How to get your Students to Prepare for Every Class

Just-in-Time Teaching (JiTT)

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http://webphysics.iupui.edu/nfw_summer15/index.html

A few of your comments

- Jeremy: Practical examples of how to deal with 150-ish students in this manner would be appreciated.
- SuperNerd: I would like to see some concrete examples …
- Data: It would be interesting to have some practical information about how to formulate good warmup exercises, and also how to use them during lectures
- Christine: I'd like to see a variety of concrete examples of pre-class assignments...

Outline

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

How did you decide how to teach?

- Steve: I try to replicate and improve the practices of the teachers who I thought taught me the most/best.
- Baba: Mostly based on how my favorite professors taught me when I was a student…
- Igua: Based on what worked well for me when I was a student.
- Zoe: The two primary ways I have decided how to teach are by: (1) following the examples of role models and (2) trial and error.

Danger of using "own experience"

- Classes designed for professors or "pre-professors"
- Problem: 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
- See R. Felder references on web site

How Else?

- K.S. I model my classes after my own favorite teachers in college and grad school… To a lesser extent I have applied information learned in the handful of education classes…
- Jeremy: Workshops, talking to colleagues, reading education literature, intuition based on my own experiences, trial and error.

Digression

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

One solution: Active learning

- Proven effective for "regular" students and excellent ones
- Used extensively at MIT, RPI, Harvard, Univ. of Illinois, other research universities
- Also many small colleges (prestigious and not), community colleges, K-12 schools…
- Close to "apprenticeship" or relationship between PhD student and advisor

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The (original) settings

- IUPUI: Public, urban university
  - 30,000 students, almost 100% live off campus
  - Most work > 25 hours/week
- United States Air Force Academy: Military
  - All students take physics, even history majors
  - All play sports, train for military
- Davidson College: Liberal arts college
  - Highly selective
  - Small classes

What is JiTT?

- Nathaniel : JiTT is the process of assessing students' knowledge of a topic prior to class so that class time can most efficiently…
- Stella: JITT is assigning work to be done before class, where the instructor can see student responses and adapt their own teaching to address problem concepts or reduce coverage of "easier" material in class.

What is JiTT?

- Mike D: JiTT is both a way to get the students thinking about the material before class and also a way for the instructor to get feedback on how well students understand the material before choosing which topics to emphasize.
- Parashu: …This strategy aims to develop interest in the subject matter to be taught which will finally lead to higher percentage of student attendance, retention and good grade.

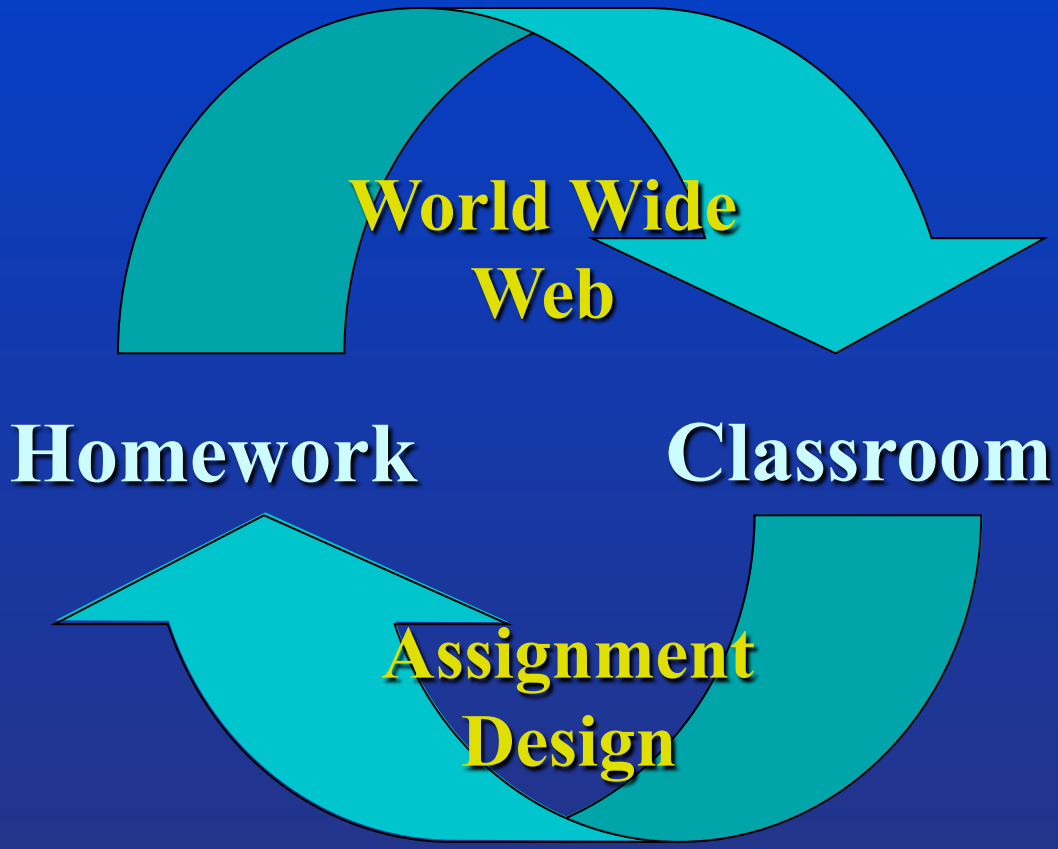
What is JiTT?

- YaYa: ….could also trigger a good interaction and conversation in the classroom while discussing different responses.
- Nathan: The instructor then uses these questions to inform class discussion, assess the level of student understanding, and increasing buy-in by the students by starting an interaction with them through directly quoting student answers in class.

What is important about JiTT?

a. assessing students' knowledge
b. adapt their own teaching
c. get the students thinking about the material
d. develop interest in the subject matter
e. higher percentage of student attendance
f. interaction and conversation in the classroom
g. directly quoting student answers

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
- “preview” of important concepts
- Jargon already familiar (JiTT, Warmup)
- Big idea (connect class to HW) already present

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.…"
  - "If you add heat to a system while the system is doing the corresponding amount of work, the temperature will not change."
  - "It is possible to add heat to an ideal gas without it changing it's 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…"

What makes a good Warmup?

- Adam: The student should be forced to examine their present understanding, and potentially address conceptual change. The assignment should provide them with a high motivation for understanding the material.
- Bill Bobaggins: A good warmup exercise is to ask a conceptual question about the material for the next class such as explain in words what Newton's third law says.

What makes a good WarmUp?

- Nick: A good warmup exercise is thought provoking, open-ended and sometimes ambiguous. I would add that the exercises should indicate a direction for class activities that make class time more student centered and optimize class time engagement.

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)
- Modern Physics, Quantum Mechanics
- Intermediate E&M (2 semester sequence)
- Mathematical Methods
- Optics, Intro Astronomy
- Needed: Condensed matter, other specialties…

Choosing and using student responses

- Always say something positive (see last example)
  - 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?
  - This is correct, but the reasoning isn't quite right…
  - This has a great beginning, but more could be added…

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 – use throughout session
- Must be routine. Do not start/stop during semester
- Upper level students can handle more "exploratory" questions, connections to prerequisites
- Faculty cedes some control!

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 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.
- Earn trust—take time on the first day of class to explain what you are doing and why.
- Hold yourself and your students to high standards—if you work hard, they will too.

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- The Challenges ✓
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Study Habits (N=155, biology)

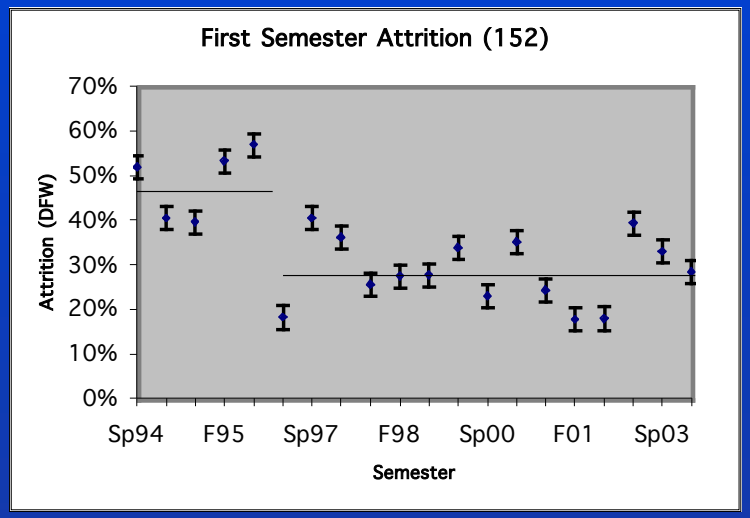
Q1 Do the WarmUps help you stay caught up?

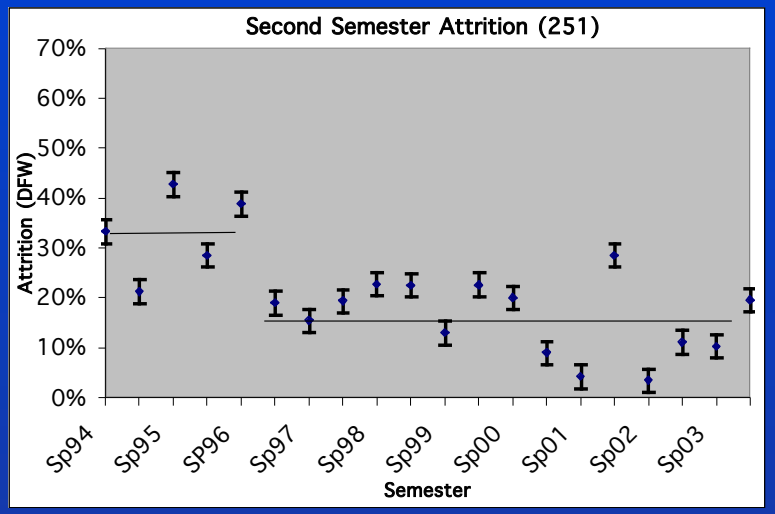
Q2 Do you "Cram" before tests in this course?

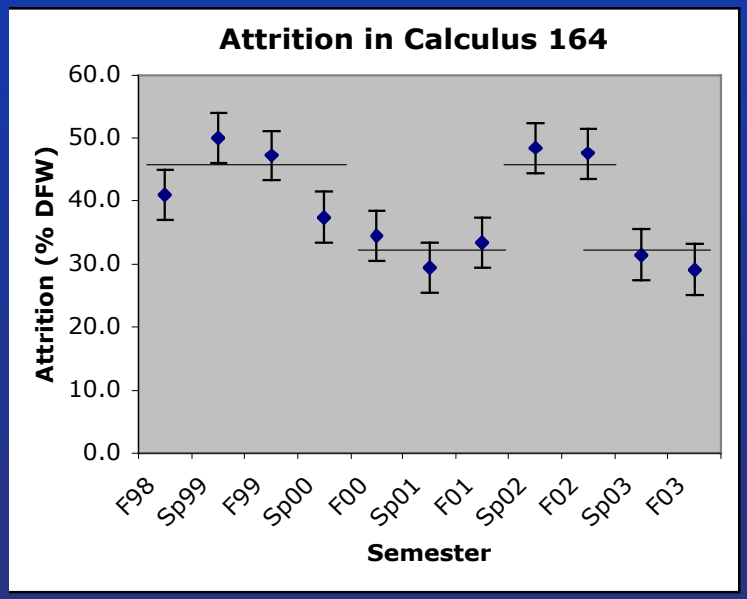
Q3 Do you "Cram" in your other courses?

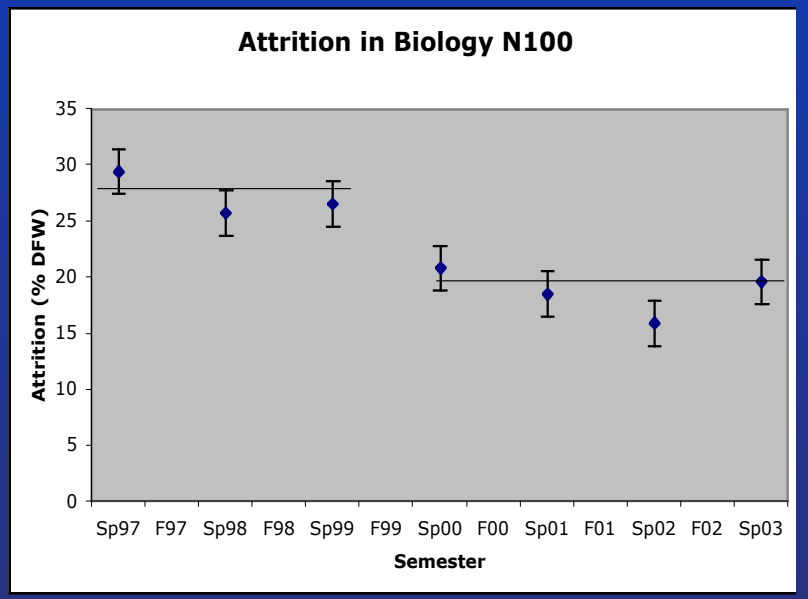
	1- Yes	2- Yes	3- Yes
"A" students	85%	14%	43%
"B" students	89 %	39%	61%
"C" students	89%	47%	68%
"D" students	84%	68%	68%
"F" students	92%	58%	58%

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%)	<g> = **0.16 7**
additional homework problems	%G = 17% (35%-18%)	<g> =**0.20 7**
WarmUp **or** cooperative learning questions	%G = 45% (59%-14%)	<g> = **0.51 1**
WarmUp **and** cooperative learning questions	%G = 56% (68%-12%)	<g> = **0.63 6**

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.

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

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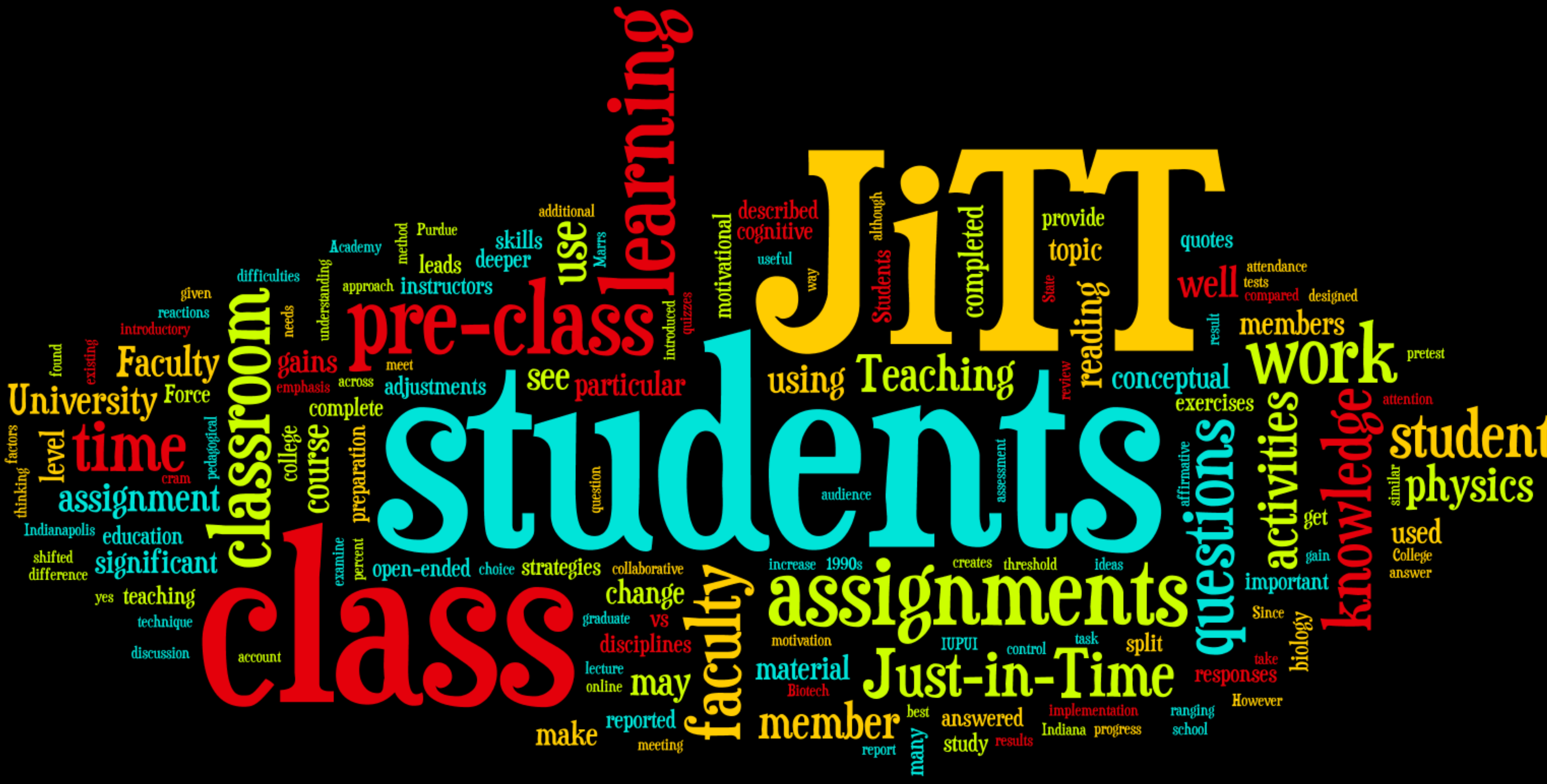
Getting started:

- **Write one question, to be part of one assignment, right now!**
- **Later, use the handout to start developing a warmup exercise for the course you are most likely to teach next fall.**


JiTT
students
class
learning
pre-class
assignments
Just-in-Time
faculty
questions
classroom
time
knowledge
work
activities
student
physics
additional
Purdue
Academy
method
skills
use
Marrs
leads
deeper
difficulties
approach
instructors
understanding
given
reactions
needs
introductory
quizzes
introduced
motivational
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cognitive
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provide
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State
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Teaching
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Since
biology
take
responses
However
make
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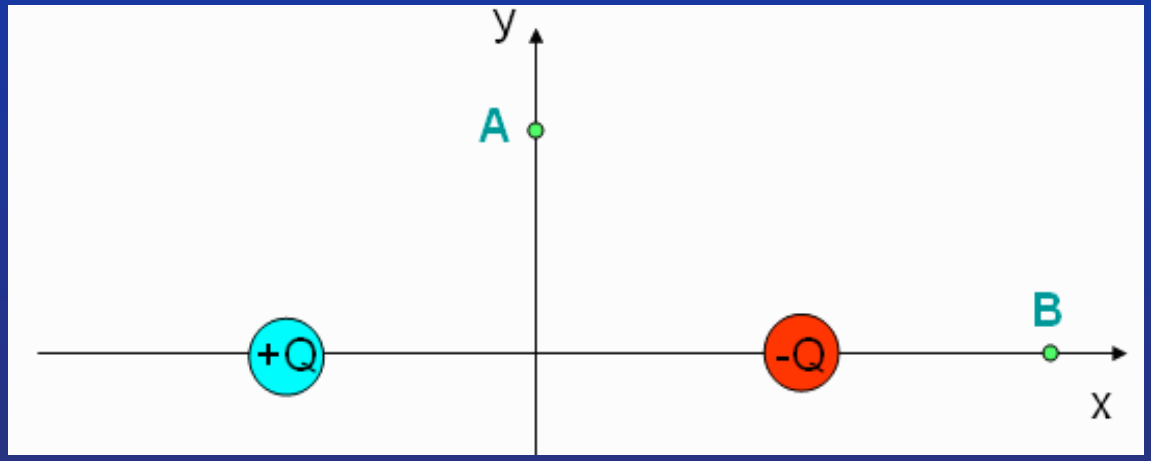
meeting
member
best
report
many
answered
study
results
implementation
Indiana
progress
ranging
school

smartPhysics checkpoint

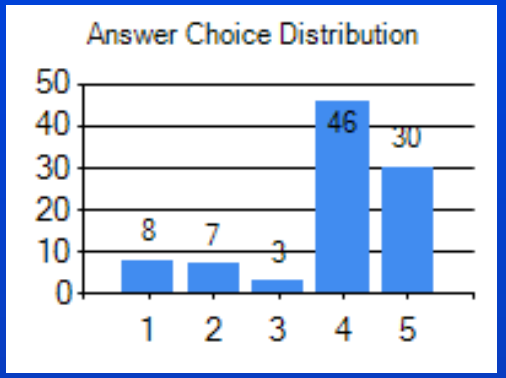
1. Two equal, but opposite charges are placed on the x axis. The positive charge is placed at to the left of the origin and the negative charge is placed to the right, as shown in the figure. What is the direction of the electric field at point A?

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

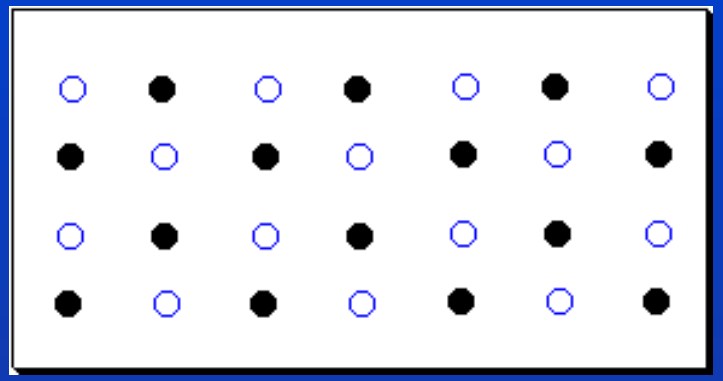
Ahmed (ahmed@imail.iu.edu)

1) 4

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

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."