics of Character Animation

Contributed – Anthony Schultz, The Graduate Center, CUNY, New York, NY 10016; tony.schultz@gmail.com

We investigate the science behind 3-D computer animation synthesized from human motion capture data. Analysis of example motion capture data is accomplished using the mathematics of kinematic chains and an associated distance metric. Various types of human movement sequences are physically characterized and used to extract the underlying movement vocabulary of the subject. This map, which we call a motion graph, may be used to generate novel movement.

GG03: 1:20-1:30 p.m. Asynchronous Group Problem Solving

Contributed - Jeffrey Phillips, Loyola Marymount University, Los Angeles, CA 90045; jphillips@lmu.edu

Using Livescribe smartpens, students in a general physics course recorded and exchanged problem solutions outside of class. The solutions are in the form of videos which display penstrokes and audio in real time. The students were instructed to articulate their thoughts as they solved the problems thereby placing the focus of the assignments on the problem solving process, rather than the refined end product. Through these activities students are expected to better self-regulate (plan, monitor and adjust) their work as they solve complex, real-world problems.

Session GH: *Panel:* GH Report on IUPAP International Conference on Women in Physics

Location: Room 104B
Sponsor: Committee on Women in Physics
Date: Wednesday, Feb. 8
Time: 1-3 p.m.

Presider: Kathleen Falconer

The 4th IUPAP International Conference on Women in Physics (ICWIP 2011) happened April 5-8, 2011, in Stellenbosch, Western Cape, South Africa. The conference was hosted by Women in Physics in South Africa (WiPiSA) and the South African Institute of Physics (SAIP). This panel will be a discussion and report on the conference. The IUPAP International Conference on Women in Physics is a forum for both scientific presentations and for discussion of issues related to attracting, retaining, and improving the status of women in physics. Please join us for an interesting and informative panel discussion.

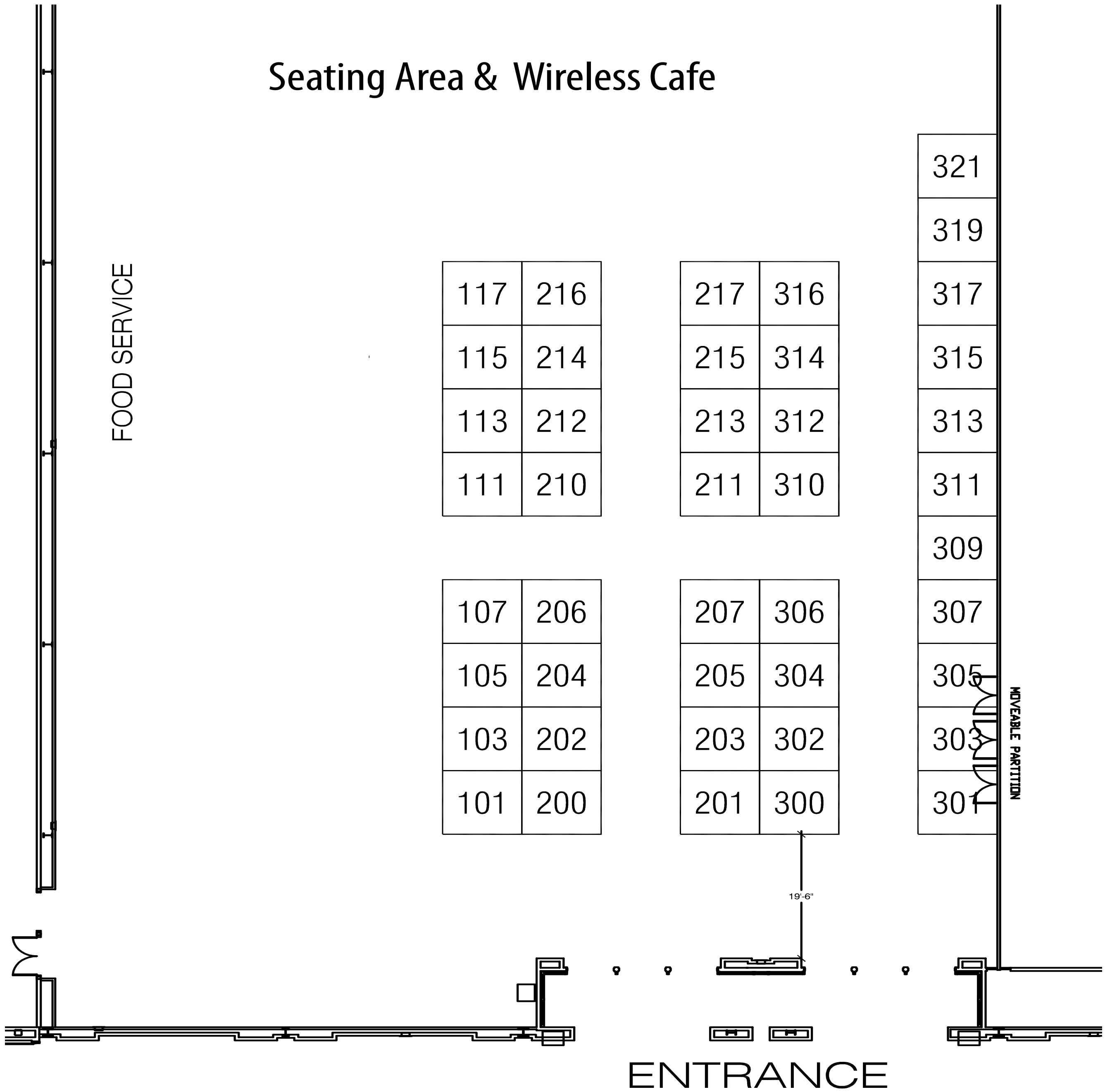
Panelists:

– Marina Milner-Bolotin, The University of British Columbia

– Beth A. Cunningham, American Association of Physics Teachers

– Kathleen A. Falconer, Buffalo State College

Exhibit Hall B – Convention Center



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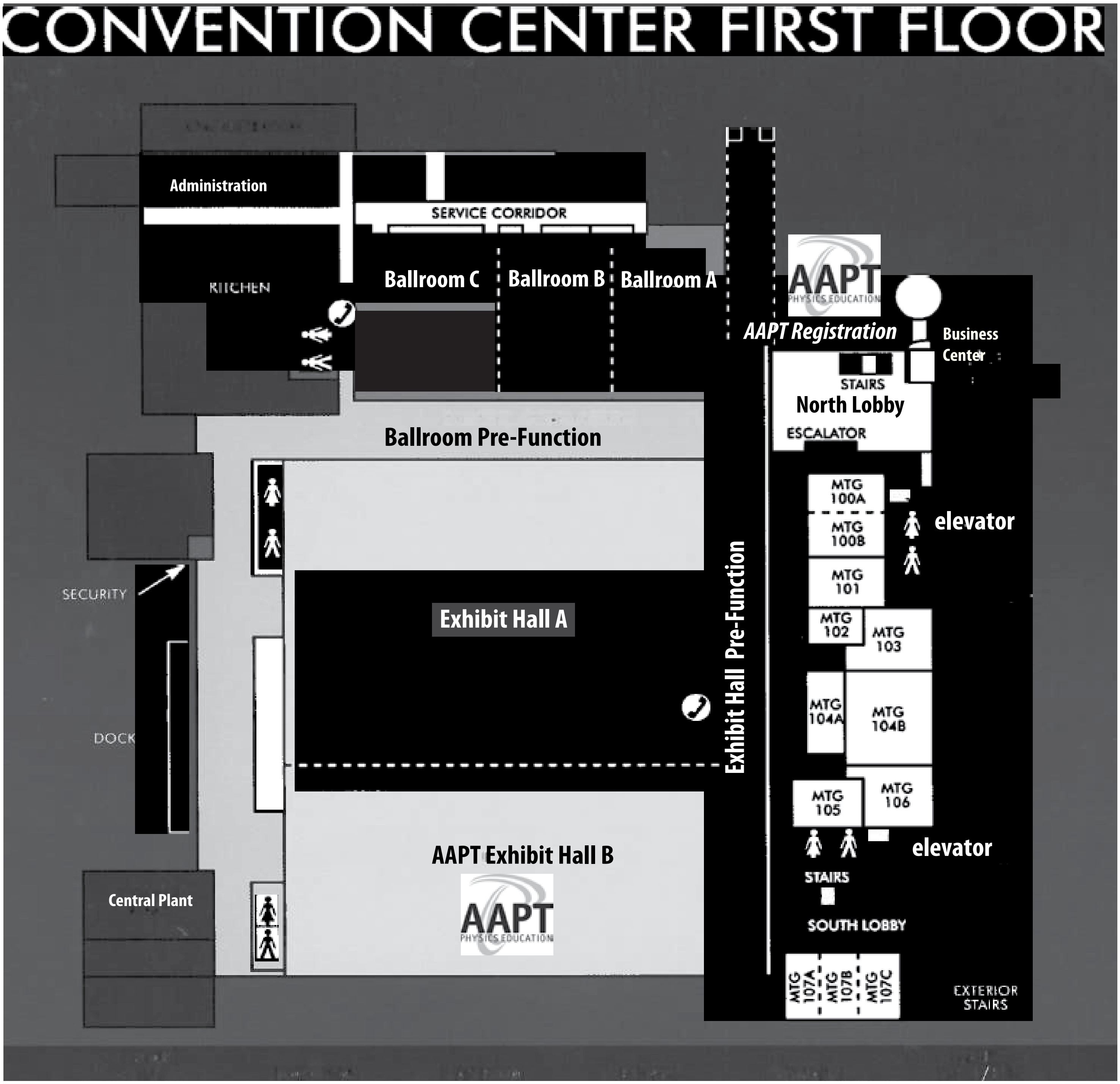

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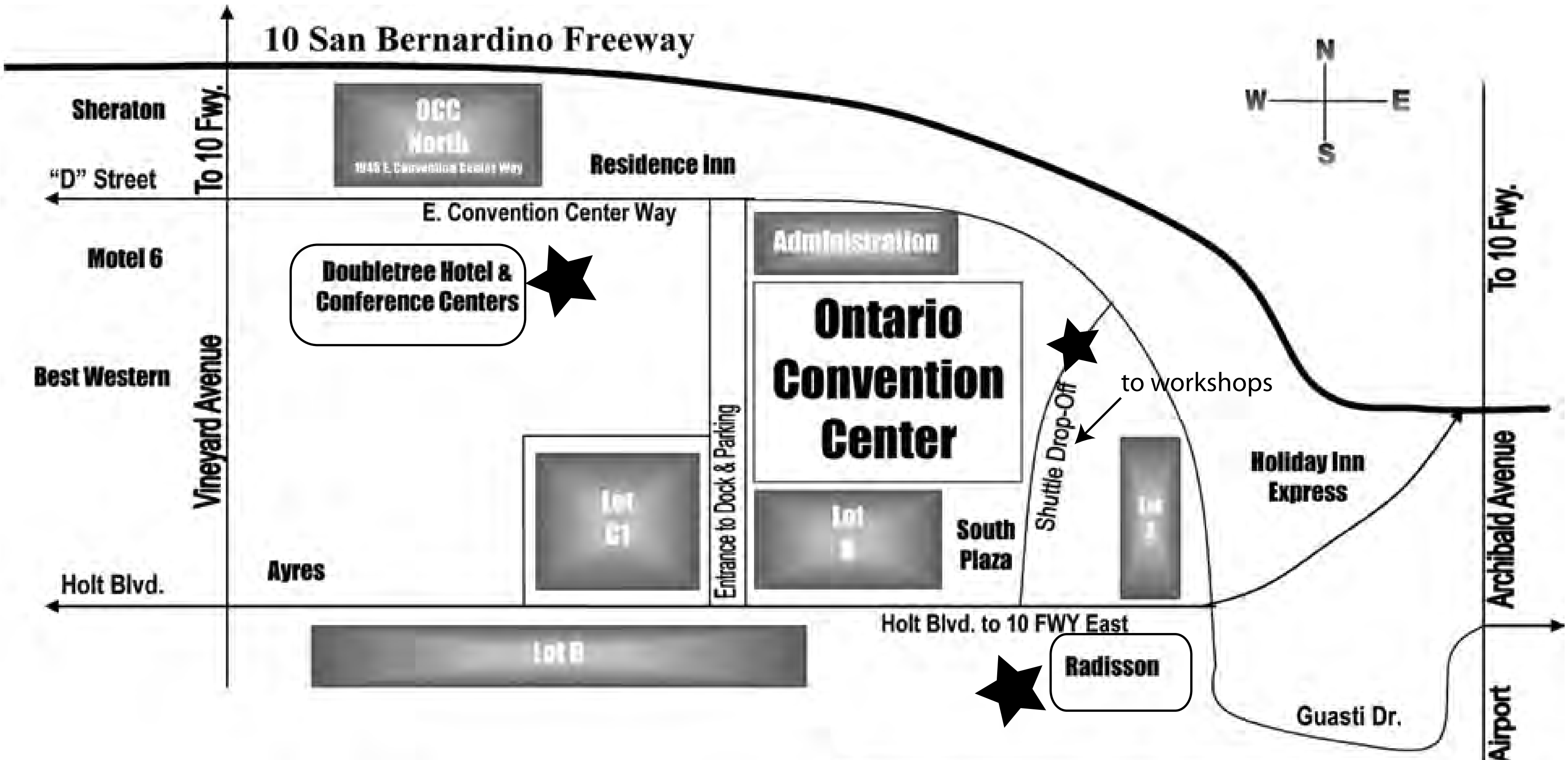

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