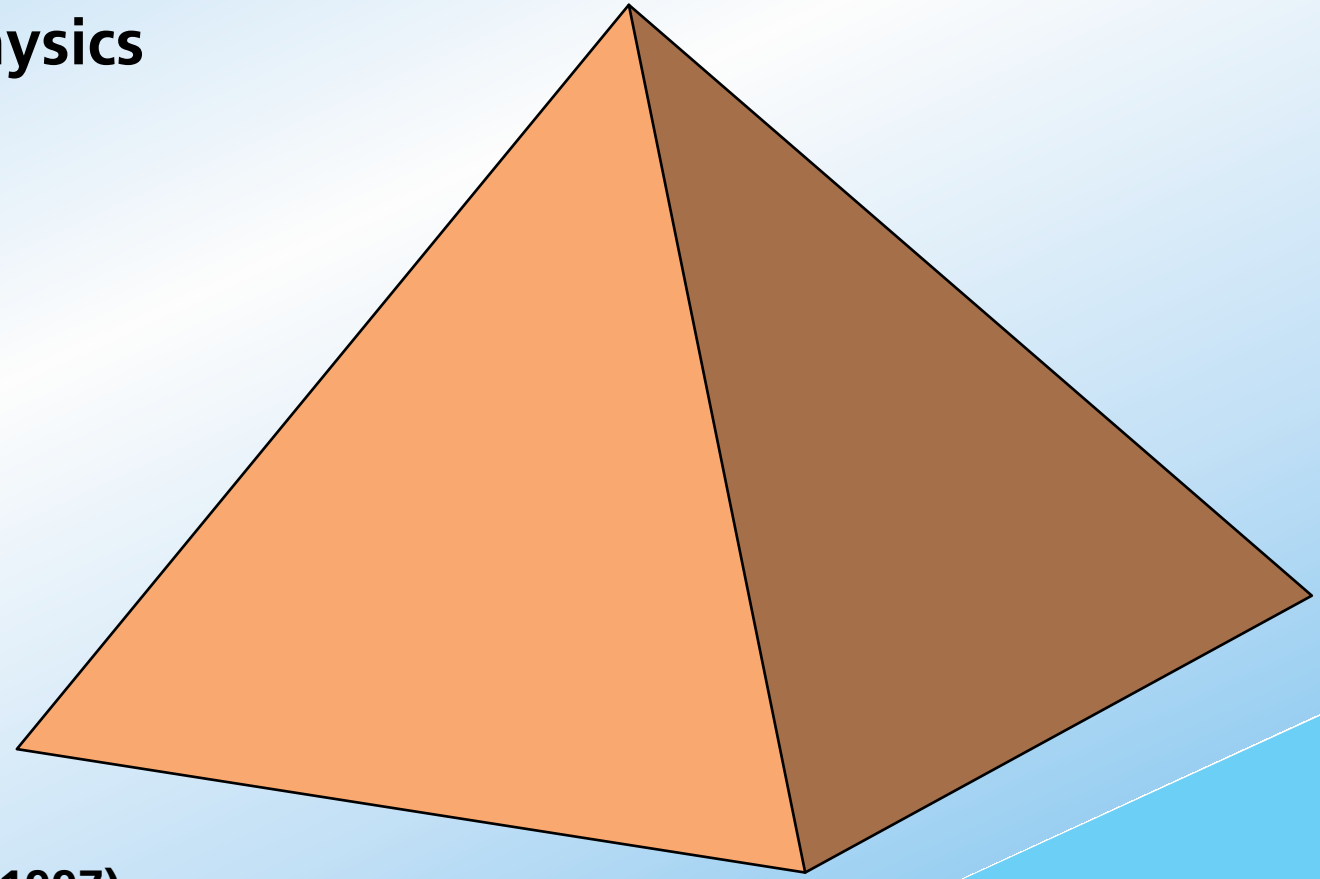
TEACHING: TRANSFERRING INFORMATION OR ENGAGING THE MIND?

Eric Mazur
Harvard University

Harvard School of Public Health
Boston, MA
3 February 2000

We have a problem

380,000 students take introductory physics each year…



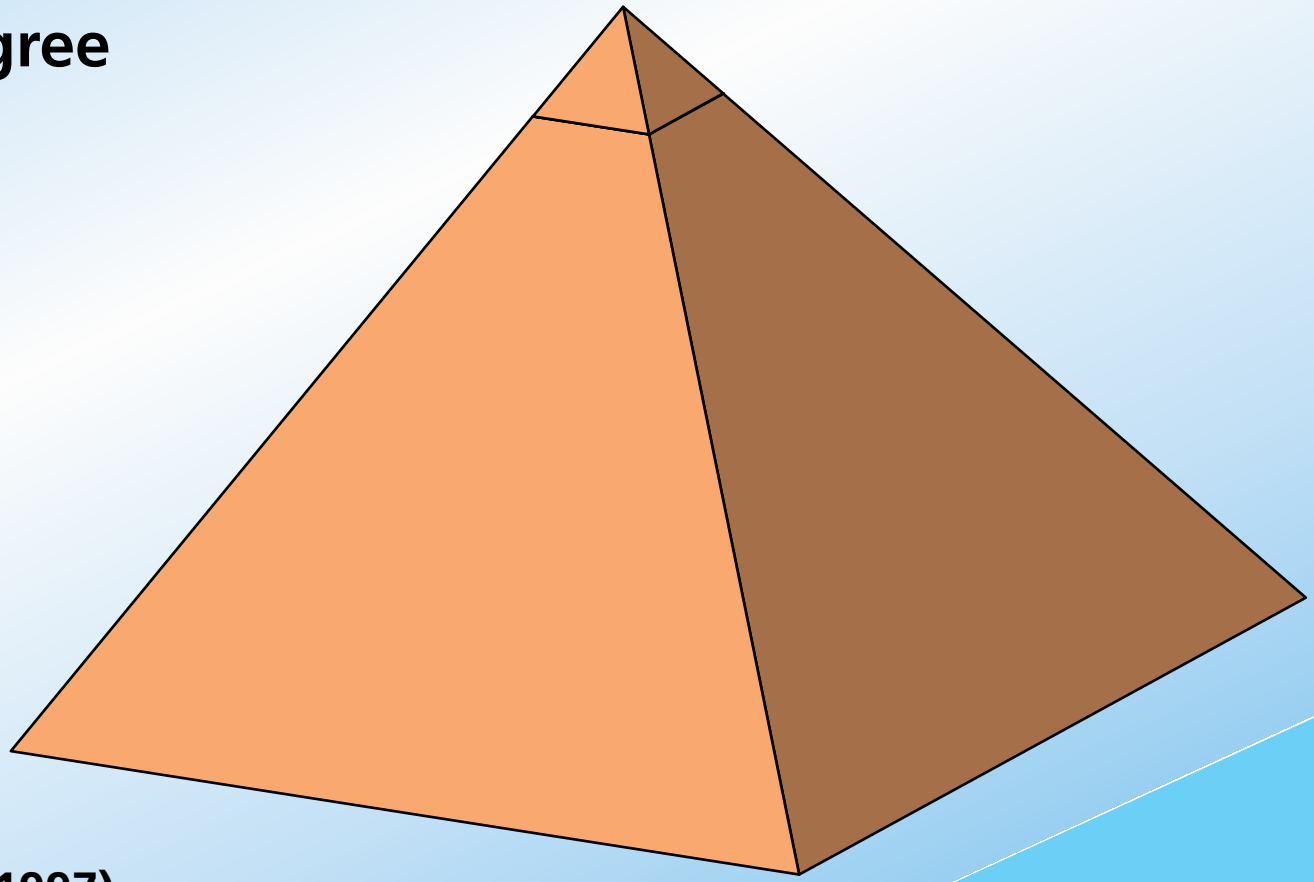
AIP Report R-151.33 **(1997)**

We have a problem

about 1% of these get

a bachelor's degree

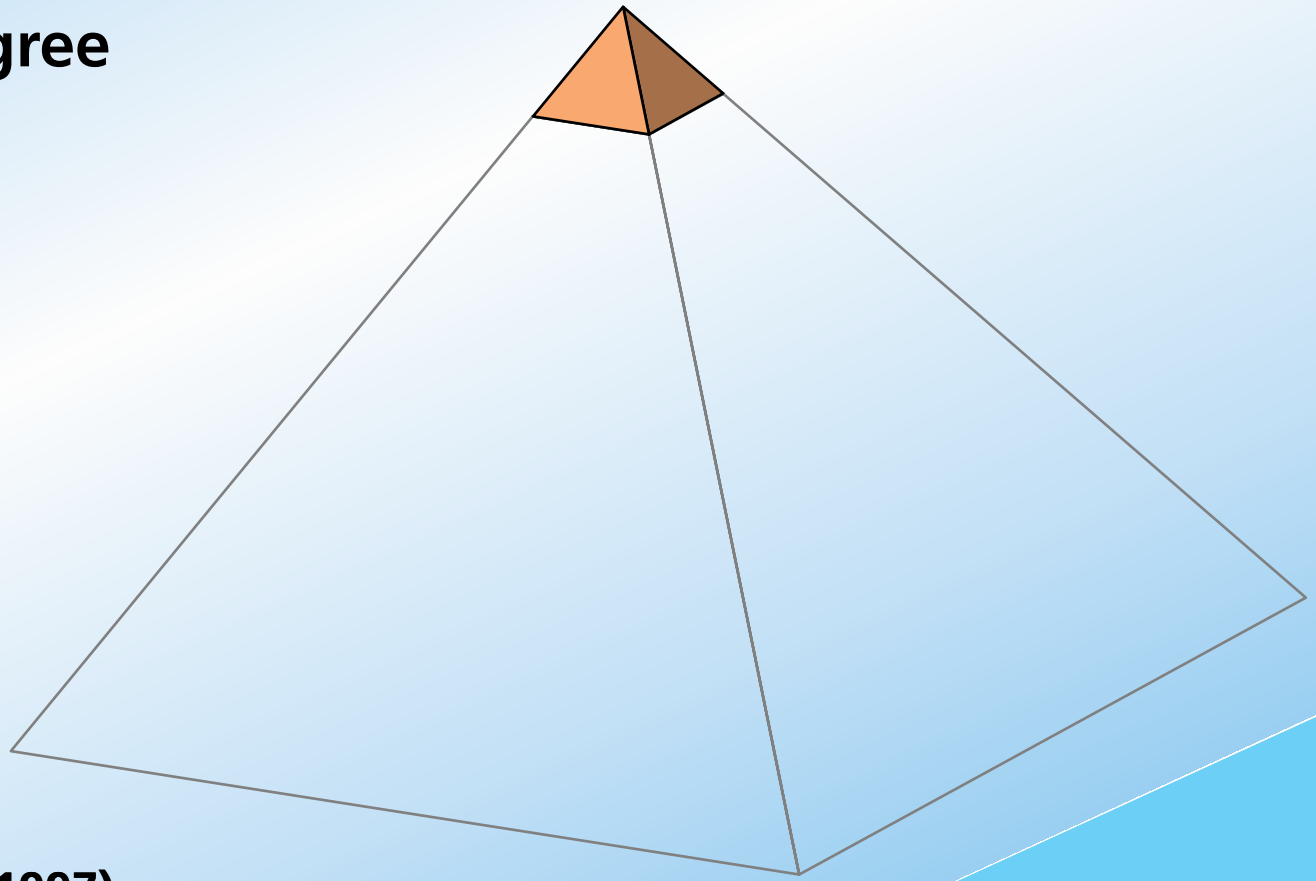
in physics



***AIP Report R-151.33* (1997)**

We have a problem

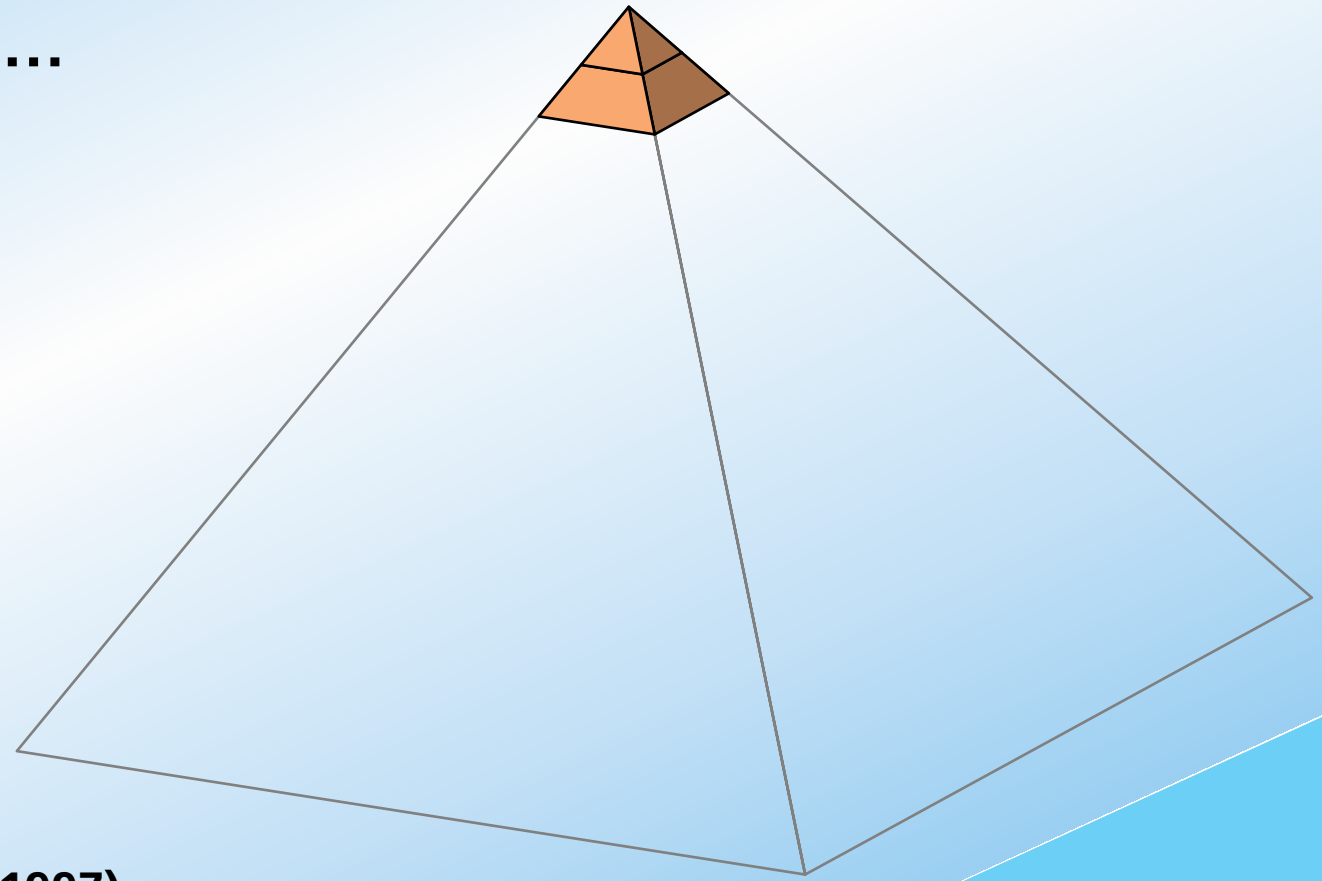
Of the 4,300 students with a bachelor's degree in physics…



***AIP Report R-151.33* (1997)**

We have a problem

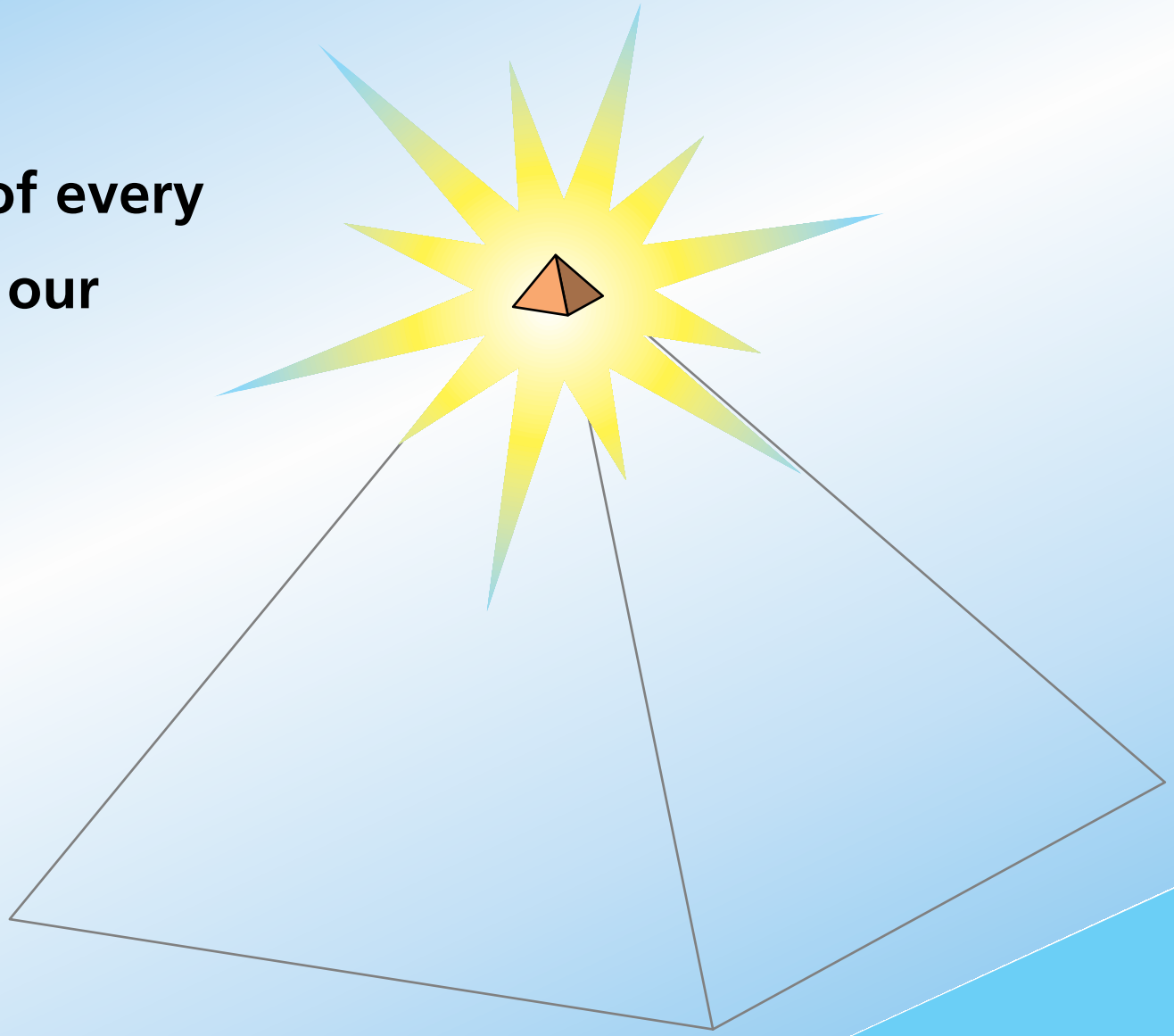
about 35% go on to get a Ph.D. in physics…



***AIP Report R-151.33* (1997)**

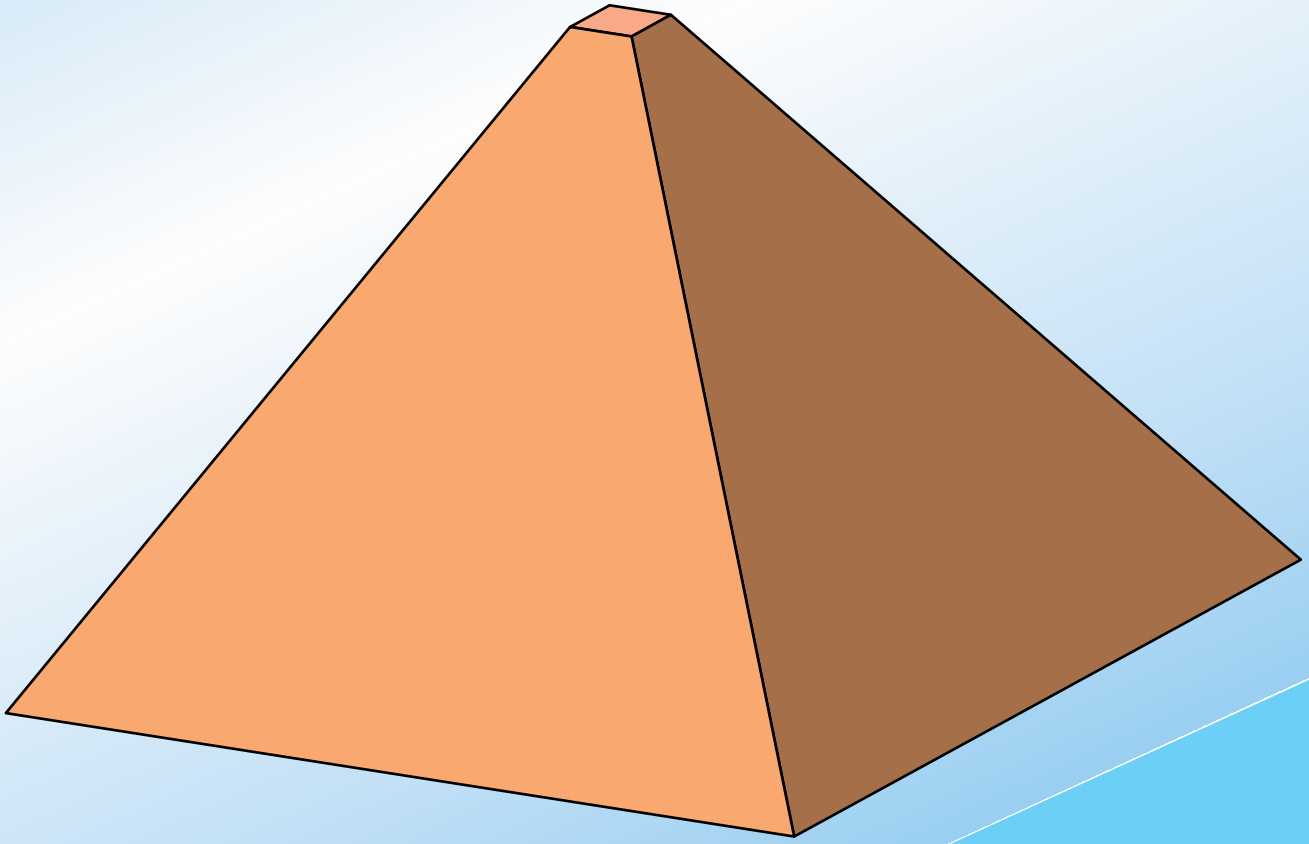
We have a problem

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



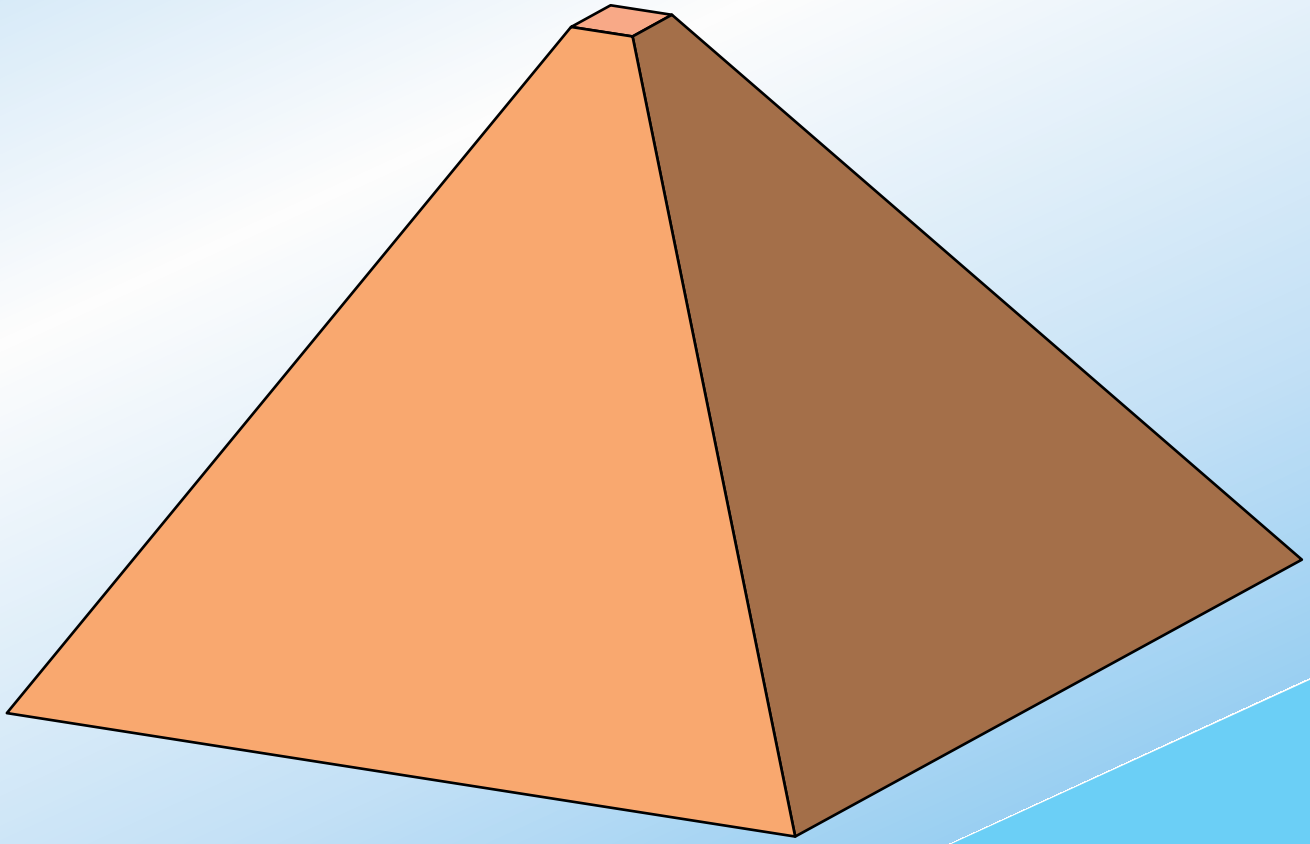
We have a problem

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?

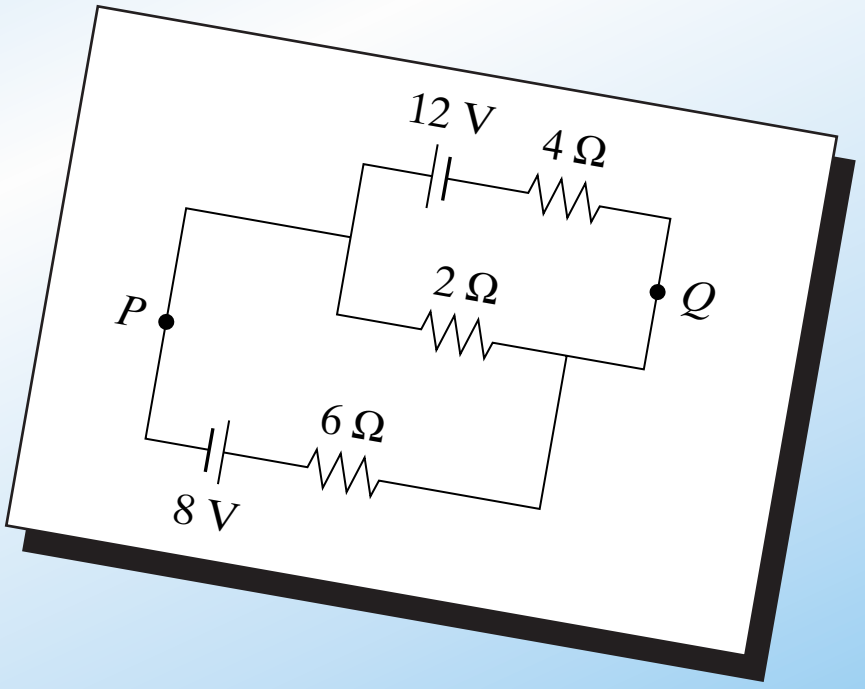
- **Lectures focus on transfer of information…**

  (but education is more than information)

- **Conventional problems reinforce bad study habits**

Why do we have this problem?

Conventional problems reinforce bad study habits



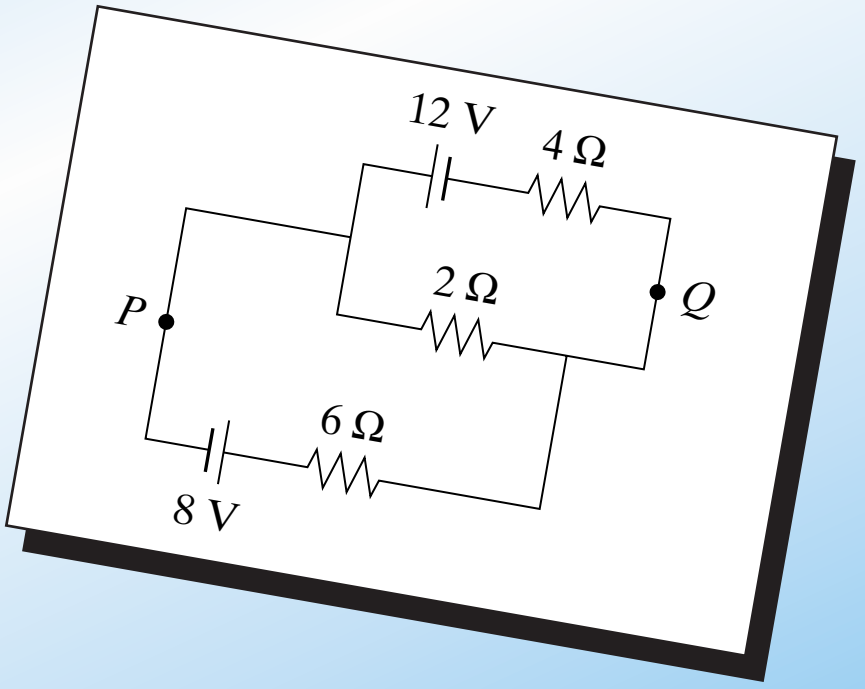
Why do we have this problem?

Conventional problems reinforce bad study habits

Calculate:

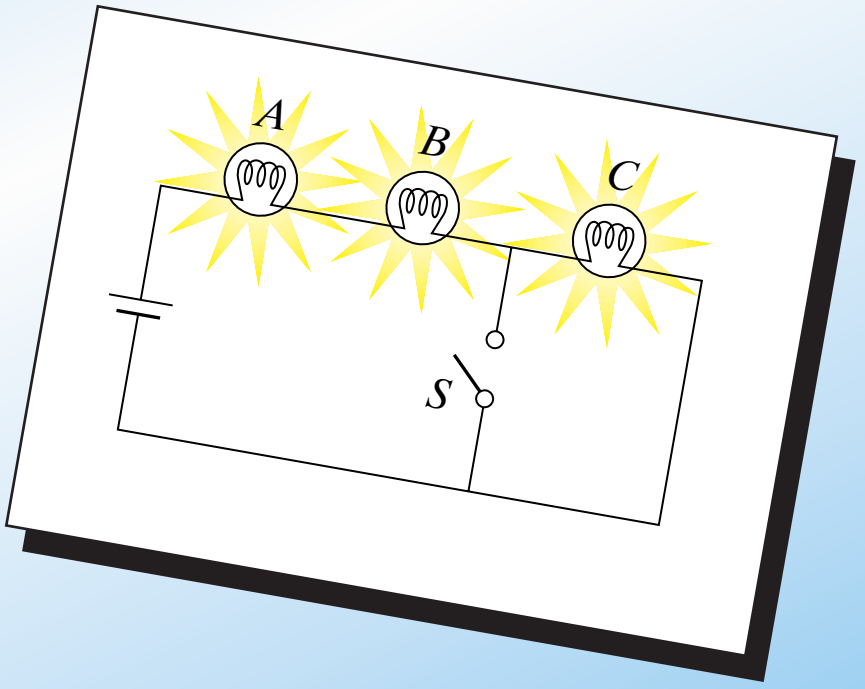
(*a*) the current in the 2-Ω resistor, and

(*b*) the potential difference between points *P* and *Q*



Why do we have this problem?

Are basic principles understood?

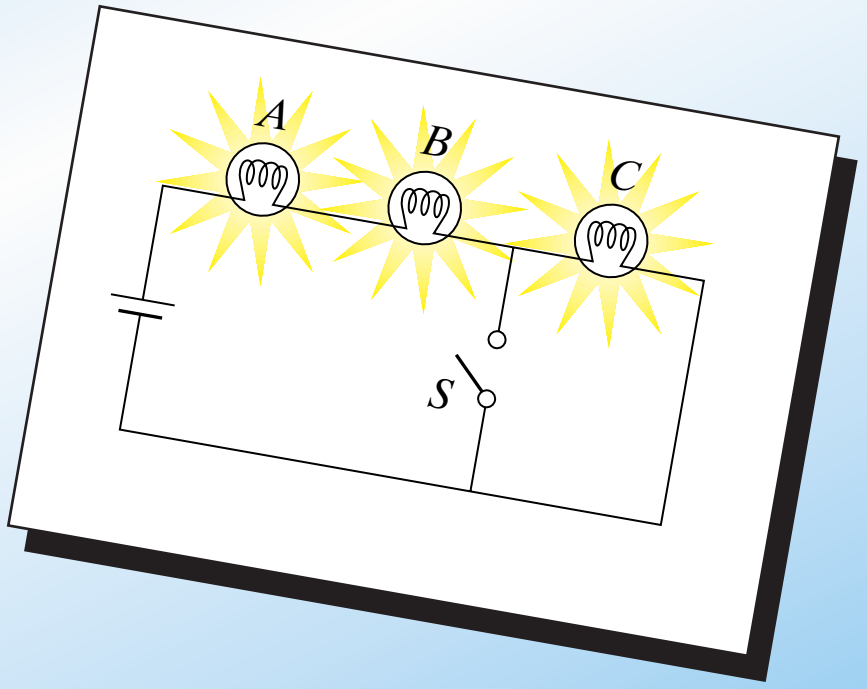


Why do we have this problem?

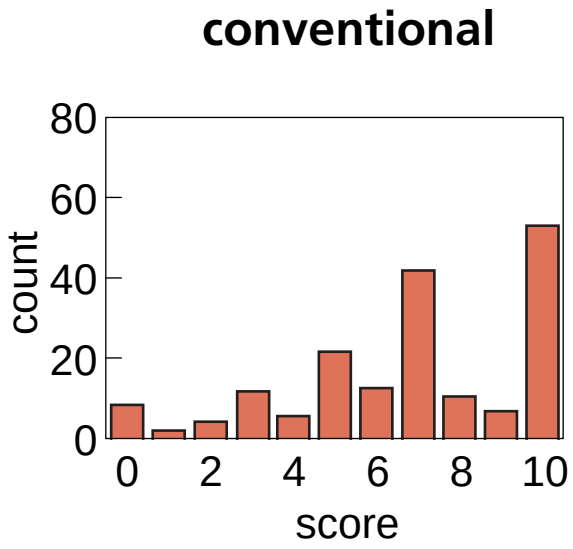
Are basic principles understood?

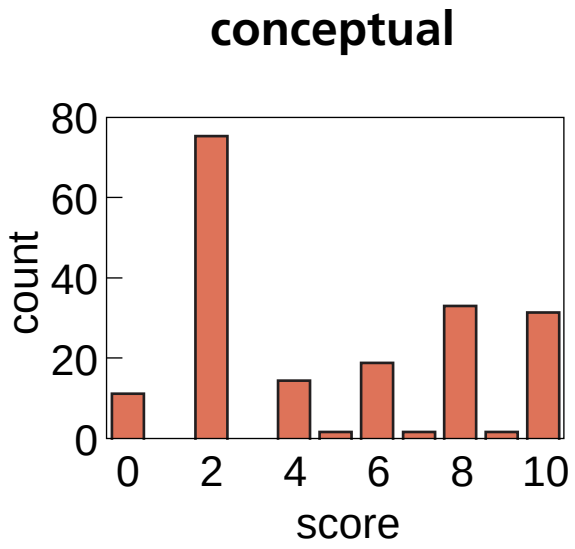
When *S* is closed, what happens to the:

(*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?

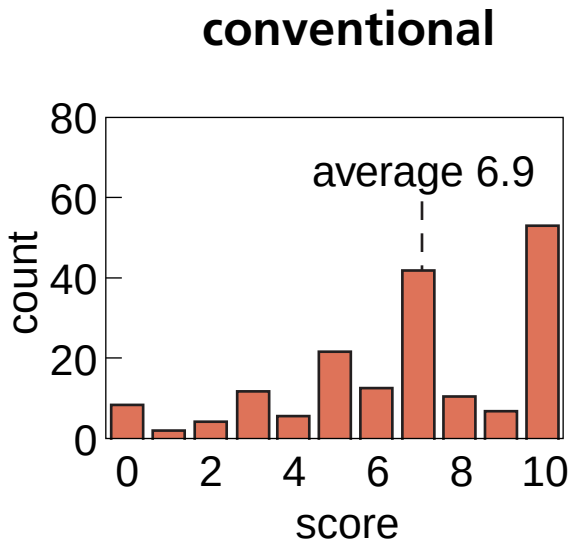


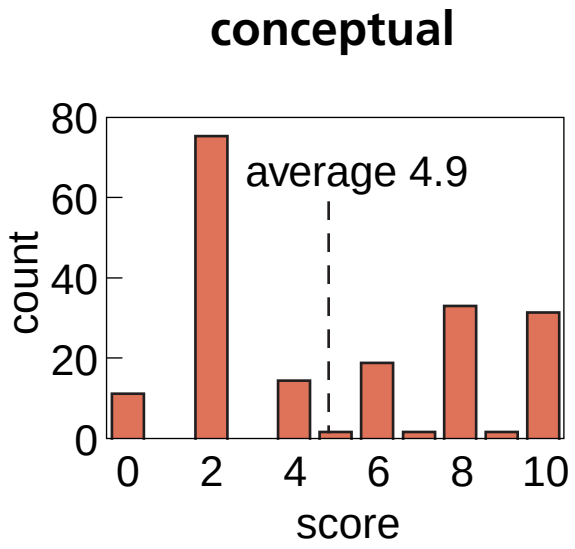
Why do we have this problem?



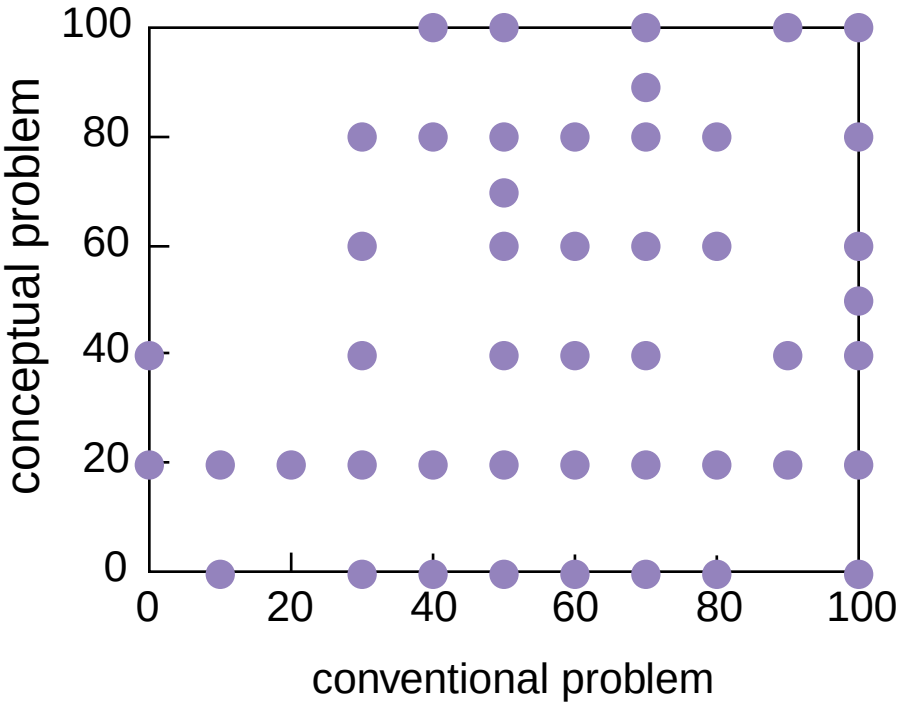


Why do we have this problem?

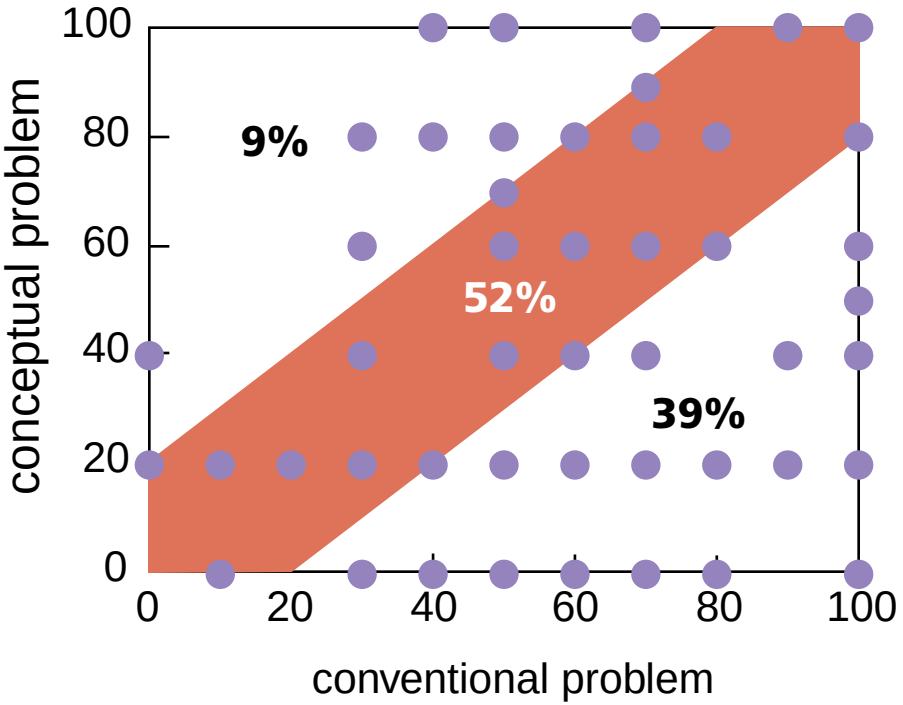




Why do we have this problem?



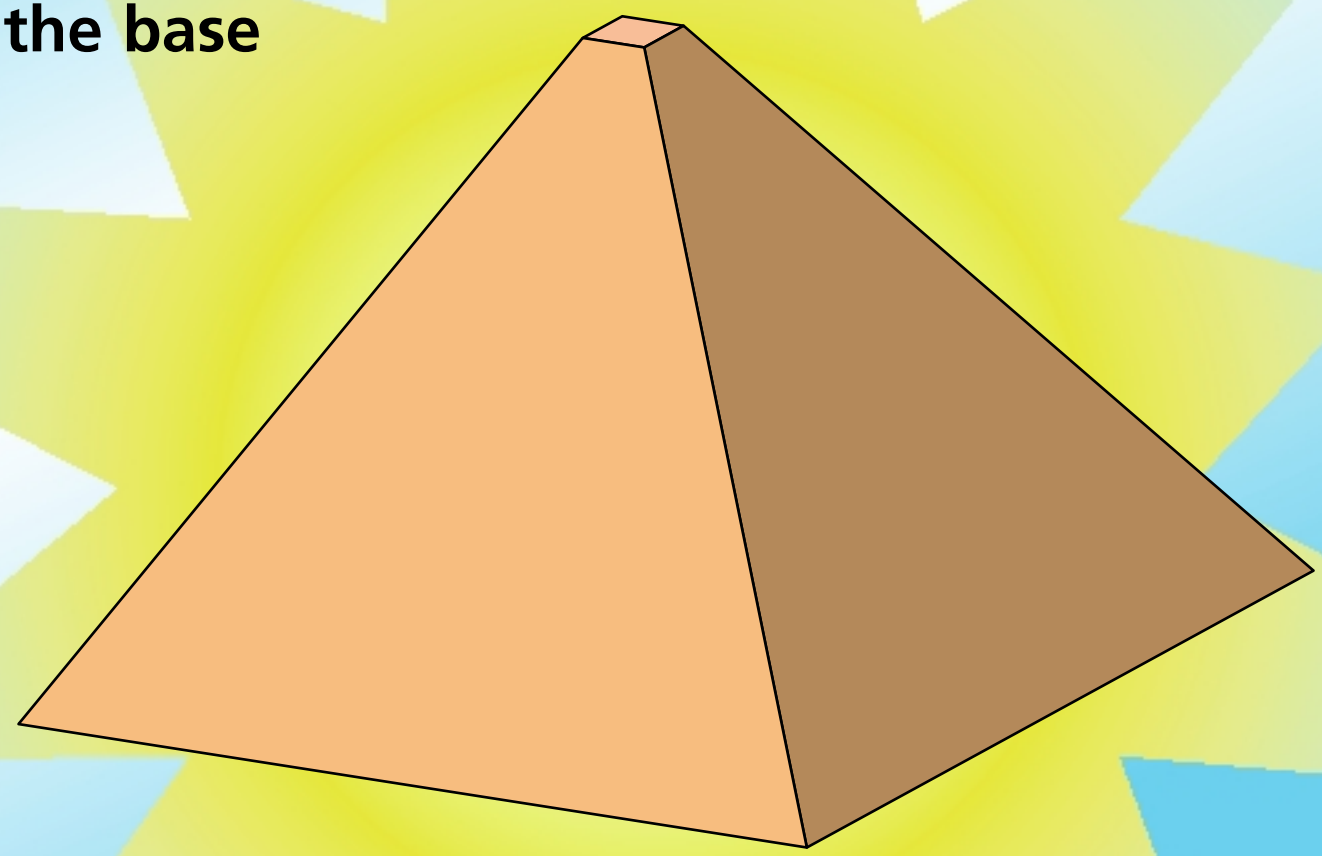
Why do we have this problem?




So what should we do?

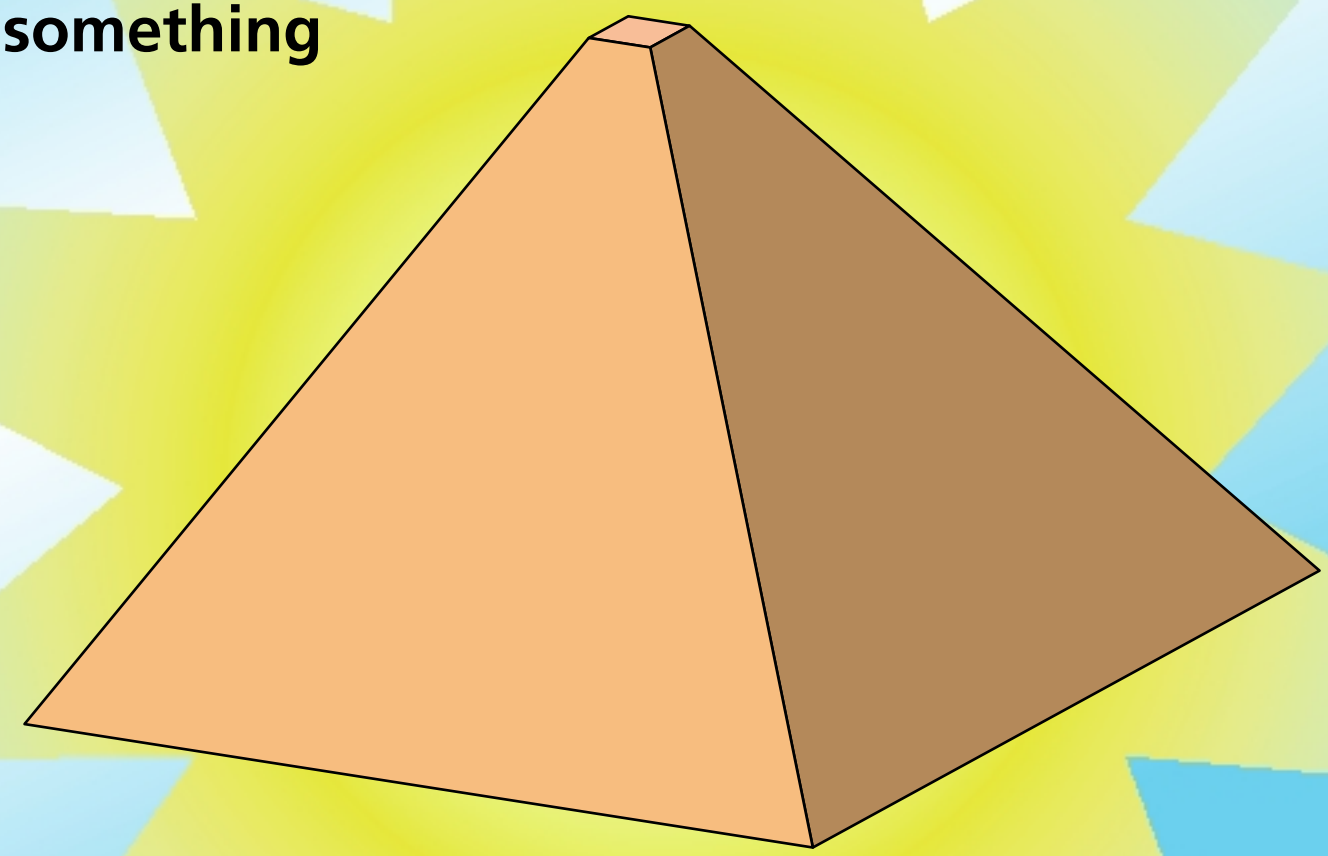
What should we do?

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!**

Peer Instruction

- **Move first exposure to the material out of the classroom: assign reading!**
- **Use class to deepen and broaden understanding**

Peer Instruction

- **Move first exposure to the material out of the classroom: assign reading!**
- **Use class to deepen and broaden understanding**
- **by identifying key ideas**

Peer Instruction

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

Main features:

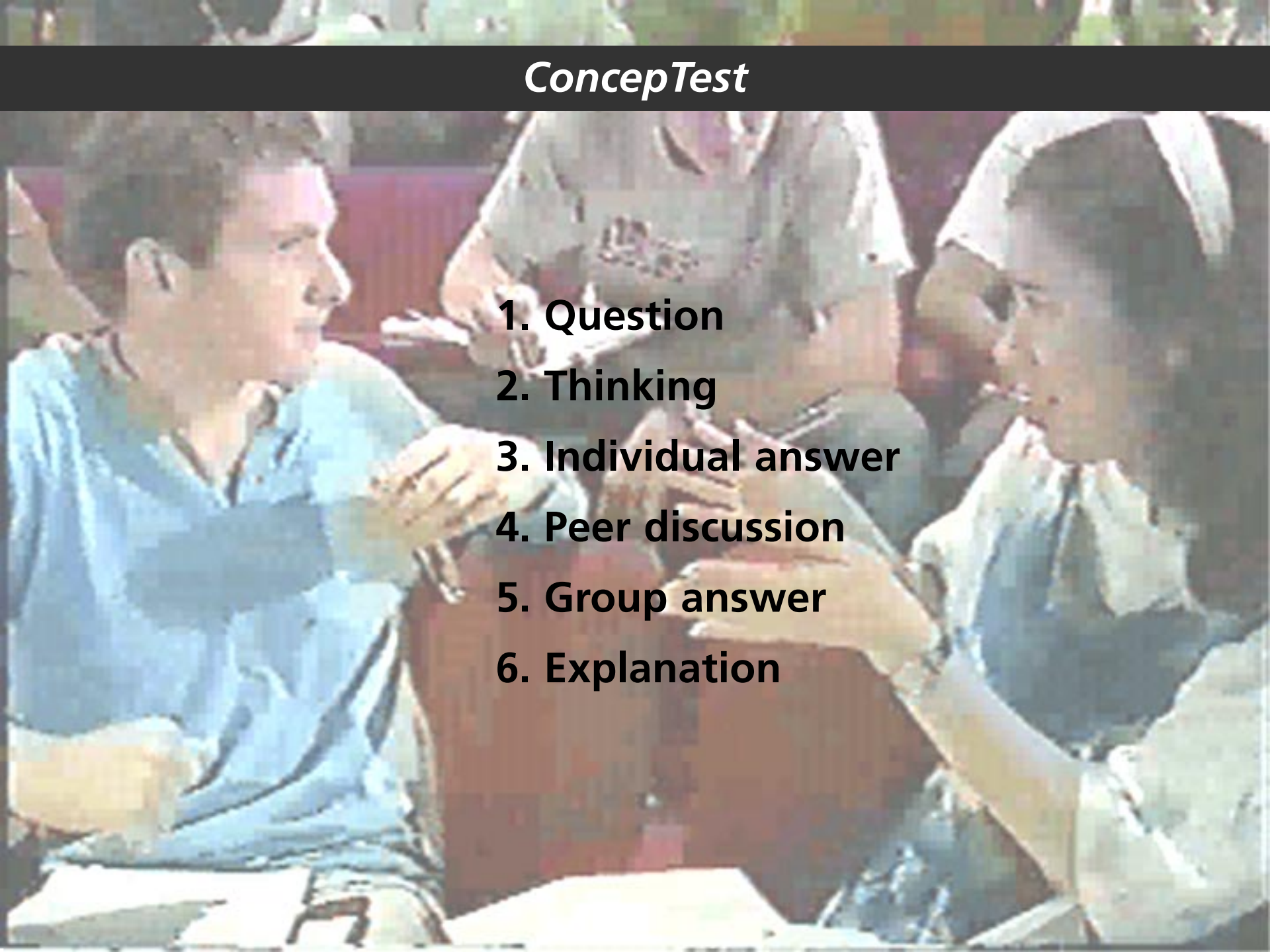
- **Pre-class reading**
- **In class: depth, not coverage**

Peer Instruction

Main features:

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

ConcepTest



1. Question
2. Thinking
3. Individual answer
4. Peer discussion
5. Group answer
6. Explanation

Results

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

Results

- **focus on concepts leads to better understanding**
- **better understanding leads to better problem solving**

Results

- **focus on concepts leads to better understanding**
- **better understanding leads to better problem solving**
- **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…

Some things to think about…

- **what is taught is not necessarily learned**

Some things to think about…

- **what is taught is not necessarily learned**
- **“good” problem solving doesn’t always indicate understanding**

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**

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