

How to get your Students to Prepare for Every Class

Just-in-Time Teaching (JiTT)

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http://webphysics.iupui.edu/efw_april13/index.html

A few of your comments

- Bass1: Instead of just asking me to "go read about JITT", this exercise helped to guide my reading and get me thinking about the applications of JITT in the classroom.
- JumpingJack: Doing this sounds exhausting, and unlikely to be appreciated by the students.... It is a good idea, but not one that I would find easy to implement.
- quincy: my experience with JiTT is that my "warm ups" are either too easy or too difficult.... I need some help in clearly understanding how to construct warm ups.

Outline

- Introduction
- Just-in-Time Teaching
 - “Theory”
 - Implementation
 - Aside: How to get great student evaluations
- Assessment
- Getting started

When you plan to teach a course what influences your thinking?

- #1 Experience as a student
- #2 Discussions with colleagues.
- Some PER, publisher materials, other

Examples

- oropendola: I try to remember what topics were difficult for me to learn...
- Michael: My experience as a student is useful for me to measure the minimum coverage...
- Marco: ...I discuss the [book] selection process with the previous instructor. So after reviewing what material is expected to be covered by the University i look at the previously selected text...
- *Commonalities? Problems?*

Counterexamples

- snipe: Recently I have been trying to introduce into my classes, various techniques I have read about in the PER literature. ...
- physics 113: I am amazed that "interaction with students" is not on the list---whether from graduate, undergraduate, or as a professor. Most of what I learn about how to teach is from my students.

Problem:

- Classes designed for professors or “pre-professors”
- Students do not learn like we do
 - Not motivated to be experts
 - Need more time to think
 - Not as good at working alone
 - Not as good at judging their own performance
 - Many under greater pressure
- Interesting work by Richard Felder (NCSU, Chem Eng.)

Digression

- Could have spent time “collecting data”
- Instead, spent time discussing it
- **Same content covered at greater depth**

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The “theoretical” background

- Active learning (students think in class)
- Student centered (it is not about you)
- Formative assessment (real-time feedback)
- Peer interaction (learning *and* motivation)
- Many learning styles (faculty not like students)

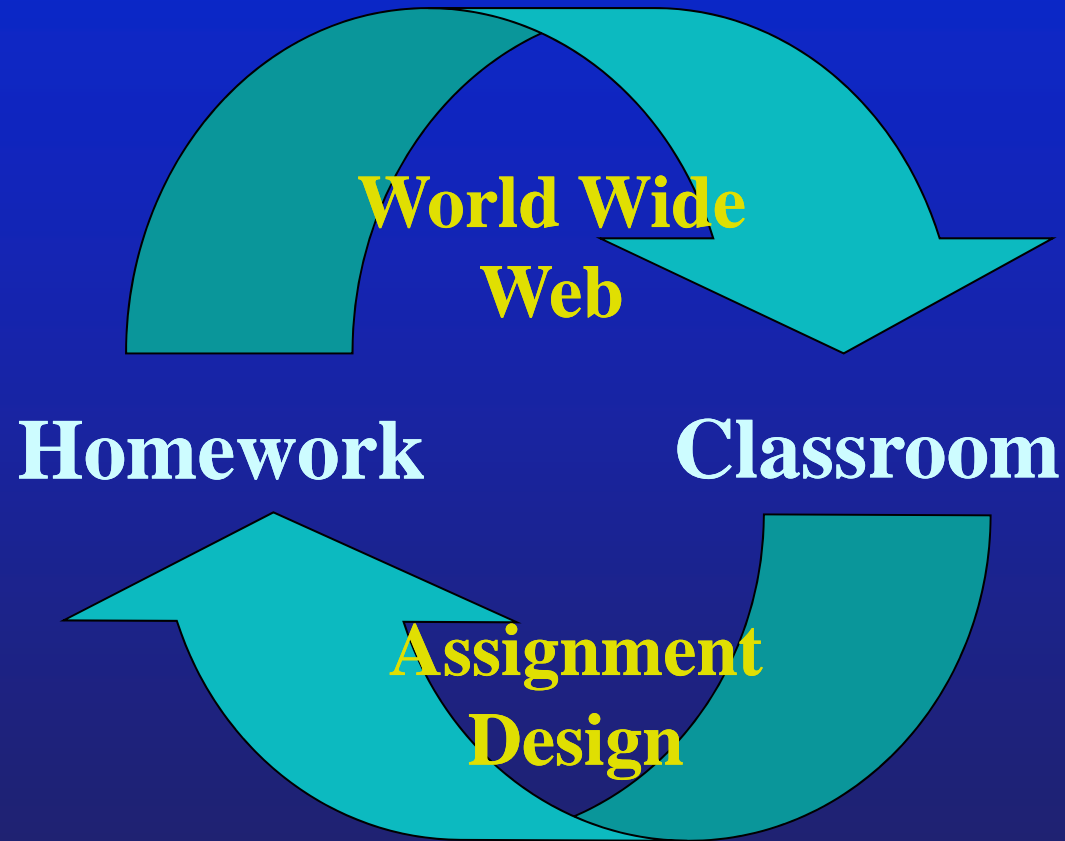
JiT (and other active learning)

- Proven effective for “regular” students and excellent ones
 - Anyone not a likely future professor
- Used extensively at MIT, RPI, Harvard, Univ. of Illinois, other research universities
- Also many small colleges (prestigious and not), Community Colleges, high schools
- Introductory, upper division, graduate
- ADAPT!

What is JiTT?

- Cello: Method to make class more responsive to students needs, and to encourage students to be better prepared for class, via pre-class assignments
- Oliver: Having the students interact with the course material you will be covering, and answer questions based upon that material well before class begins.
- Bob: Enhancing the learning experience for students by engaging them in exercises that require them to think before entering the classroom.
- Dr. B. JiTT is a feedback loop ... The goal is to maximize student engagement and learning during a face-to-face class meeting.

Just-in-Time Teaching (JiTT)



Just-in-Time Teaching

- **Adaptable**
- **Combines “high tech” with “high touch”**
- **WarmUp Exercises = Online, pre-class reading quiz:**
 - Due few hours before class
 - A few open-ended conceptual questions
 - Cover that day’s material

Another Digression

- JiTT described in your words
- Jargon already familiar (JiTT, WarmUp)
- “preview” of important concepts

The “Interactive Lecture”

- Step 1: Synchronization
Read (some of) the students’ responses...
What do they understand?
- Step 2: Preparation
Select excerpts from students work, adjust
clicker questions, etc.
- Step 3: Execution
**Class is a dialog based on student
excerpts and faculty notes**

Example

- *Question: Is it possible to add heat to an ideal gas without changing its temperature? If it is possible, please explain how it is done.*
 - “It is not possible because the internal energy of an ideal gas only depends on the temperature.... the internal energy will increase when the temperature rises....”
 - “It is possible to add heat to an ideal gas without it changing its temperature by the gas receiving the heat, and the atoms of that gas getting excited enough to disperse that heat as fast as they receive it...”
 - “If you add heat to a system while the system is doing the corresponding amount of work, the temperature will not change.”

Choosing and using student responses

- Always say something positive
 - This is true, but what if something else occurs simultaneously...
 - This makes sense, but something is missing...
 - This is a great response... how would we know how much heat to add?
- More useful phrases...
 - This is a good answer, but to a different question...
 - This has a great beginning, but more could be added...
 - This is correct, but the reasoning isn't quite right...

Tips and Pitfalls

- Explain methods and purpose on first day
- No need to review all responses before class; sample for “useful” quotes, grade later
- Focus on students strengths, too, not just misconceptions and other problems.
- Use answers from many students: not favorites.
- Do not “isolate” WarmUps - scaffold lecture
- Must be routine. Do not start/stop during semester
- Upper level students can handle more “exploratory” questions, connections to intro.

What makes a good WarmUp?

- **king:** A good "warmup exercise" lets a student motivate and think for the upcoming lecture on that topic. It is like the "spark-plug" in a car.
- **JD:** ...One that connects directly to the main goals, new notations, and possible misconceptions in the upcoming material
- **Tycho:**... those that test the student's understanding and those that stimulate class discussion and are typically more open ended.

Online archive of Warmup exercises

http://webphysics.iupui.edu/warmup/physics_archive.html

- Introductory physics (2 semester sequence)
- Statistical/Thermal Physics (2 sets)
- Intermediate Mechanics (2 sets)
- Quantum Mechanics
- Mathematical Methods
- Intermediate E&M (2 semester sequence)
- Introductory Astronomy
- Modern Physics (*coming soon*)

smartPhysics

<http://www.smartphysics.com/smartphysics/default.aspx>

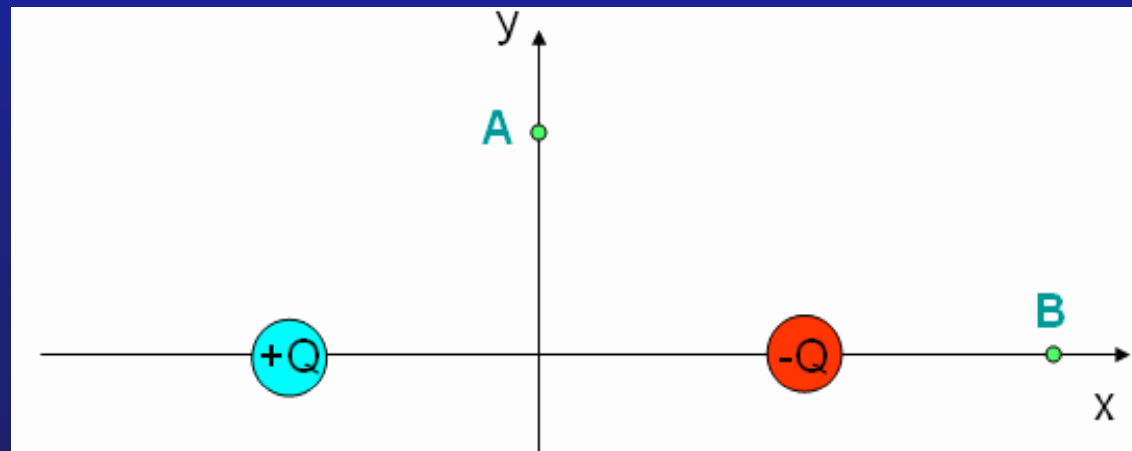
- Calculus-based Mechanics, E&M
- Pre-lecture videos (~15min/class)
- Small, paperback text
- Integrated homework, “checkpoints”
- Authored at UIUC by Gladding, Stelzer, Selen
- Published by W. H. Freeman
- ~\$40/semester

smartPhysics checkpoint

1. Two equal, but opposite charges are placed on the x axis. The positive charge is placed at to the left of the origin and the negative charge is placed to the right, as shown in the figure. What is the direction of the electric field at point A?

a) up b) down c) left d) right e) zero

2. Explain your reasoning



smartPhysics output

Aaron (aaron@iupui.edu)

- 1) 4
- 2) the field from Q^+ points up and to the right, while Q^- points down and to the right therefore when adding them together it points to the right.

Beatrice (beatrice@iupui.edu)

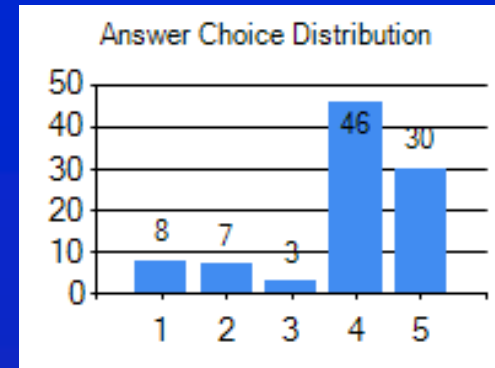
- 1) 4
- 2) point A is equidistant from each charge and they would therefore cancel out

Ada (ada@iupui.edu)

- 1) 2
- 2) The charges will cancel out so the direction of the force will be down

Ahmed (ahmed@imail.iu.edu)

- 1) 4
- 2) the field is toward the negative charge and away from the positive charge which makes the direction to the right



Results

- Students better prepared for class
 - Familiar with jargon
 - Given thought to ideas
- Faculty better prepared for students
 - Misconceptions identified
 - Just in time adjustment to coverage
- Class time spent more productively
 - Students interact during class

How to get great student evaluations

- First five minutes are critical!
- Be honest, and direct—take time on the first day of class to explain what you are doing and why.
- Be a leader—college is hard, and students look to you for motivation, don't disappoint them.
- Build a team—let students know that you and they are working towards a common goal.
- Hold yourself and your students to high standards—if you work hard, they will too.

Outline

- The Challenges ✓
- Just-in-Time Teaching ✓
 - Background ✓
 - implementation ✓
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Study Habits (N=155, biology)

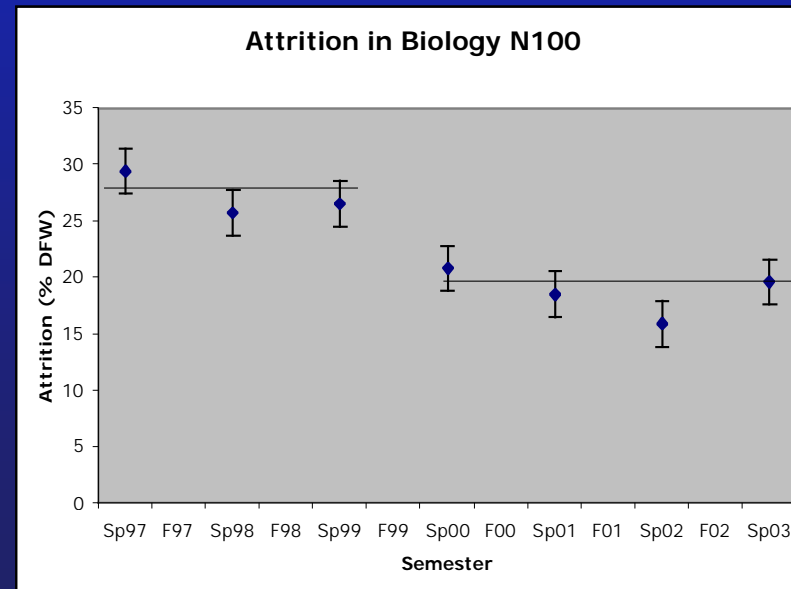
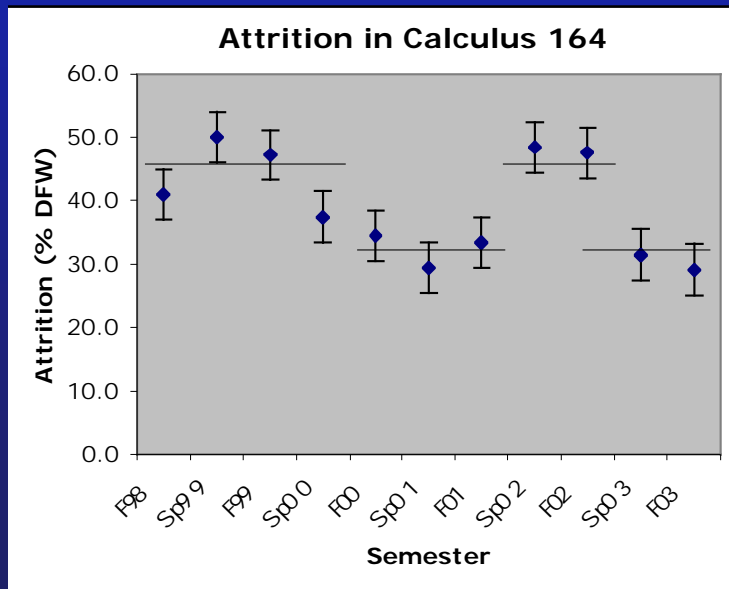
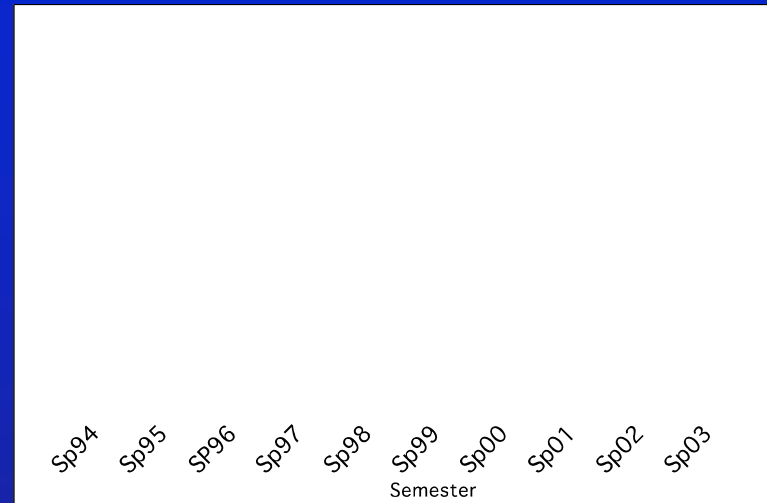
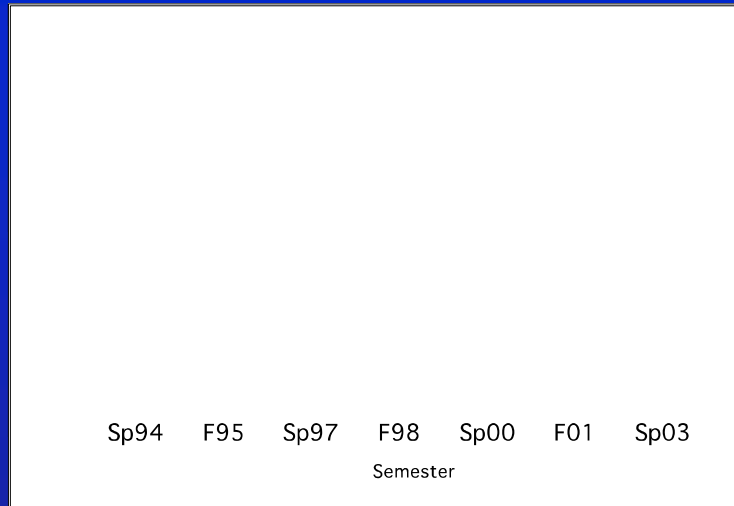
Q1 Do the WarmUps help you stay caught up?

Q2 Do you “Cram” before tests in this course?

Q3 Do you “Cram” in your other courses?

	1- Yes	2- Yes	3- Yes
“A” students	85%	14%	43%
“B” students	89 %	39%	61%
“C” students	89%	47%	68%
“D” students	84%	68%	68%
“F” students	92%	58%	58%

Retention (N~80-150/semester)



Cognitive (biology, N~200)

Final exam questions tied to...	% Gain (Post%-pre%)	Average Normalized Gain
no interventions	%G = 15% (25%-10%)	$\langle g \rangle = 0.167$
additional homework problems	%G = 17% (35%-18%)	$\langle g \rangle = 0.207$
WarmUp or cooperative learning questions	%G = 45% (59%-14%)	$\langle g \rangle = 0.511$
WarmUp and cooperative learning questions	%G = 56% (68%-12%)	$\langle g \rangle = 0.636$

Affective (E&M, N~60)

1. Do you feel that the warm-up assignments helped your professor make good use of the classroom time?	Yes 47 87%	No 7 13%
2. Do other professors have better ways to determine how class time should be used?	Yes 14 26%	No 40 74%
3. Do you feel that the warm-up assignments helped your professor focus on important topics in class?	Yes 49 91%	No 7 13%
4. Do your other professors have effective methods for focusing on important topics in class?	Yes 33 61%	No 21 39%
5. Did the warm-up assignments help your professor get a good feel for what the students know?	Yes 42 81%	No 10 19%
6. Do your other professors have effective methods for getting a feel for what their students know?	Yes 20 38%	No 33 62%
7. Do you think the warm-up assignments help your professor get students involved during the lecture?	Yes 37 70%	No 16 30%
8. Do your other professors have effective methods for getting their students involved in lecture?	Yes 23 43%	No 31 57%

Student Comments

- “This was a fantastic course. It was the hardest course I’ve taken yet, but also the most fun.”
- I think the WarmUps are a good idea because they give students a chance to think about the material prior to lecture.
- “This course was very well structured. It was obvious that a lot of time was spent in preparation for it.”
- “152 & 251 have made me reach more than any courses I have taken.”
- Don’t tell anyone, but I think I will greatly miss my physics class.

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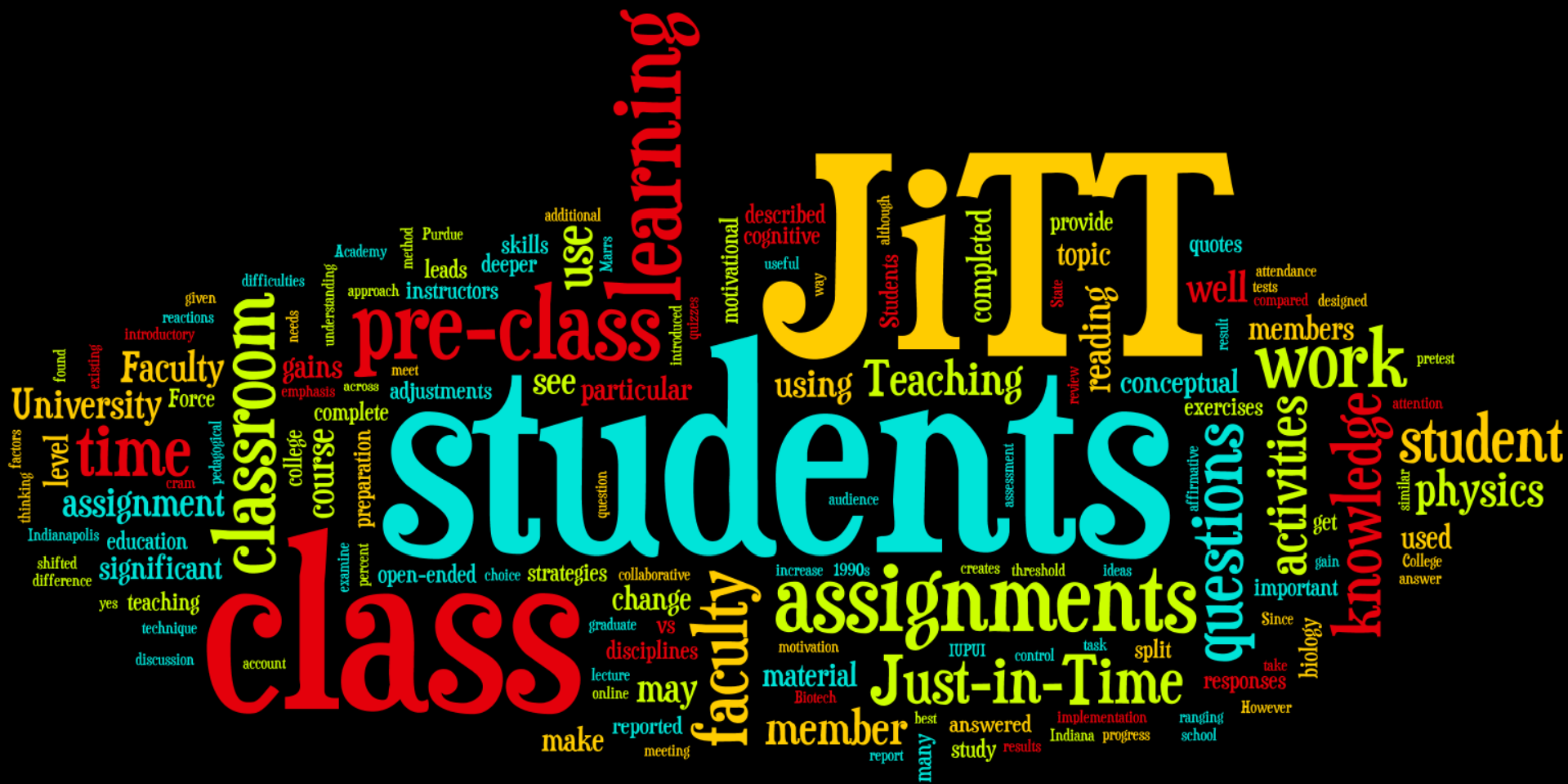
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Summary

- JiTT is based on feedback between homework and classroom
- WarmUp exercise: a pre-class, online reading quiz
- Improved study habits, retention, content knowledge, morale.
- Instructor knowledge of student difficulties
- Easily adopted and adapted

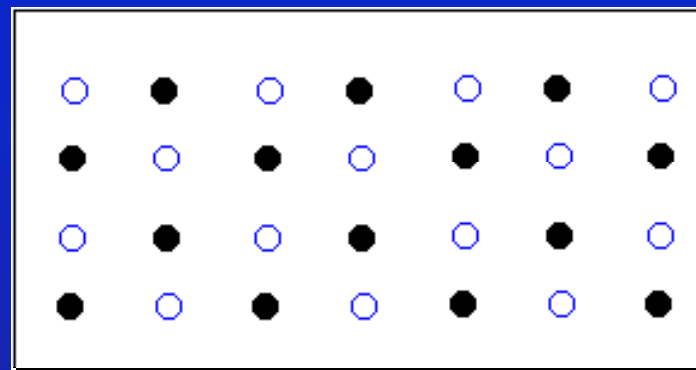
Getting started:

- **Use the handout to start developing a warmup exercise for the course you are most likely to teach next fall**
- **Additional copies will be available online**



Chemistry example

This picture depicts matter at the submicroscopic level. Describe what you see and take a guess as to what the identity of the substance is.



- “The particles are well spaced out so I would guess the substance to be a gas. The substance is a gas composed of 2 elements that are in an equal ratio.”
- “After reading Chapter 1 in the book I would guess that the substance is water in the form of a solid because the atoms are in order. However, I could be wrong because I think the atoms in a solid might be closer together.”