

INTRODUCTORY SCIENCE LECTURES: A MISSED OPPORTUNITY

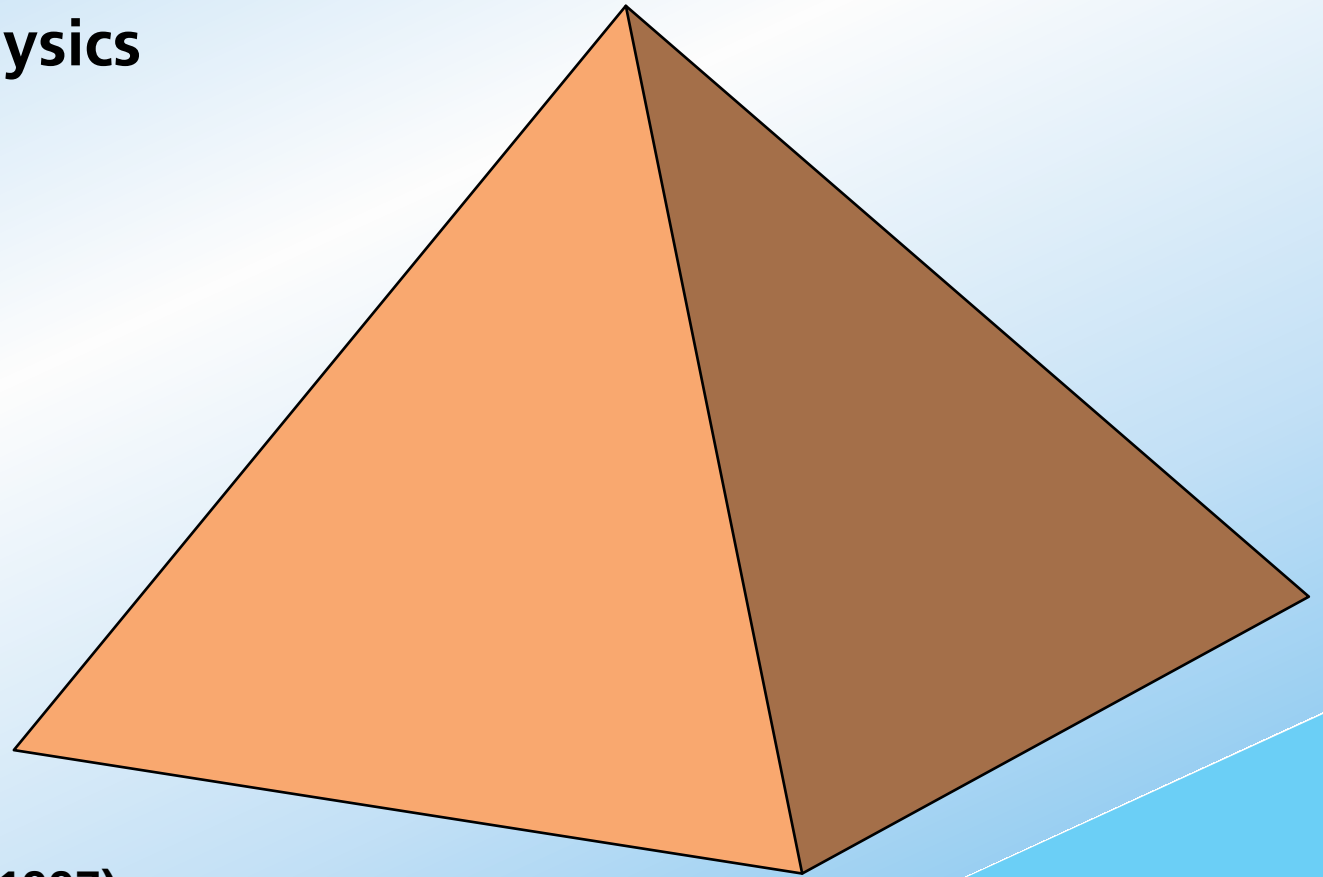
**Eric Mazur
Harvard University**

**Hechinger Institute on Education and the Media
New York, NY
25 September 1999**



We have a problem

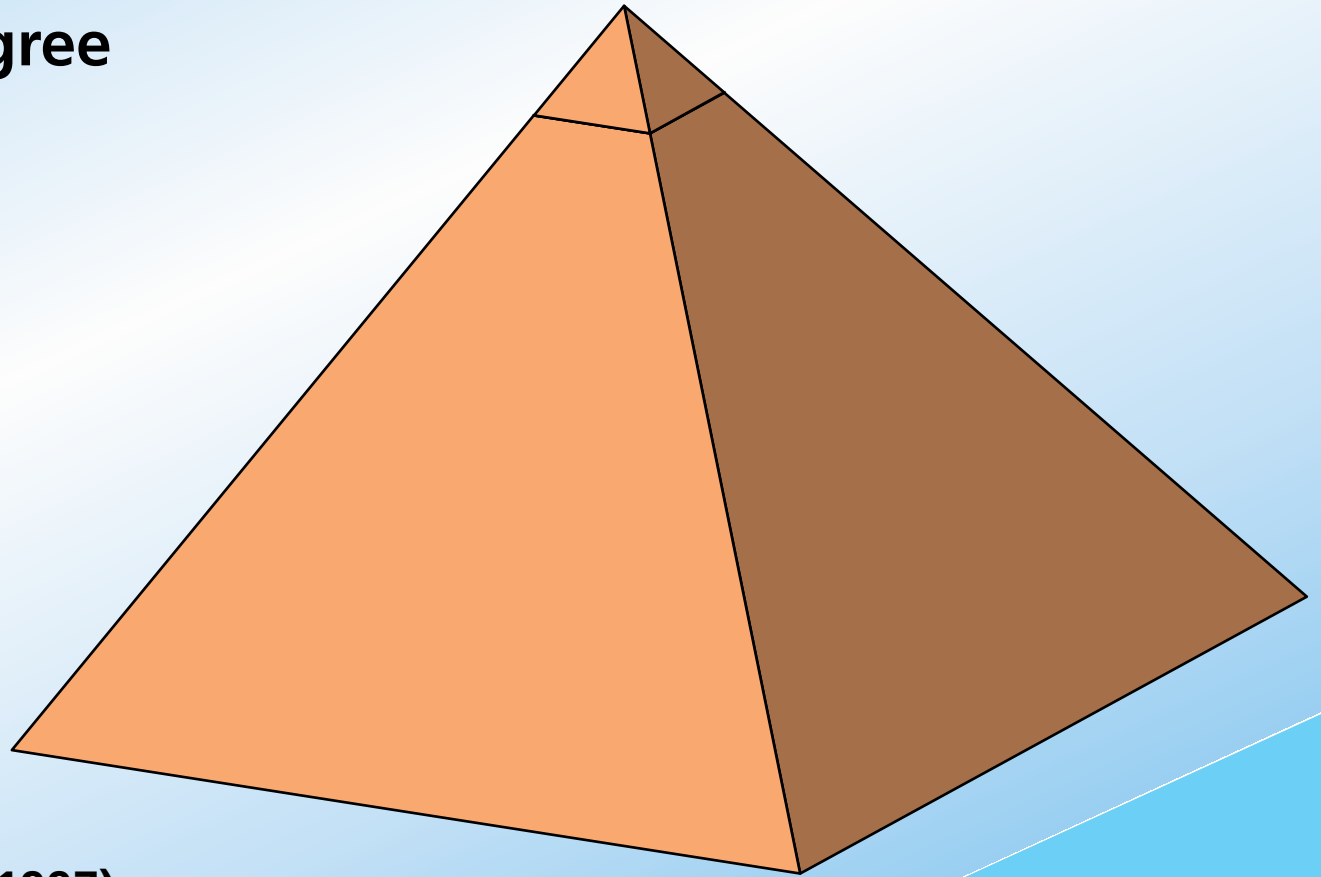
**380,000 students take
introductory physics
each year...**



AIP Report R-151.33 (1997)

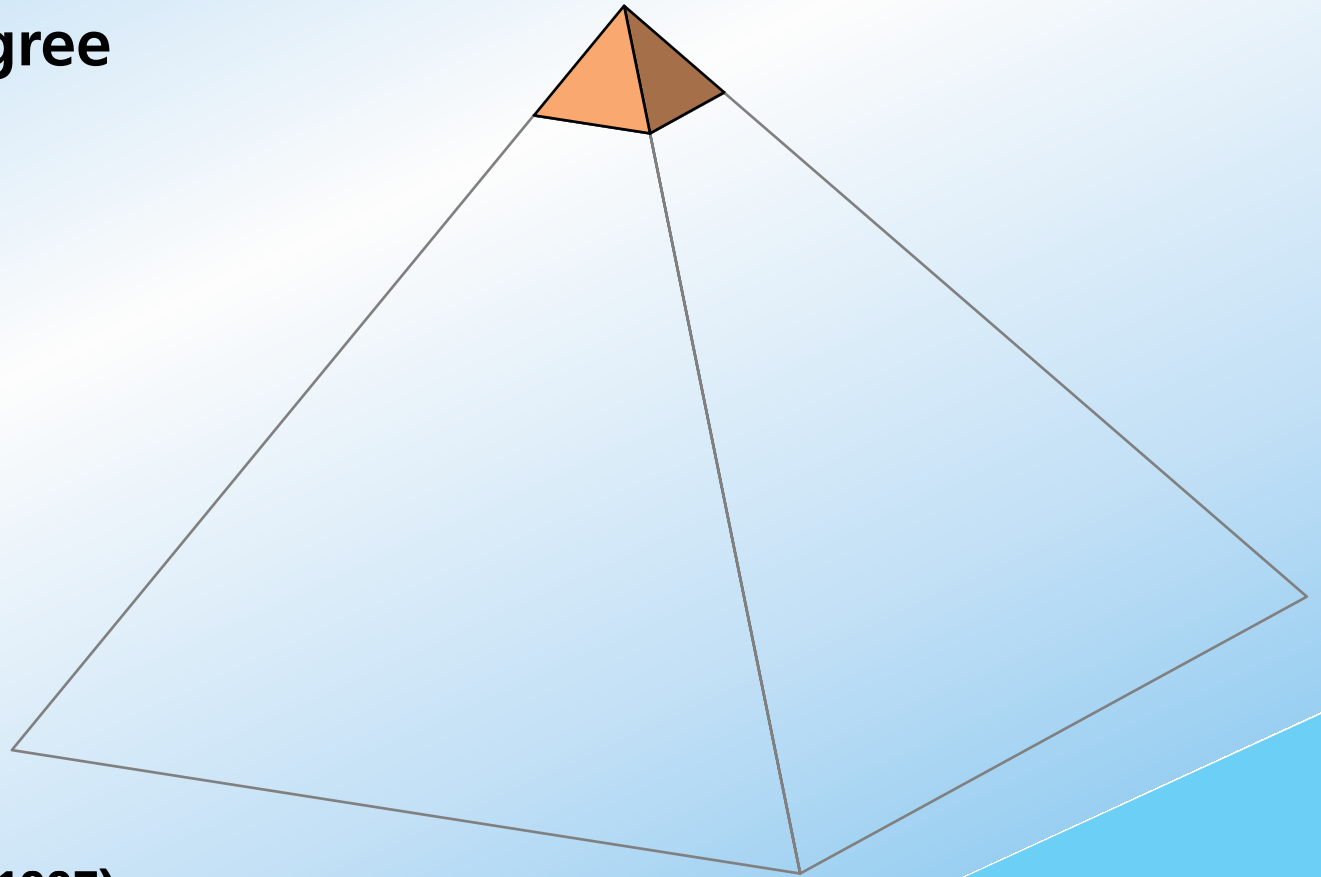
We have a problem

**about 1% of these get
a bachelor's degree
in physics**



We have a problem

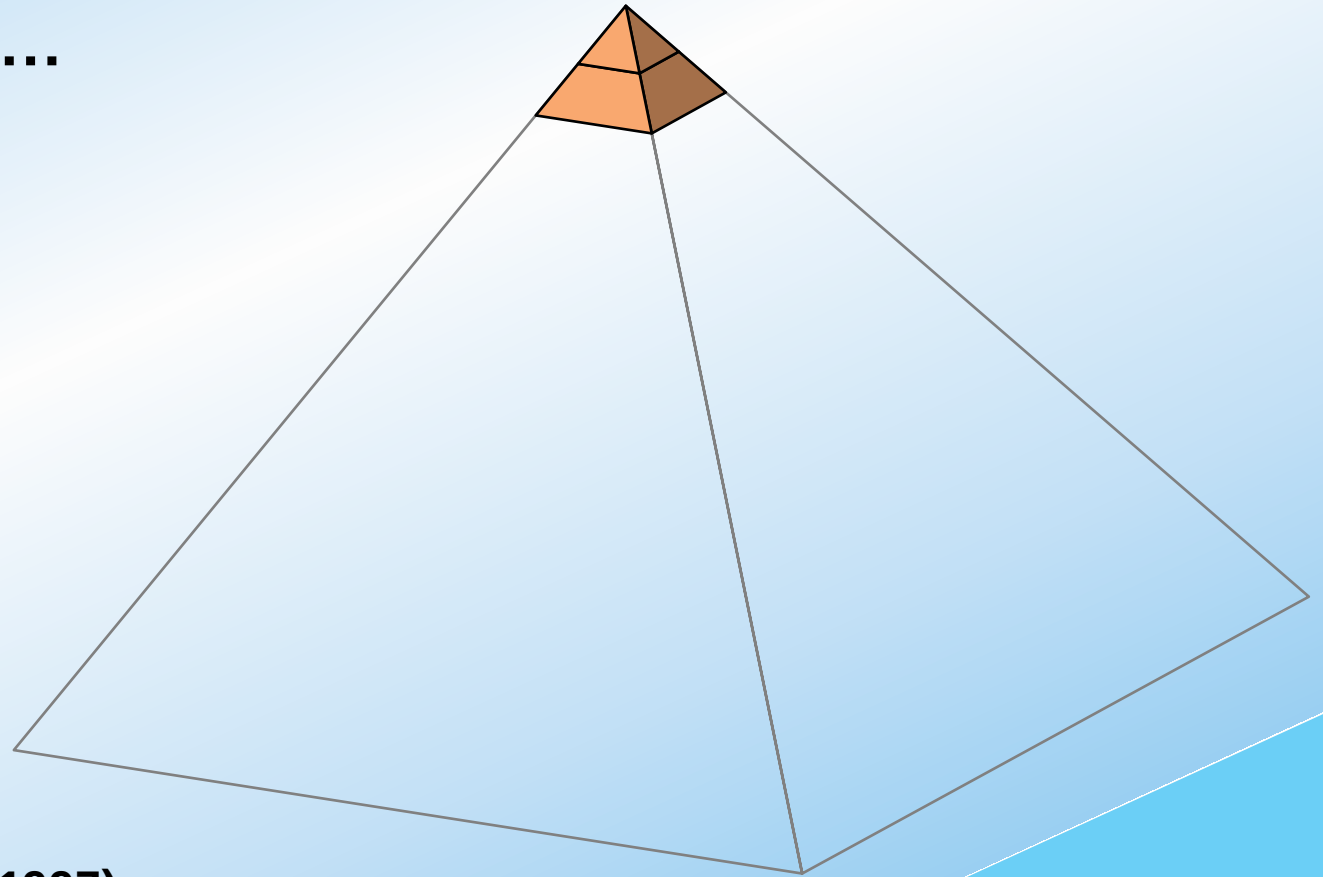
**Of the 4,300 students with
a bachelor's degree
in physics...**



AIP Report R-151.33 (1997)

We have a problem

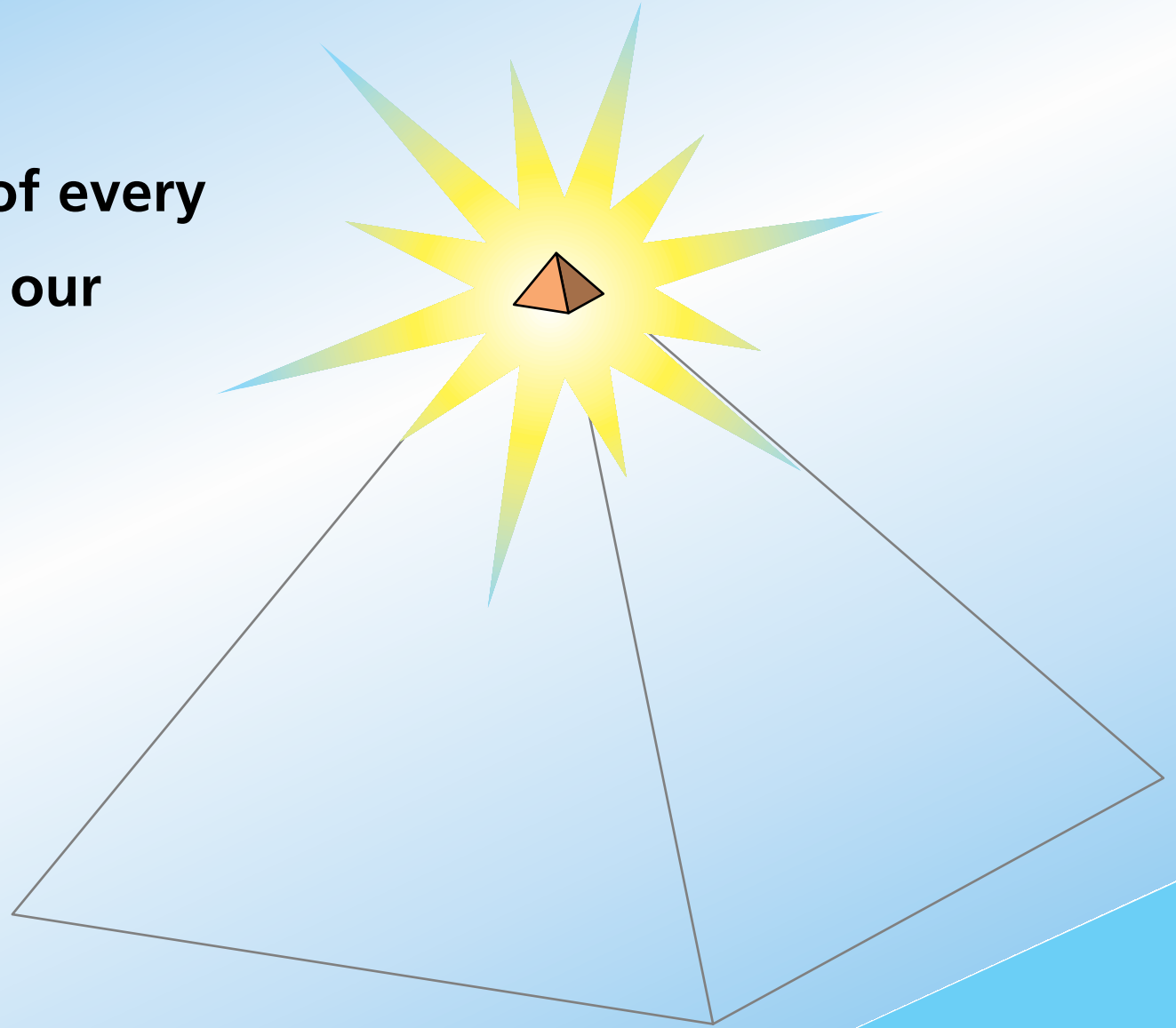
**about 35% go on to get a
Ph.D. in physics...**



AIP Report R-151.33 (1997)

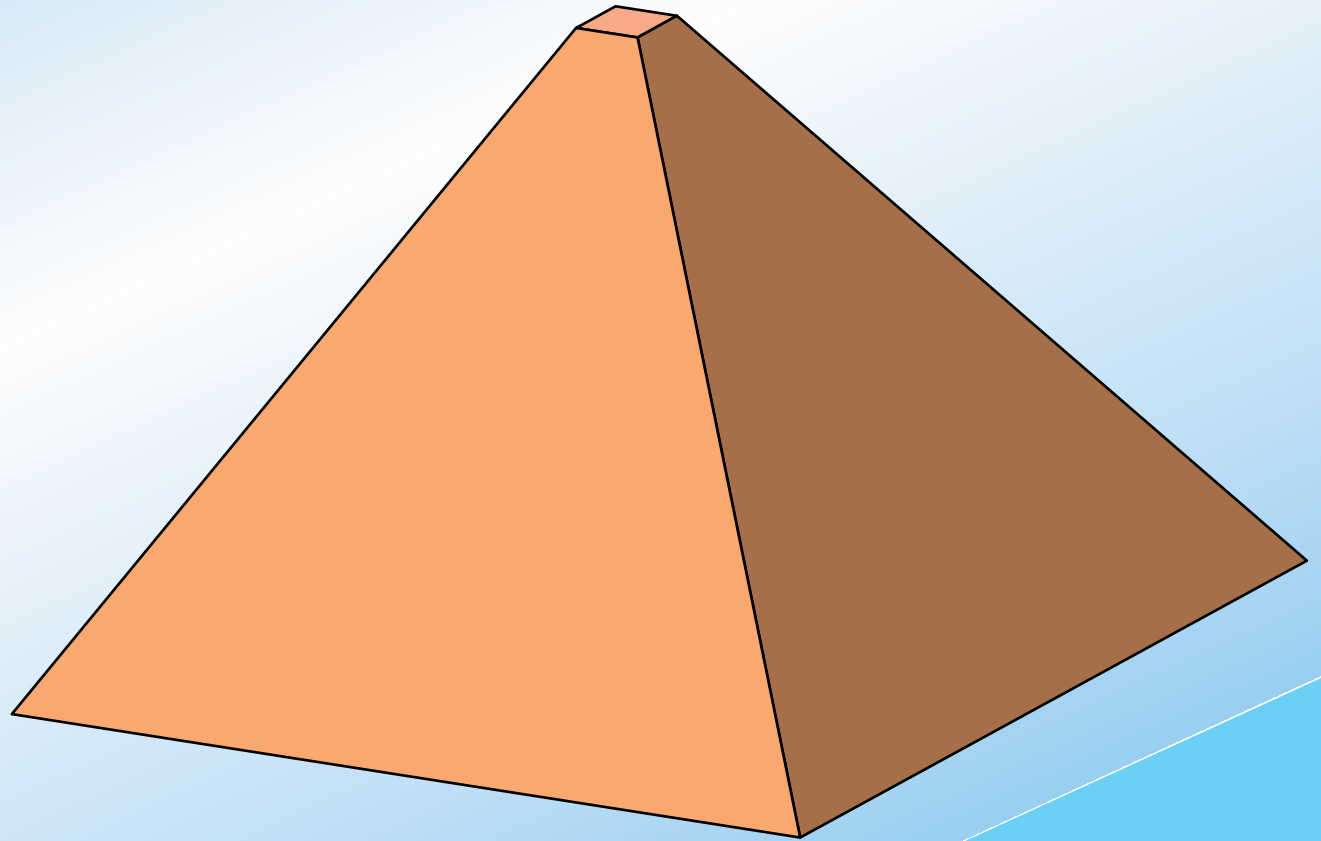
We have a problem

**That's one out of every
260 students in our
introductory
courses!**



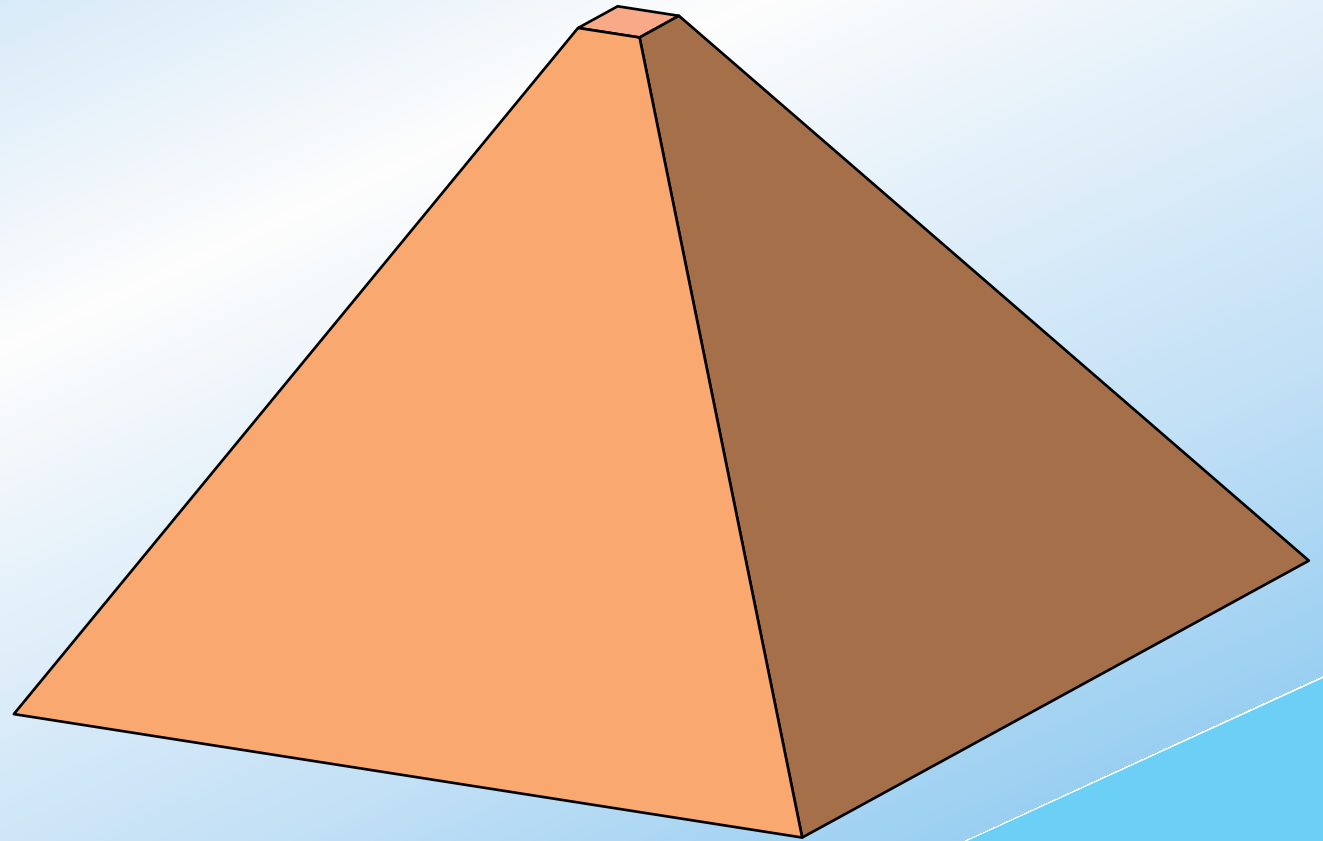
We have a problem

**What about the
other 259...?**



We have a problem

**What do we know
about these
students?**



We have a problem

Some disturbing symptoms:

- ▶ **frustration**
- ▶ **lack of understanding**
- ▶ **lack of basic knowledge**

We have a problem

They know the jargon:

- ▶ **circular motion**
- ▶ **barometric pressure**
- ▶ **light radius**
- ▶ **something to the power times ten to the something**

We have a problem

They are aware of their lack of knowledge

- ▶ **I graduated from college but I didn't study *astronomy***
- ▶ **It's been a while since I've had physics**

We have a problem

They are aware of their lack of knowledge

- ▶ **I graduated from college but I didn't study *astronomy***
- ▶ **It's been a while since I've had physics**

...and they don't care!

We have a problem



We have a problem



**Math suks (math suks),
Math suks (math suks)
I'd like to burn this text book
I hate that stuff so much
Math suks (math suks),
Math suks (math suks)**

Jimmy Buffett
*on **Beach House on the Moon***

We have a problem



I don't know and I don't care

**Another song by Jimmy Buffett
on *Beach House on the Moon***

We have a problem

Should we worry?

We have a problem

We'd better!

We have a problem

"I took four years of science and four years of math...

**A waste of my time,
a waste of the teacher's time,
and a waste of space...**

**You know,
I took *physics*.**

For *what?*"





Why do we have this problem?

Why do we have this problem?

- ▶ **Lectures focus on transfer of information...**

Why do we have this problem?

- ▶ **Lectures focus on transfer of information...**
(but education is more than information)

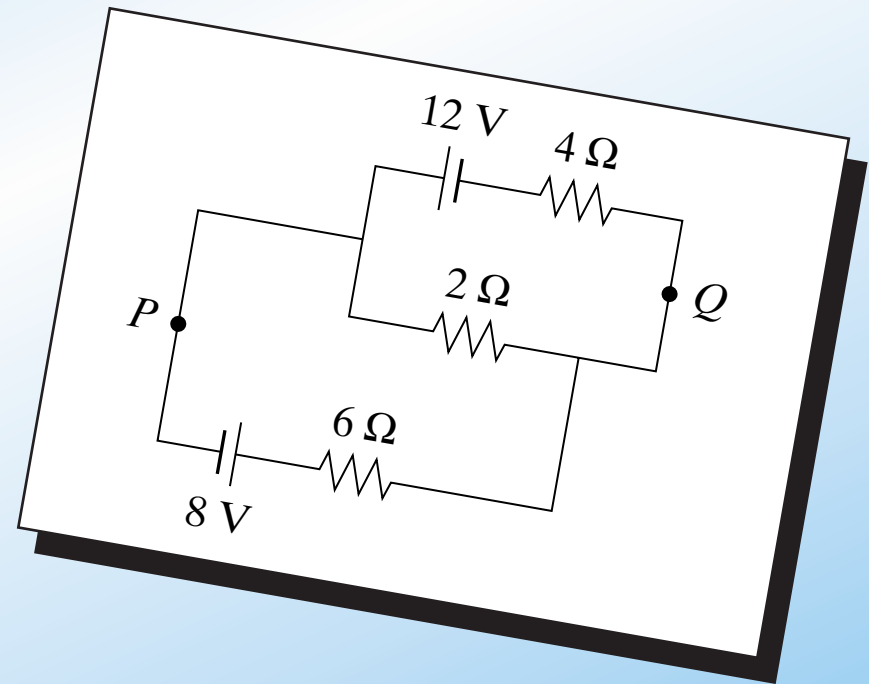
Why do we have this problem?

- ▶ **Lectures focus on transfer of information...**
(but education is more than information)

- ▶ **Conventional problems reinforce bad study habits**

Why do we have this problem?

Conventional problems reinforce bad study habits

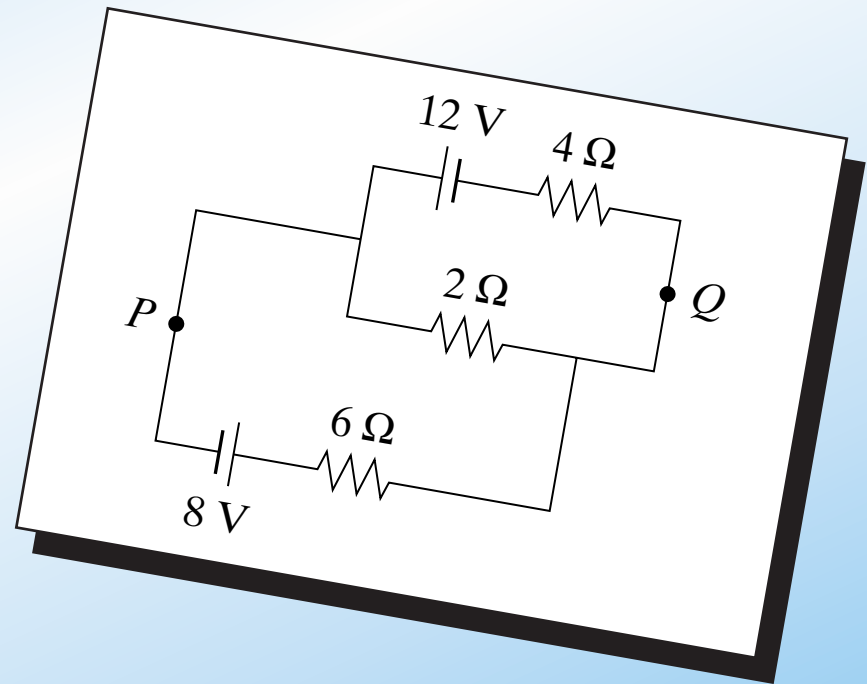


Why do we have this problem?

Conventional problems reinforce bad study habits

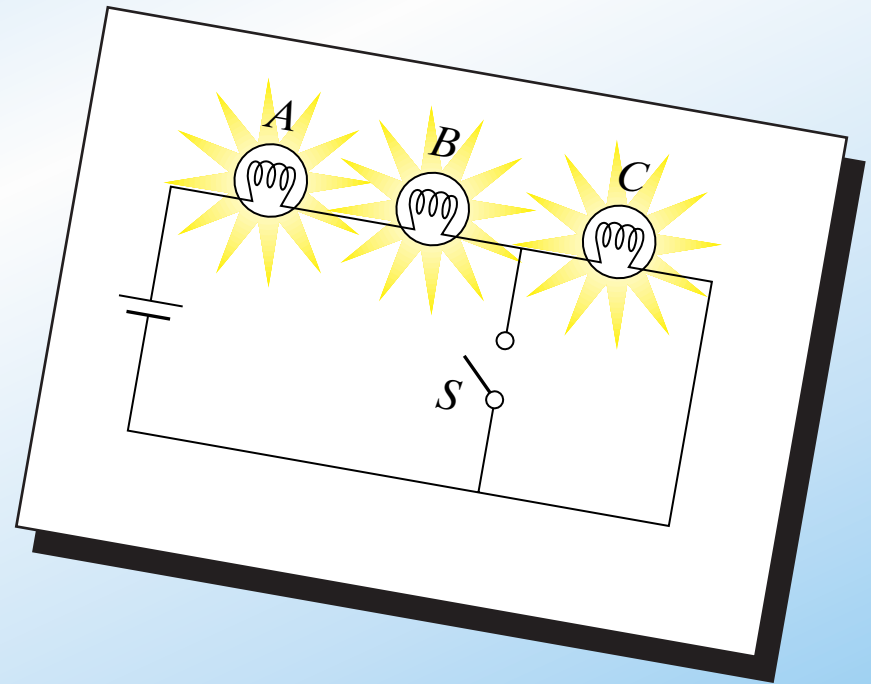
Calculate:

- (a) the current in the $2\text{-}\Omega$ resistor, and
- (b) the potential difference between points P and Q



Why do we have this problem?

Are basic principles understood?

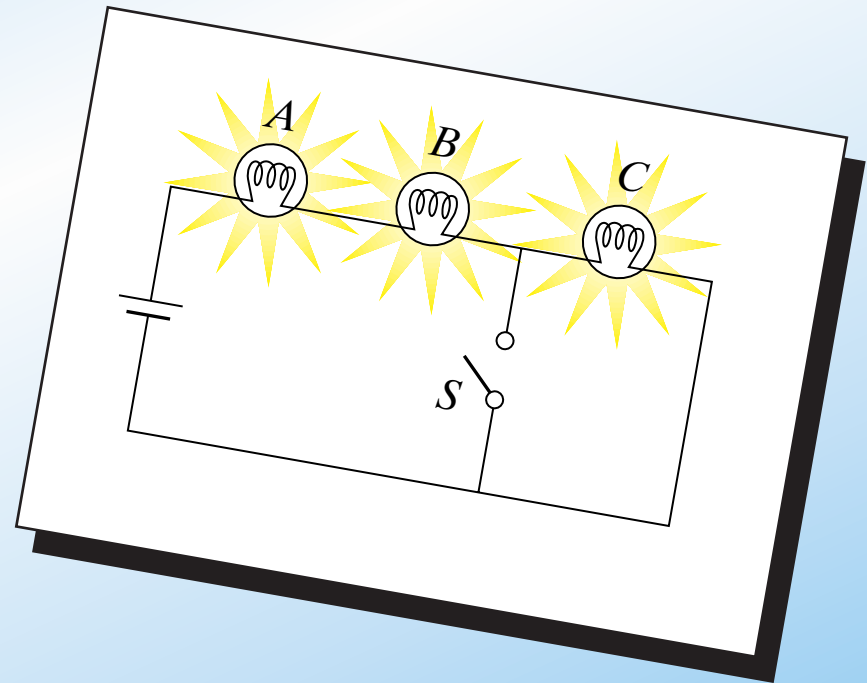


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Are basic principles understood?

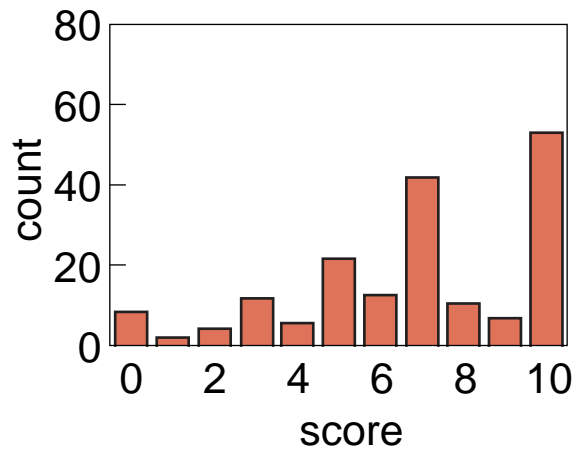
When S is closed, what happens to the:

- (a) intensities of A and B ?
- (b) intensity of C ?
- (c) current through battery?
- (d) voltage drop across A , B , and C ?
- (e) total power dissipated?

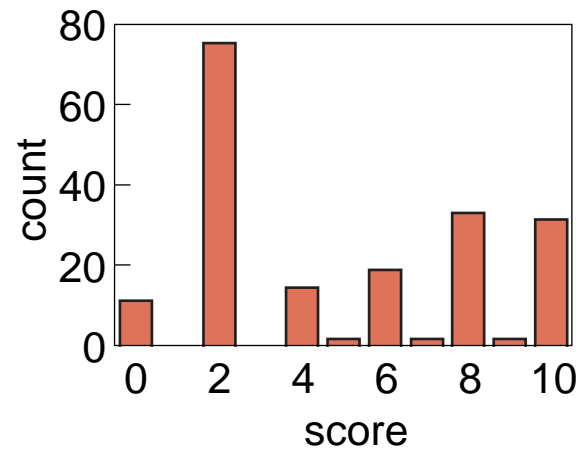


Why do we have this problem?

conventional

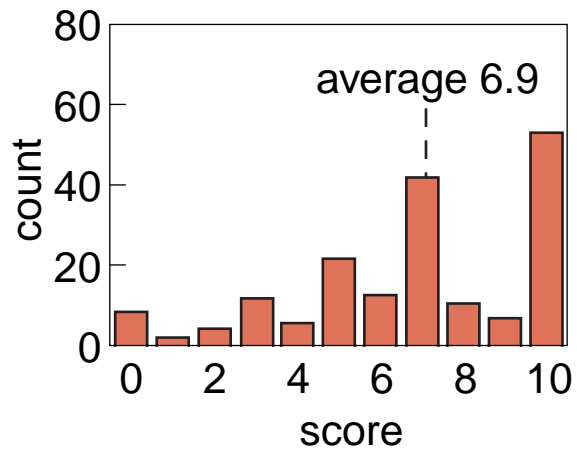


conceptual

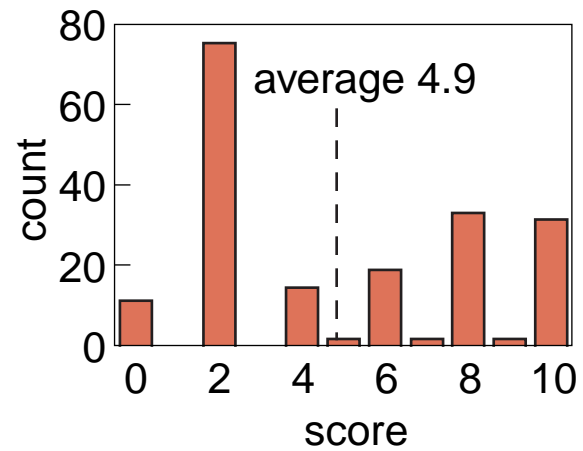


Why do we have this problem?

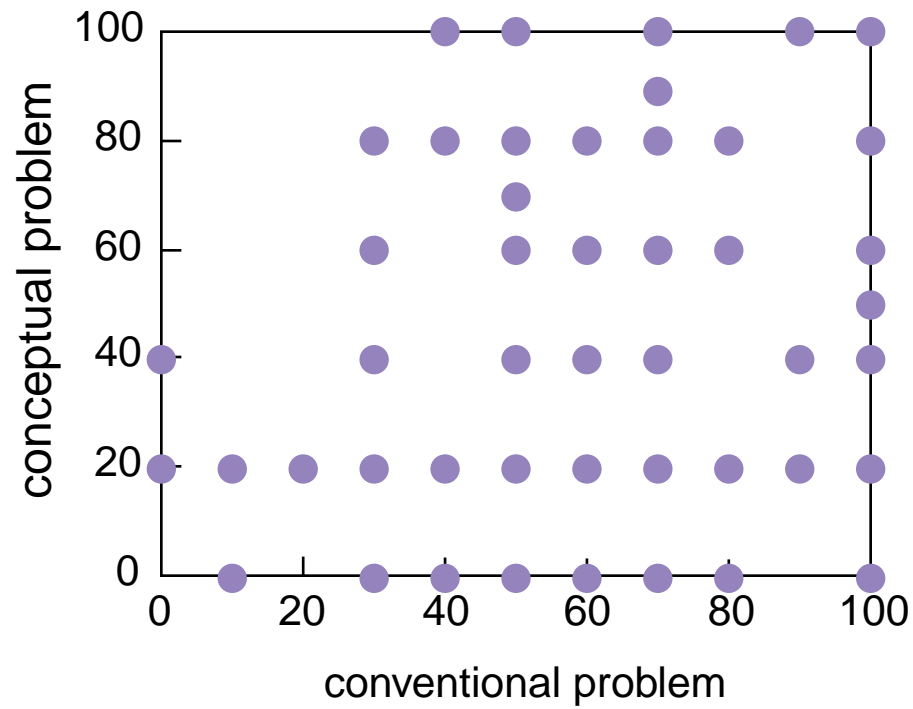
conventional



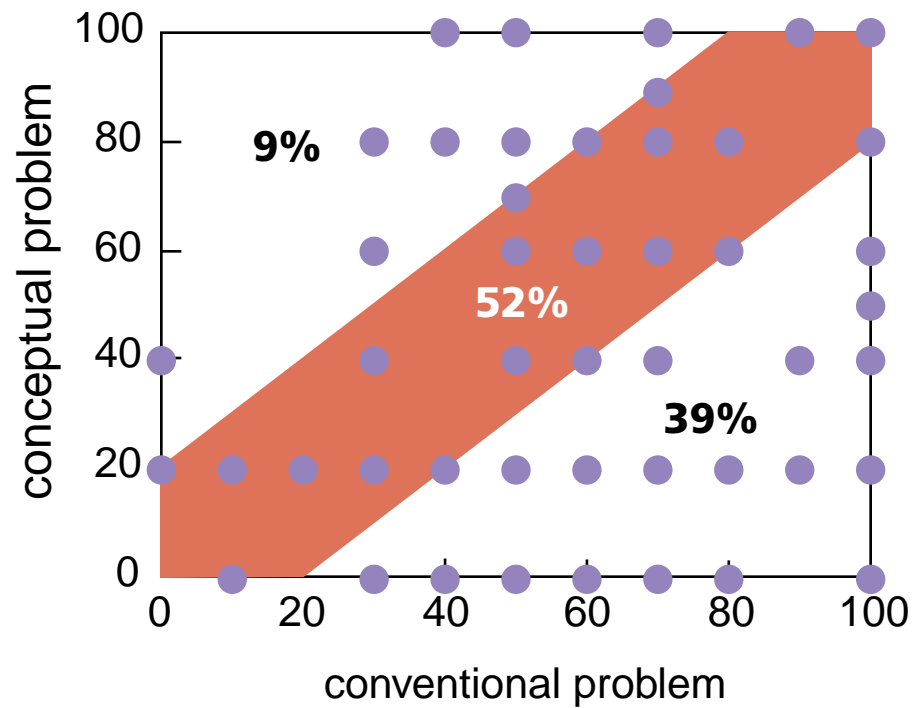
conceptual



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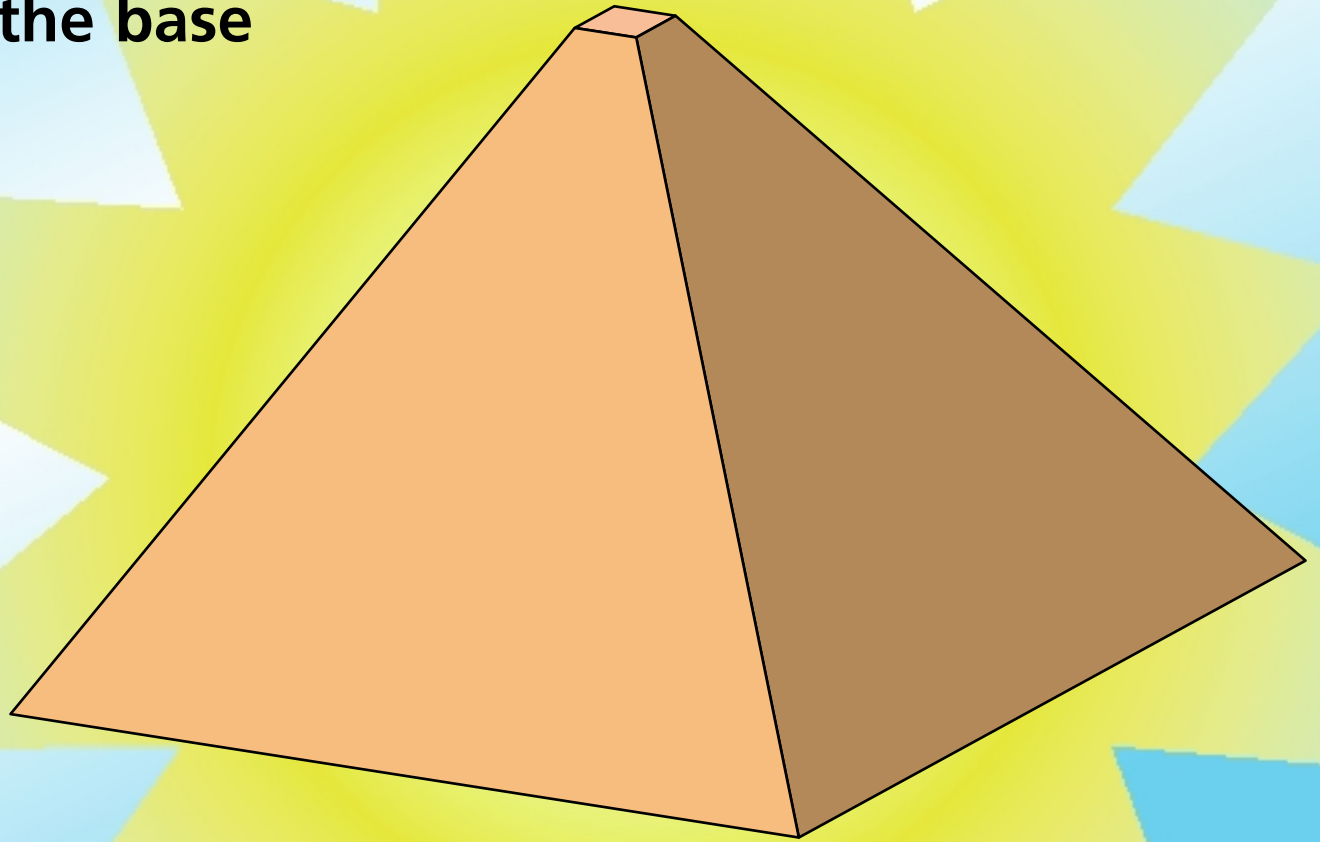


A wide-angle photograph of a large lecture hall. The room is filled with students seated at desks, facing a stage. On the stage, a lecturer is standing at a podium, and another person is visible further back. A large projection screen at the front of the room displays text and a diagram. The text on the screen includes the heading "What are the following..." followed by several bullet points. The room has a curved wall and a dark ceiling. The overall atmosphere is that of a formal academic setting.

So what should we do?

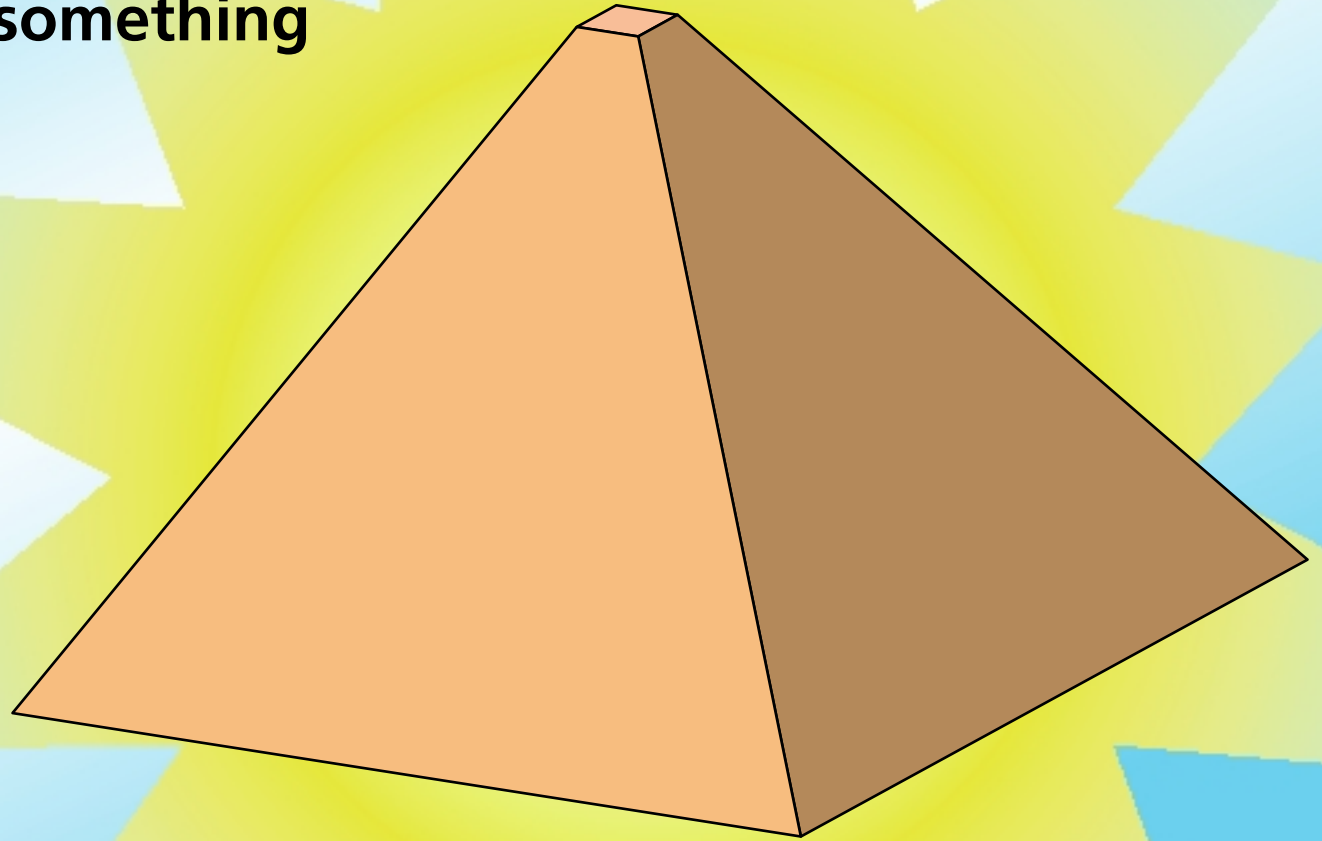
What should we do?

**Let's not forget the base
of the pyramid!**



What should we do?

**Let's give them something
of value!**



Peer Instruction

Help students take more responsibility for learning!

Peer Instruction

- ▶ **Move first exposure to the material out of the classroom...**

Peer Instruction

- ▶ **Move first exposure to the material out of the classroom: *assign reading!***

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- ▶ **by identifying **key ideas****

Peer Instruction

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- ▶ Use class to deepen and broaden understanding
- ▶ by identifying **key ideas**
- ▶ and giving students opportunities to **think**

Peer Instruction

Main features:

- ▶ **Pre-class reading**

Peer Instruction

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- ▶ **In class: depth, not coverage**

Peer Instruction

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- ▶ **Pre-class reading**
- ▶ **In class: depth, not coverage**
- ▶ **ConcepTests**

Results

- ▶ **focus on concepts leads to better understanding**

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- ▶ **less frustration, more satisfaction**

Results

- ▶ **focus on concepts leads to better understanding**
- ▶ **better understanding leads to better problem solving**
- ▶ **less frustration, more satisfaction**
- ▶ **no (hidden) gap between students' performance and instructor's expectation**

Some things to think about...

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Some things to think about...

- ▶ **what is taught is not necessarily learned**
- ▶ **“good” problem solving doesn’t always indicate understanding**
- ▶ **there are many ready-to-implement solutions**
- ▶ **we must act *now!***

Funding

National Science Foundation

**For a copy of this presentation and
additional information:**

<http://mazur-www.harvard.edu>