

# **PEER INSTRUCTION: TURNING A LECTURE INTO A SEMINAR**

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**University of California San Diego  
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# *Outline*

▶ **Problem**

# *Outline*

▶ **Problem**

▶ **Cause**

# *Outline*

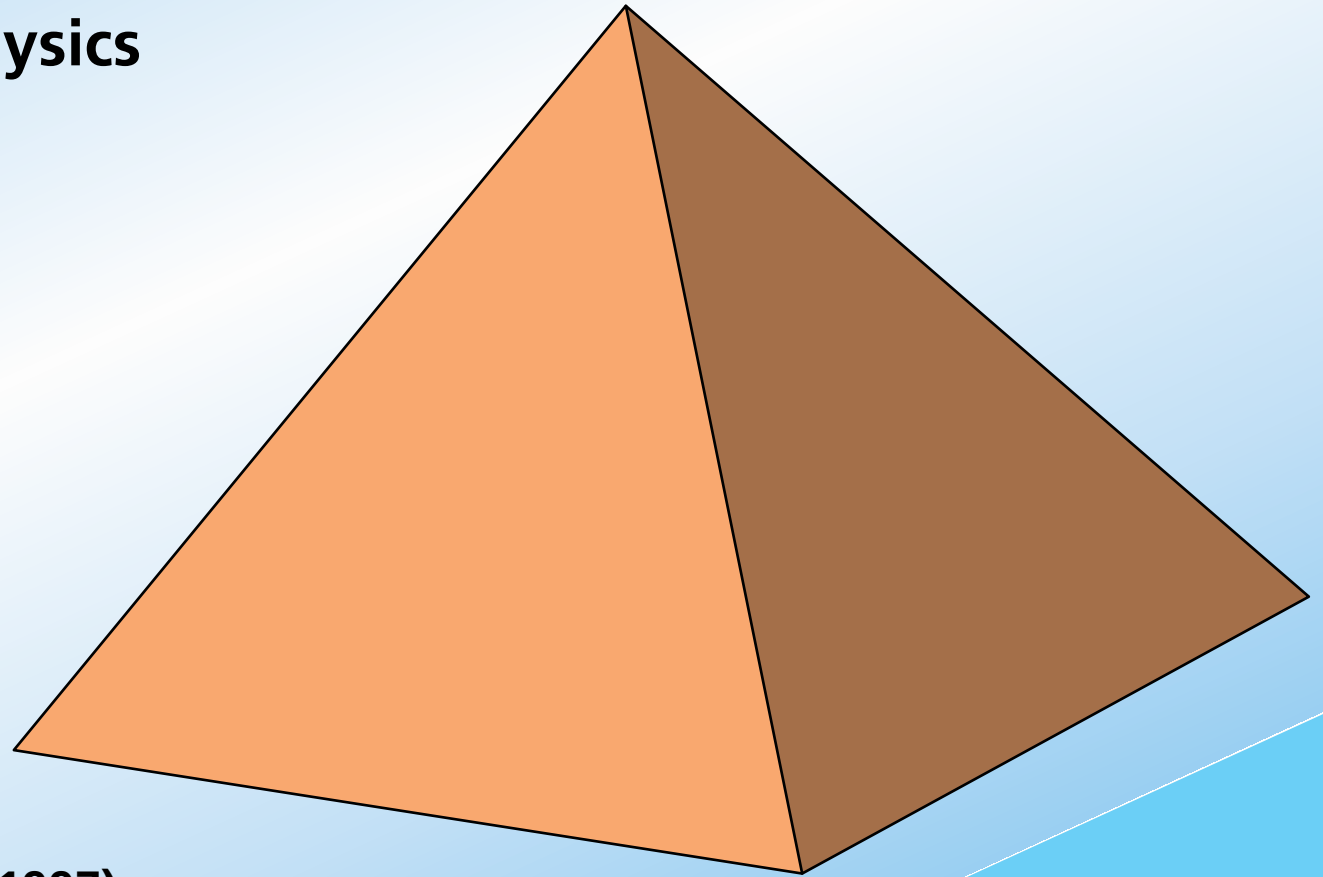
▶ **Problem**

▶ **Cause**

▶ **Remedy**

# *We have a problem*

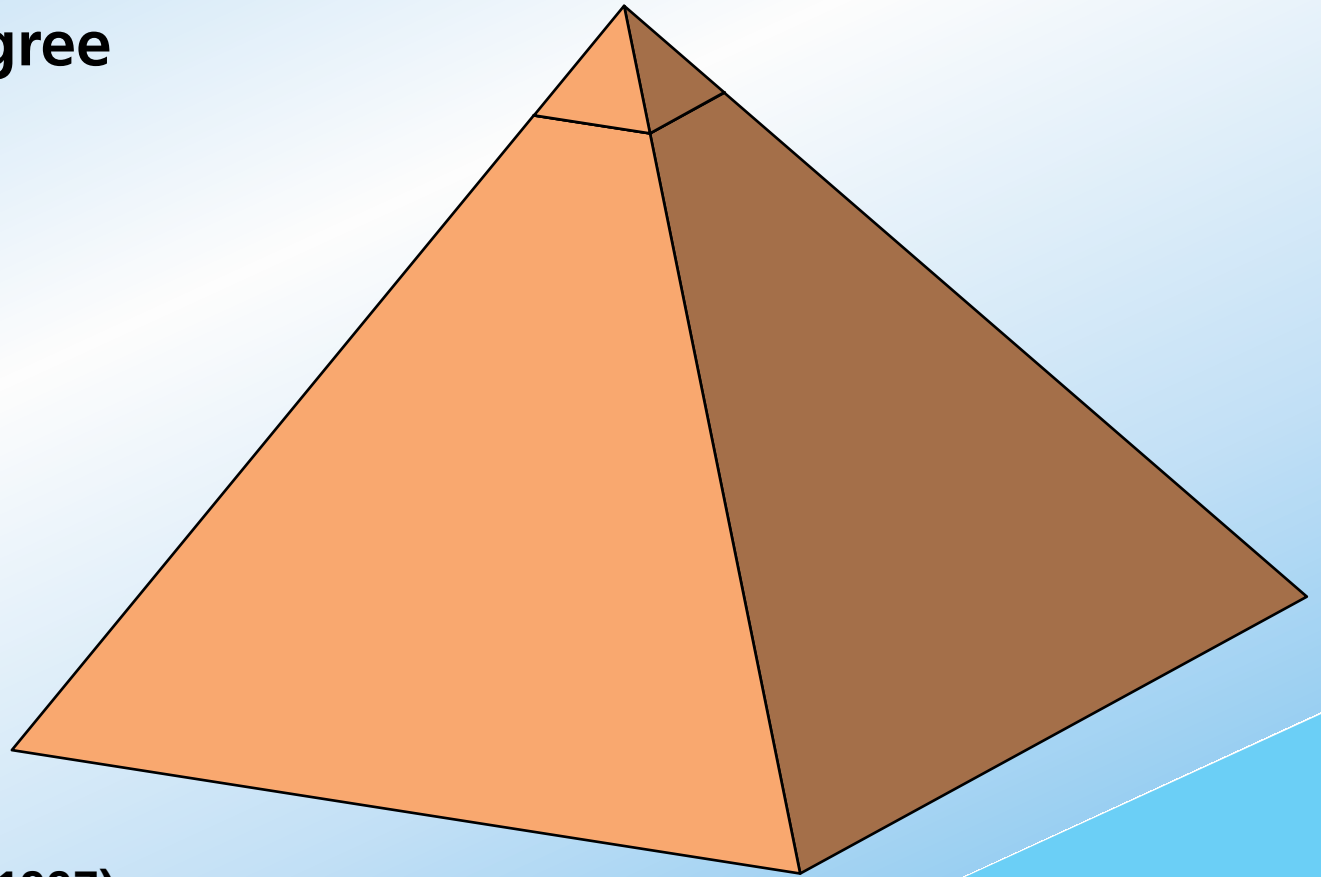
**380,000 students take  
introductory physics  
each year...**



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

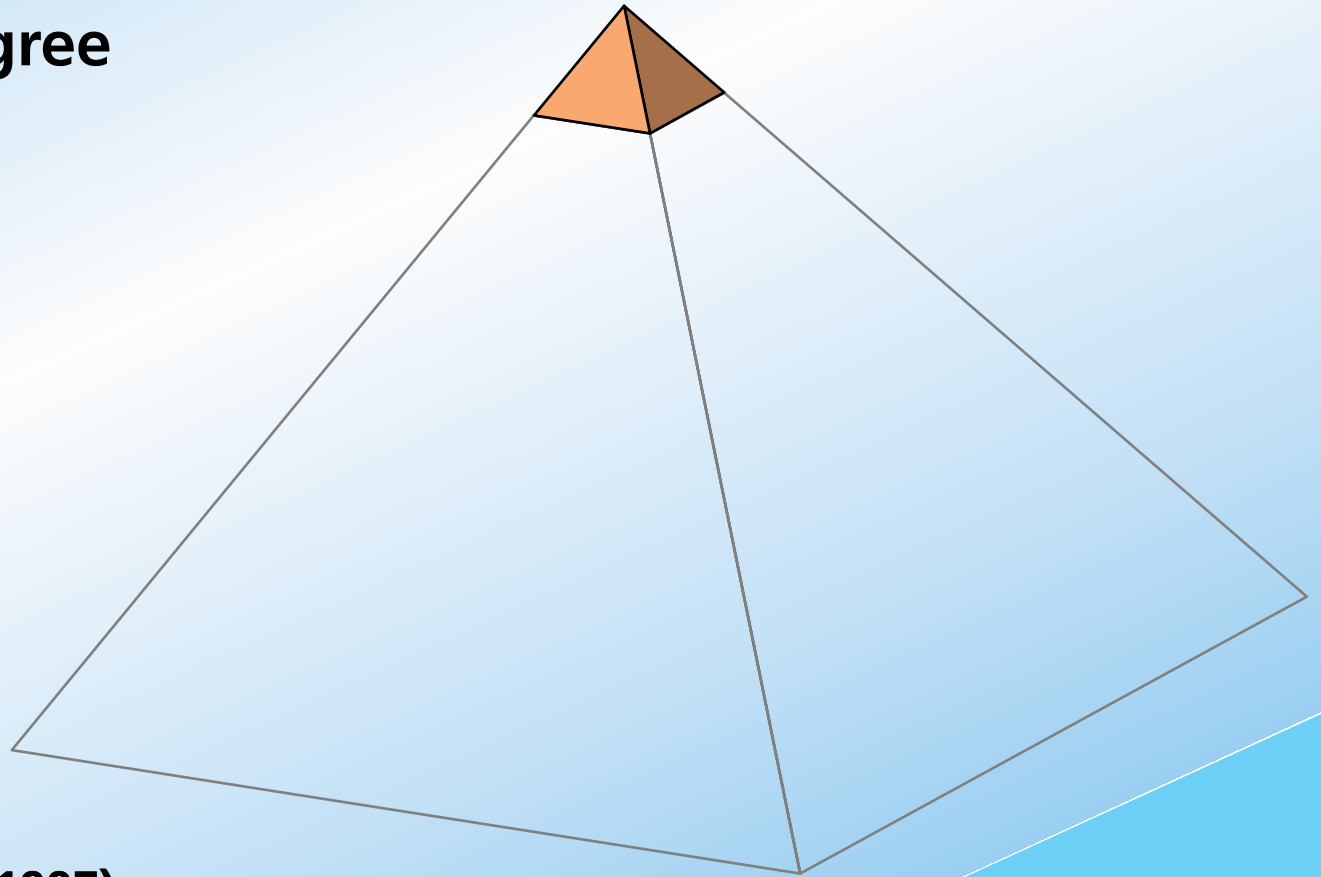
# *We have a problem*

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



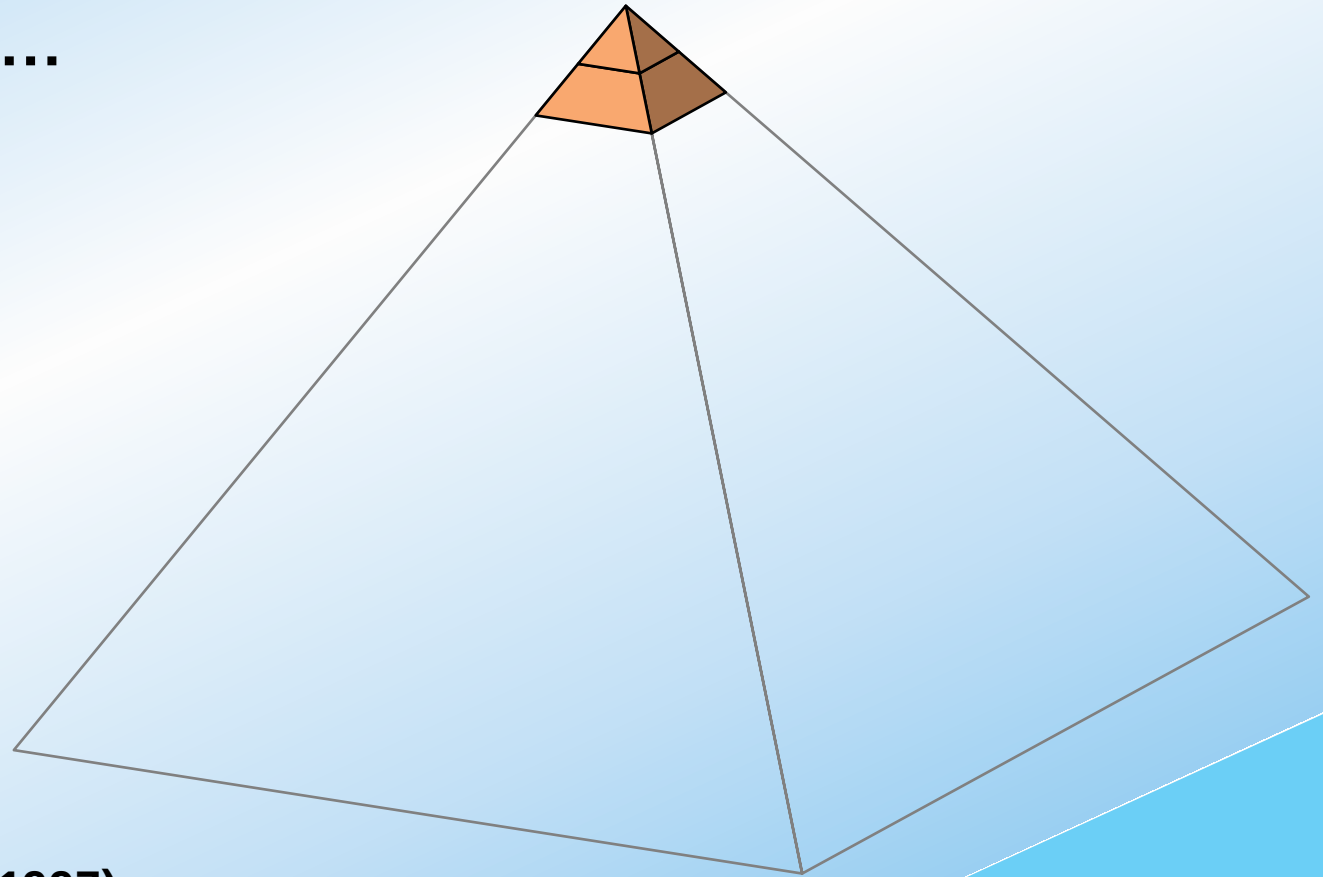
# *We have a problem*

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



# *We have a problem*

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

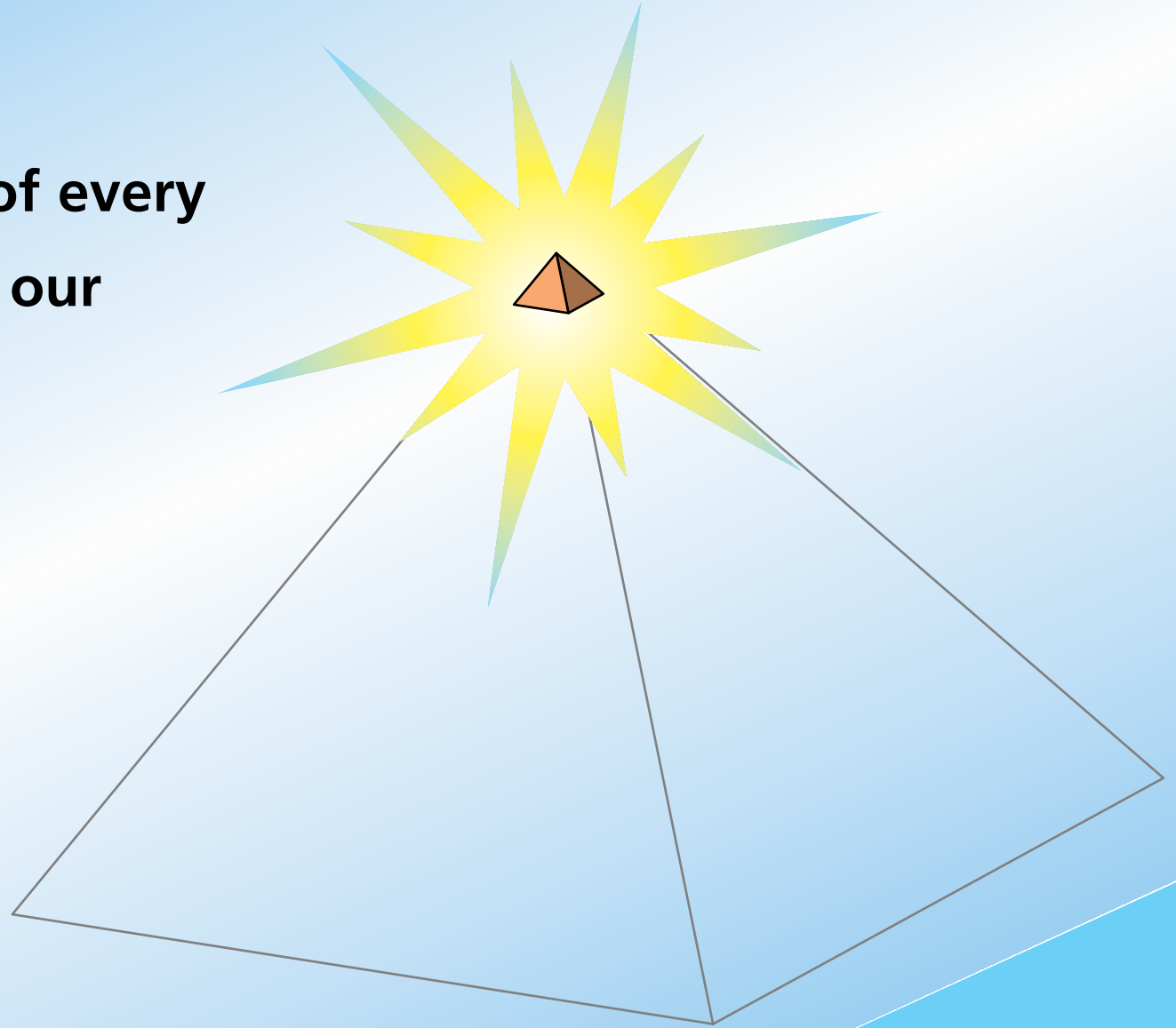


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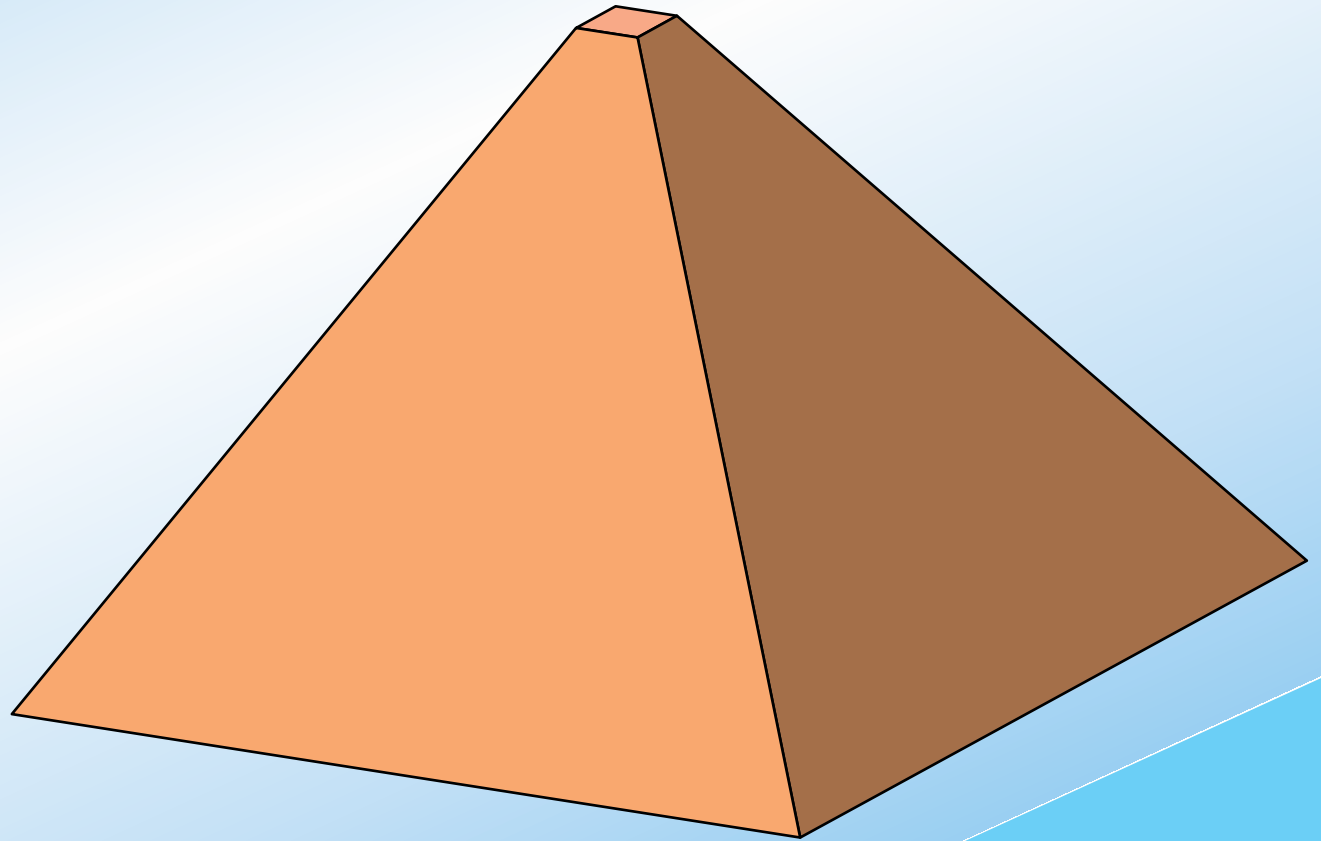
# *We have a problem*

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



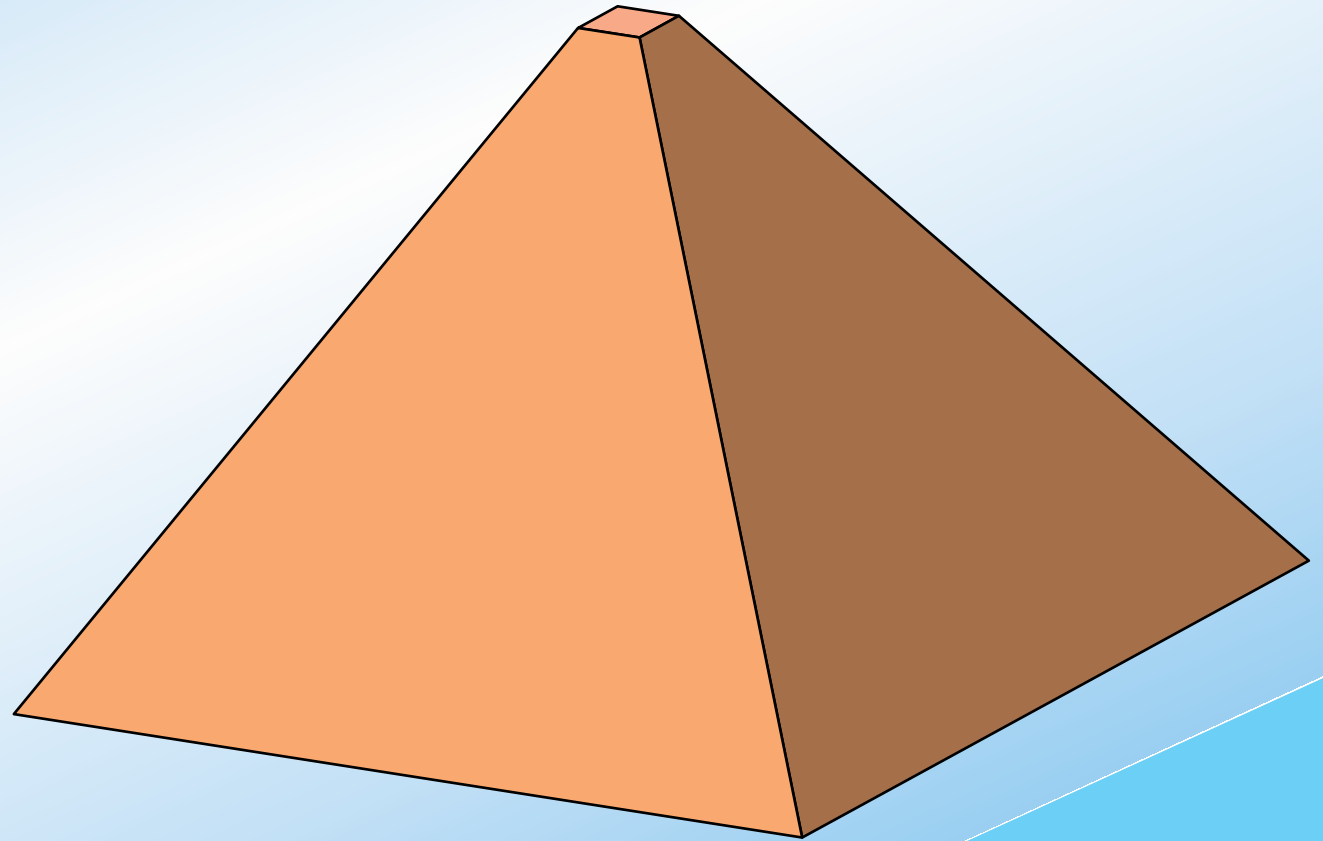
# *We have a problem*

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



# *We have a problem*

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





# *We have a problem*

**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*

**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?*"**



# *We have a problem*

## **Some disturbing symptoms:**

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



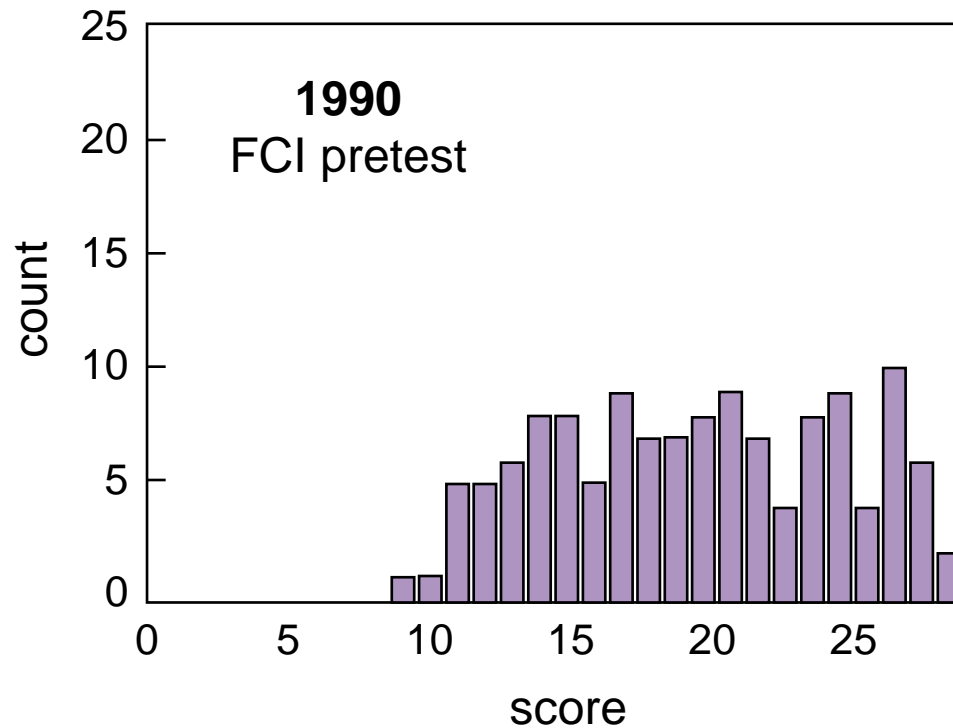
**Why do we have this problem?**

## *Why do we have this problem?*

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

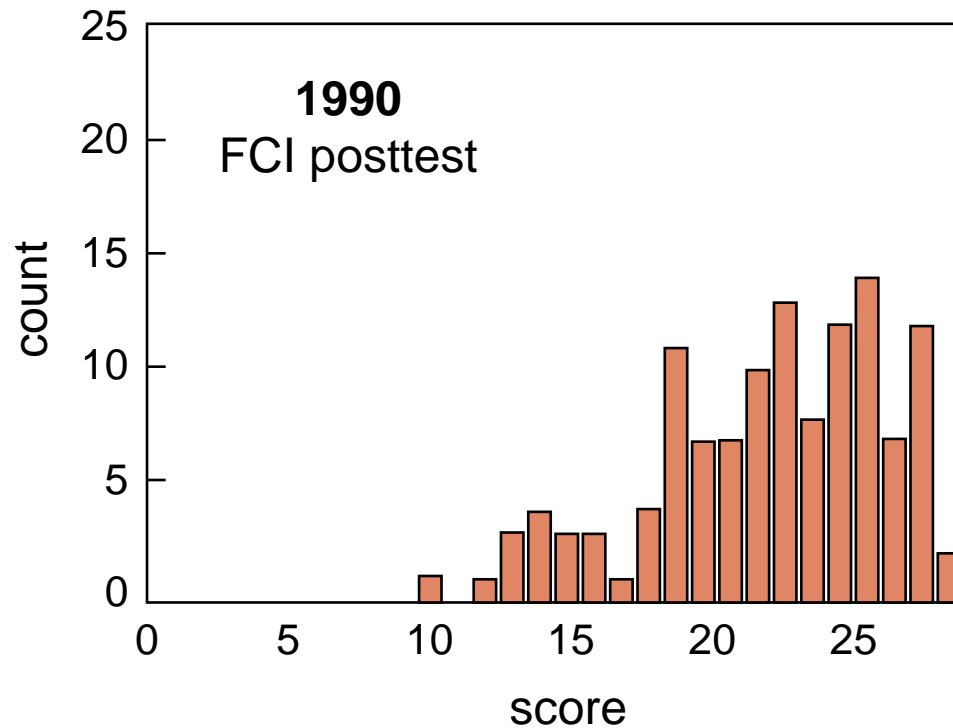
# *Why do we have this problem?*

**...but physics is not just information!**



# *Why do we have this problem?*

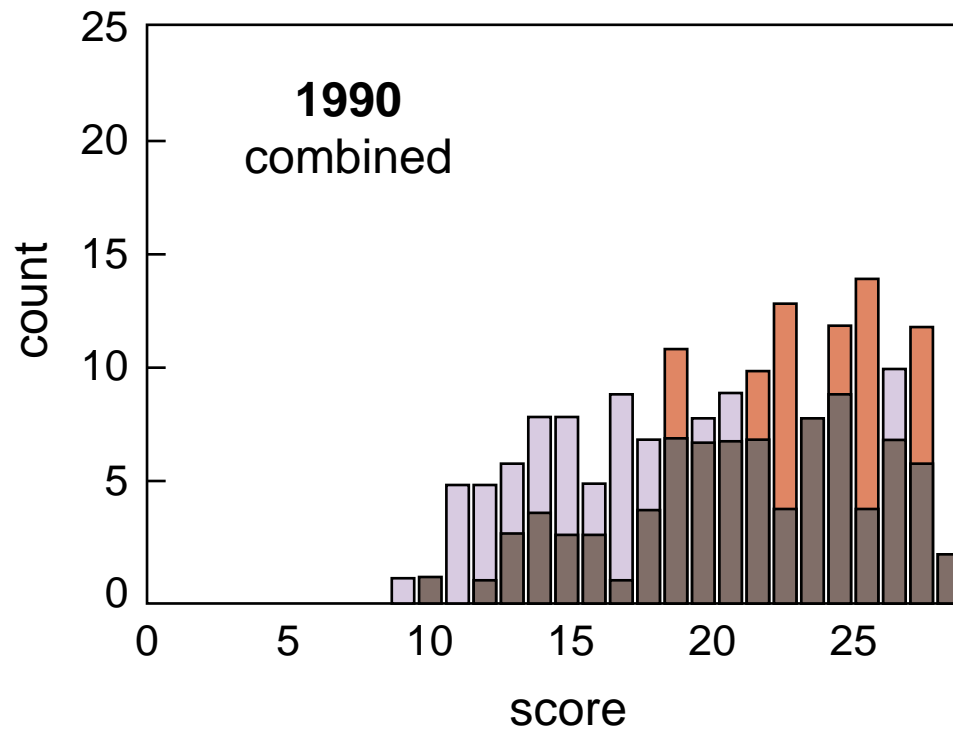
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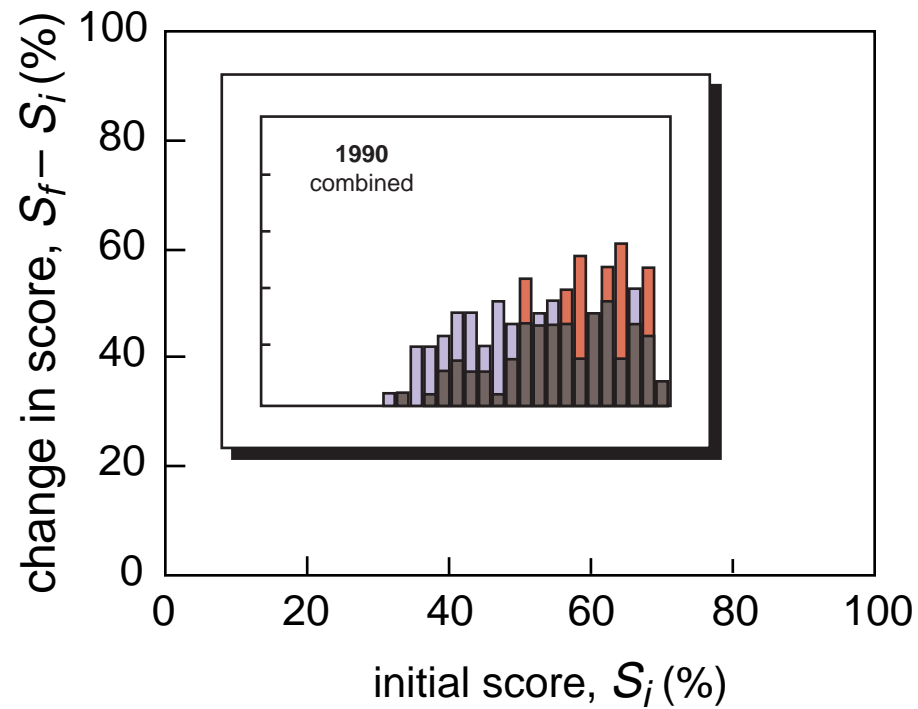


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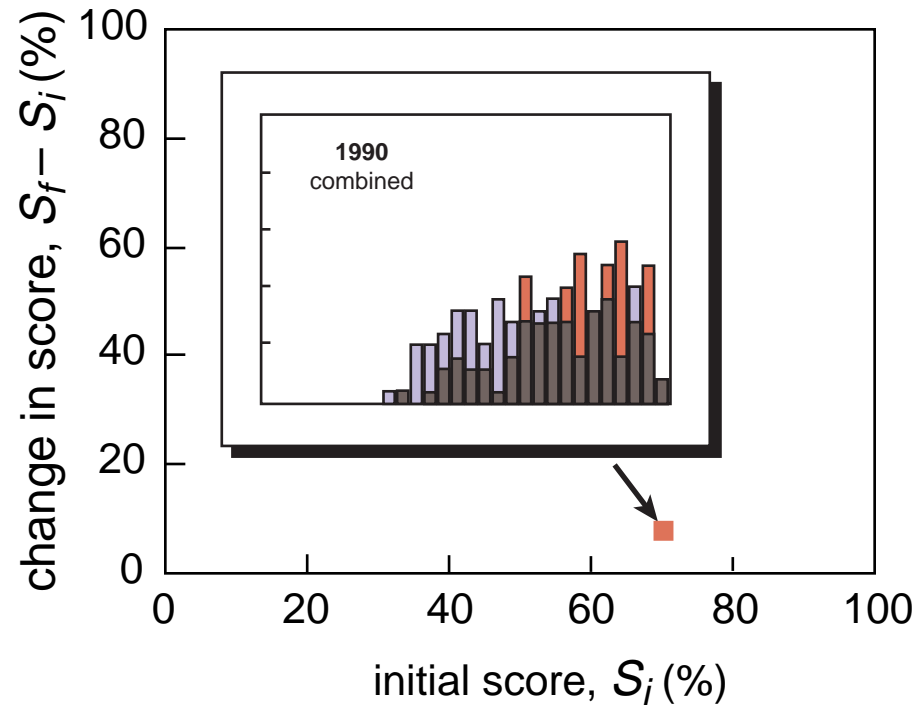
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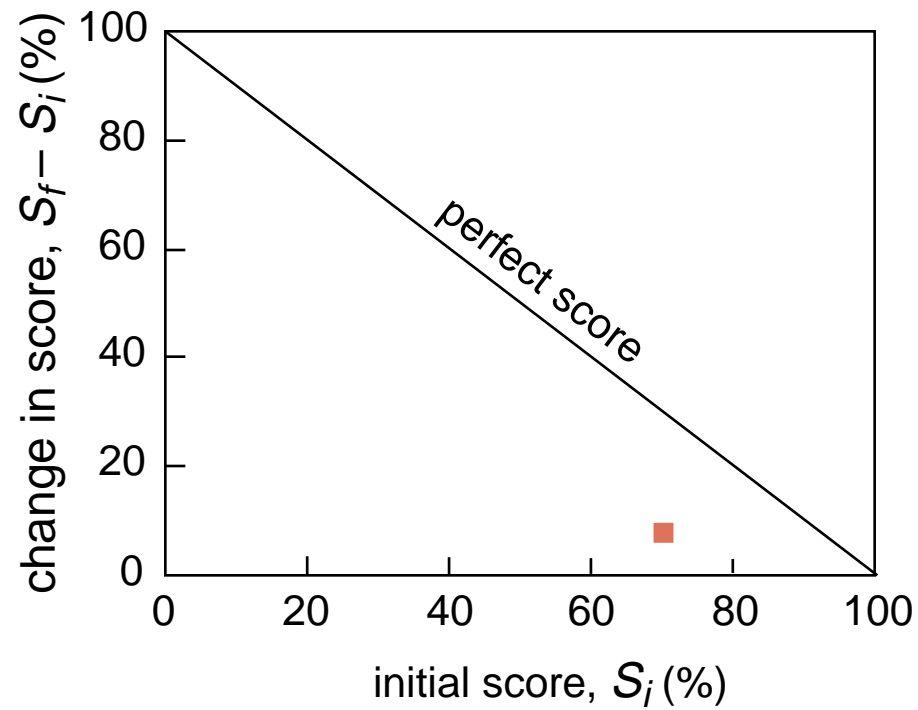
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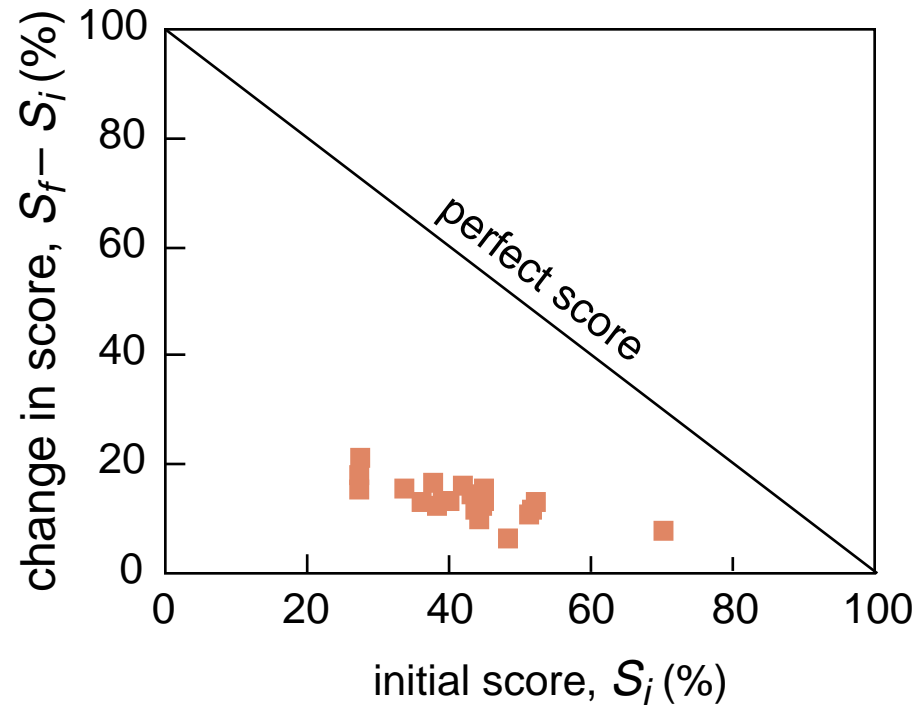
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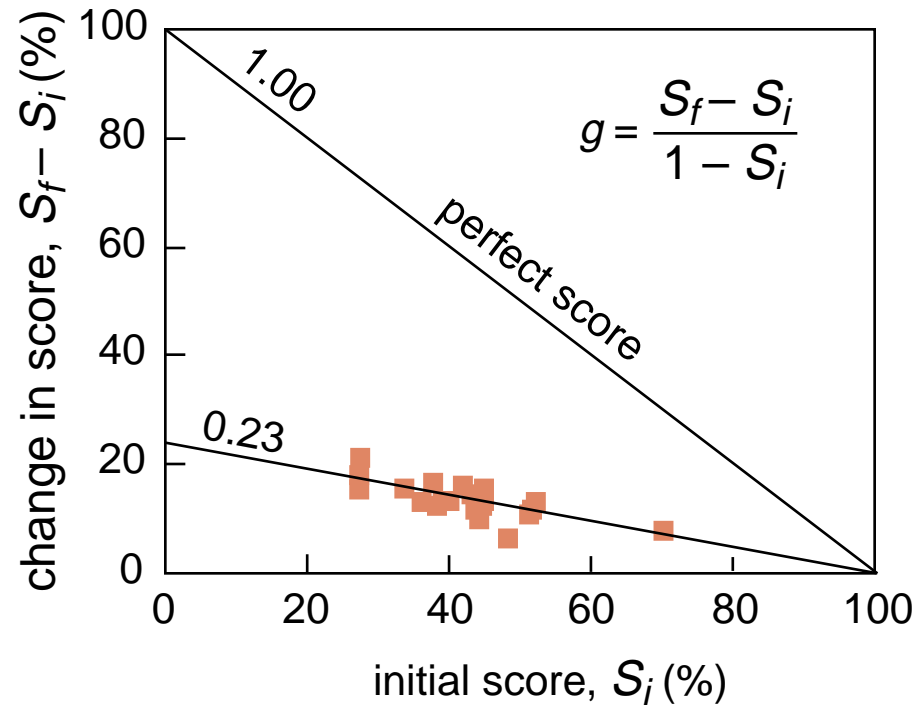
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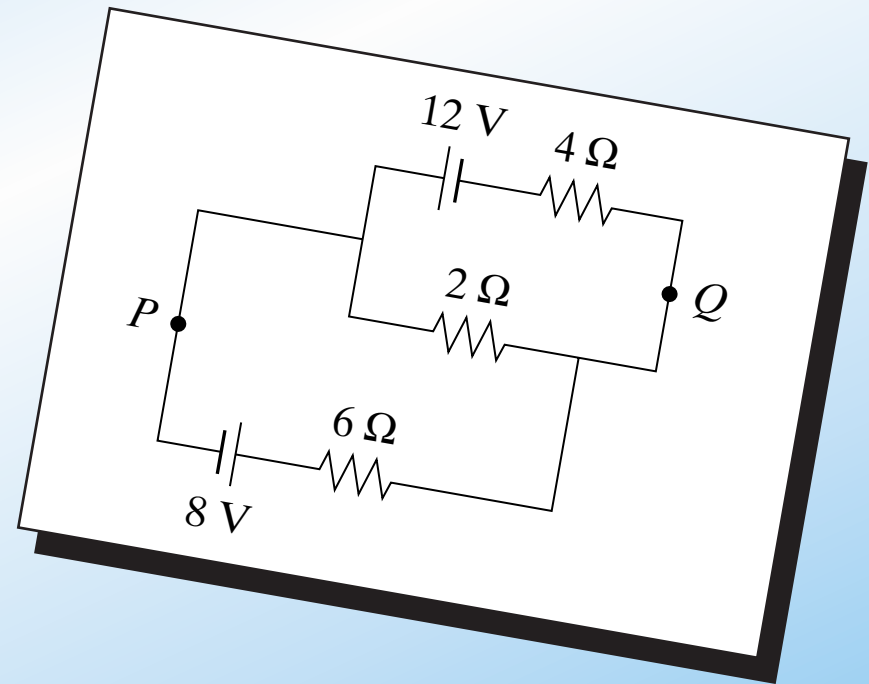


## *Why do we have this problem?*

**Conventional problems reinforce bad study habits**

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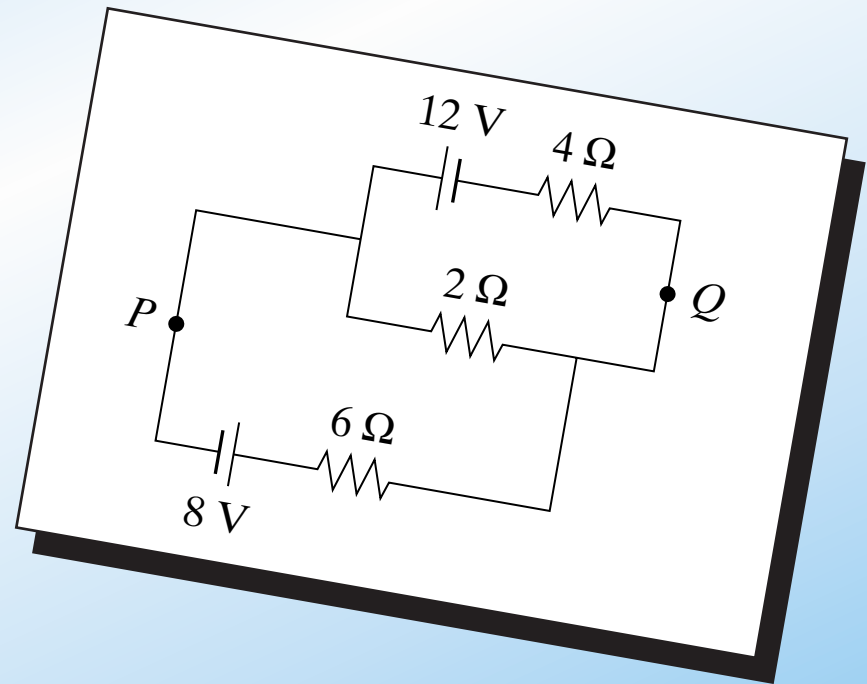


# Why do we have this problem?

## Conventional problems reinforce bad study habits

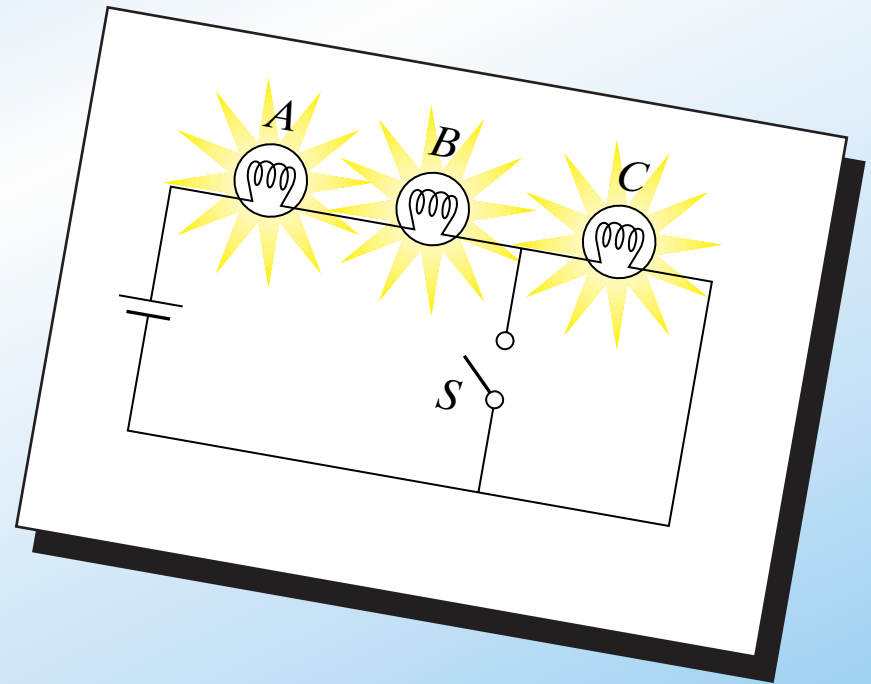
Calculate:

- (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?**

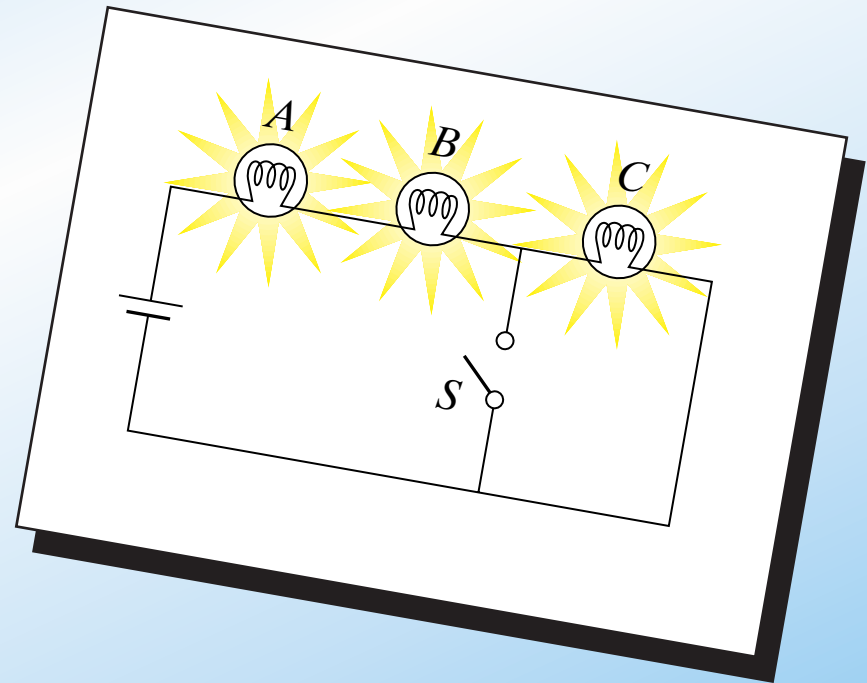


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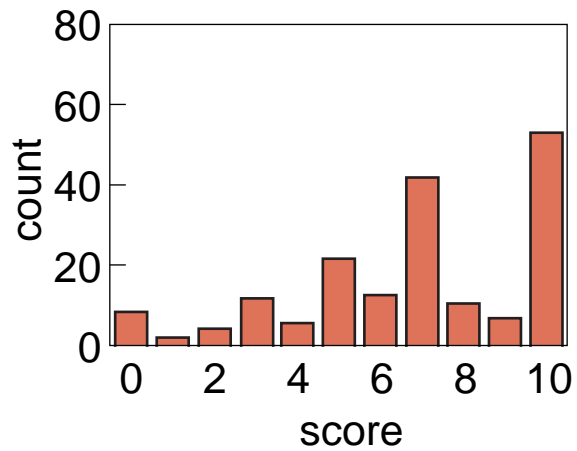
When  $S$  is closed, what happens to the:

- (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?

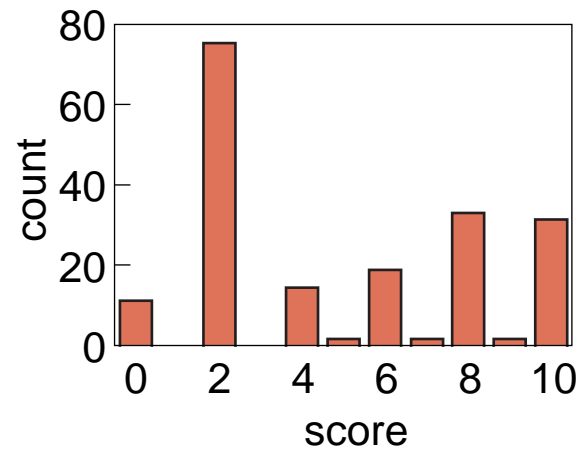


# Why do we have this problem?

conventional

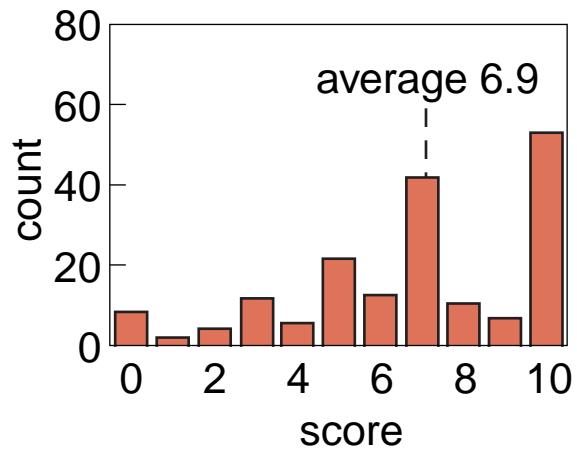


conceptual

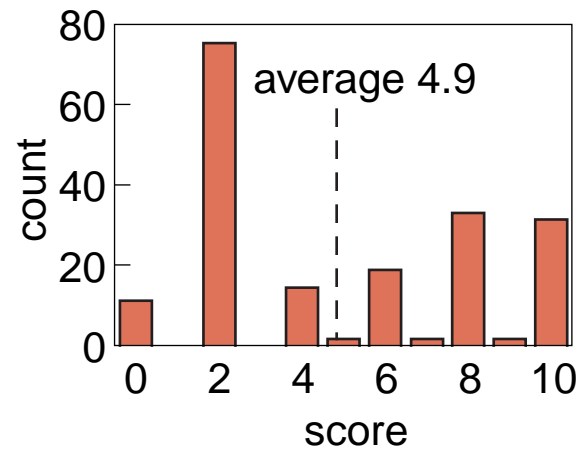


# Why do we have this problem?

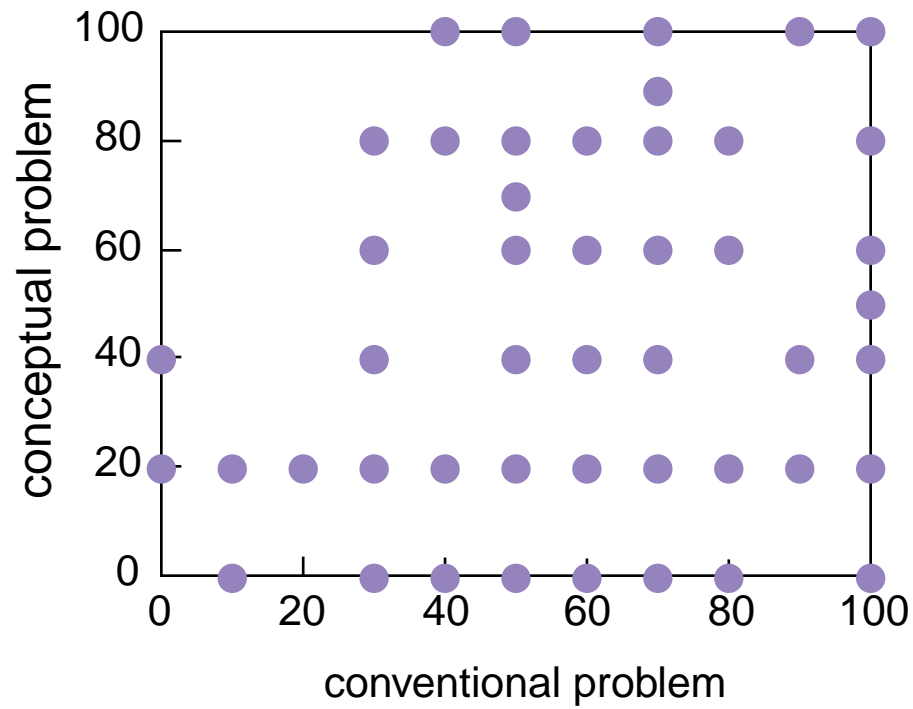
**conventional**



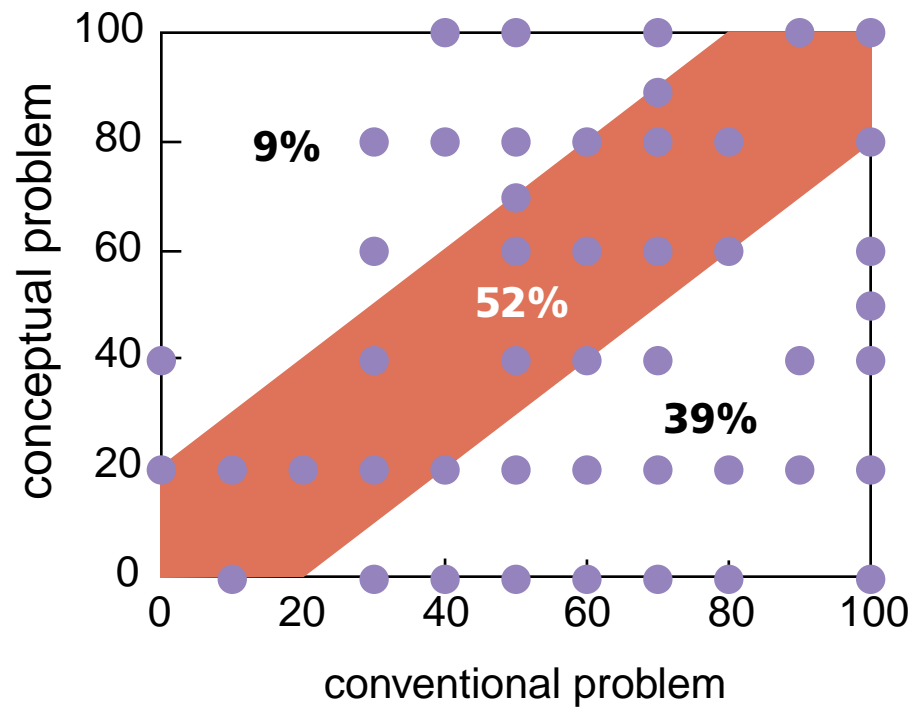
**conceptual**



# Why do we have this problem?



# Why do we have this problem?





A large lecture hall filled with students seated at desks, facing a stage. A lecturer is standing at a podium on the stage, and a large projection screen displays text. The text on the screen is partially legible and appears to be a list of items or a document. The room is dimly lit, with the stage area being the primary light source.

So what should we do?



# *Peer Instruction*

**Help students take more responsibility for learning!**

## *Peer Instruction*

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

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## *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**

# *Reading*

- ▶ **Web-based assignment due before class**



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- ▶ **Three questions (content and feedback)**

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- ▶ **Web-based assignment due before class**
- ▶ **Three questions (content and feedback)**
- ▶ **Graded on effort**
- ▶ **5% of final grade**

# *Peer Instruction*

## **Main features:**

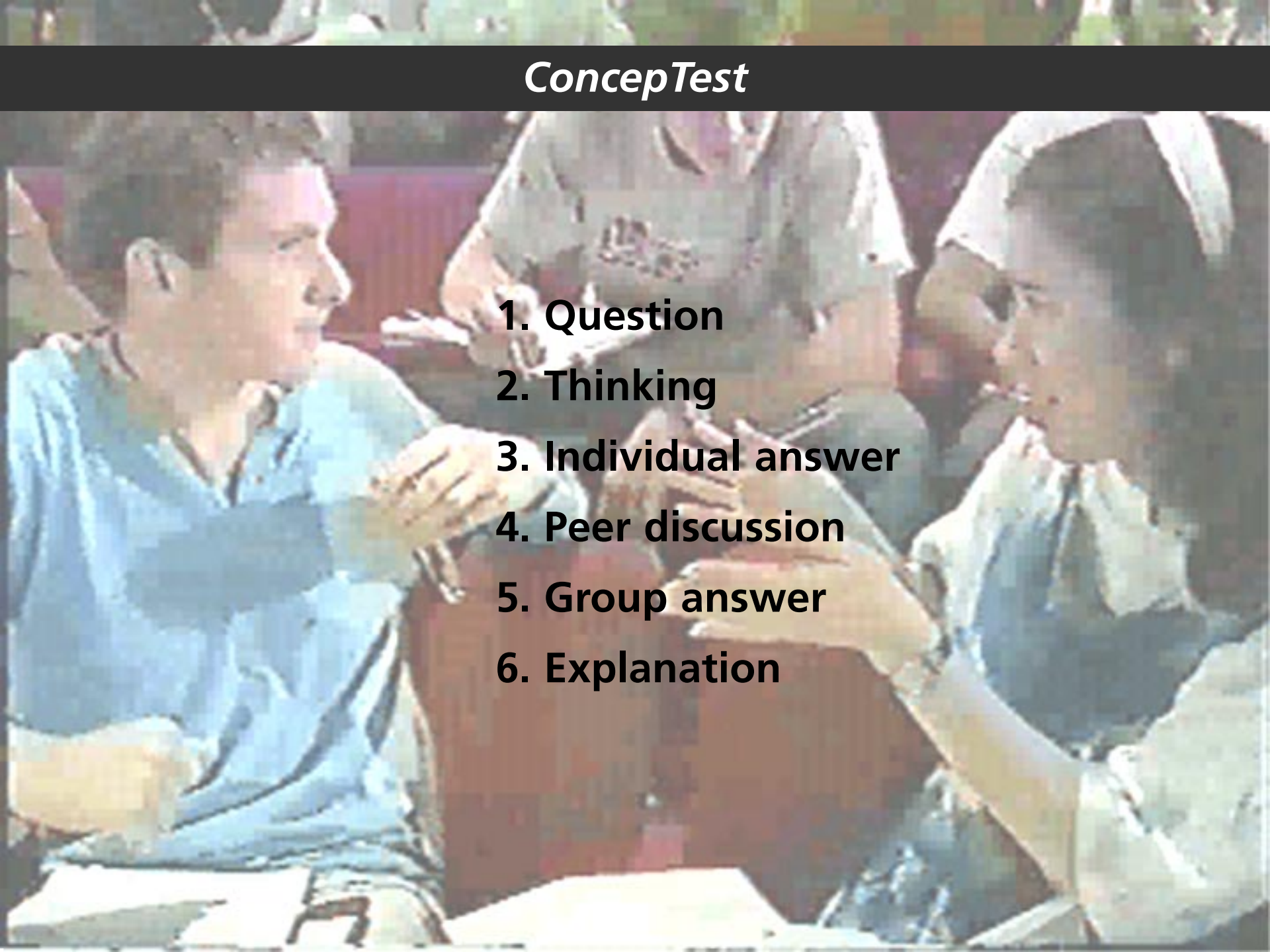
- ▶ **Pre-class reading**
- ▶ **In class: depth, not coverage**

# *Peer Instruction*

## **Main features:**

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

## *ConcepTest*

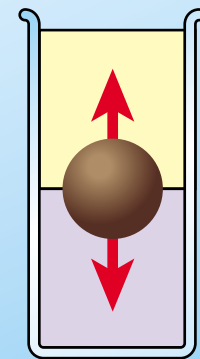
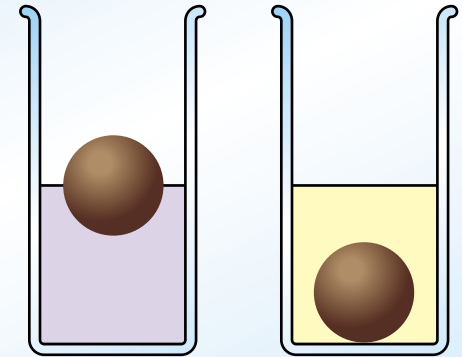
1. Question
  2. Thinking
  3. Individual answer
  4. Peer discussion
  5. Group answer
  6. Explanation
- 
- A photograph of three students in a classroom. A male student in a blue shirt is on the left, gesturing with his hands while speaking. A female student in a white headscarf is on the right, listening intently. A third student is partially visible in the background. They appear to be engaged in a group discussion or peer review activity.

## Sample ConceptTest

Consider an object that floats in water but sinks in oil. When the object floats in water, half of it is submerged.

If we slowly pour oil on top of the water so it completely covers the object, the object

1. moves up.
2. stays in the same place.
3. moves down.







# *Motivating students*

- ▶ **Suitable ConcepTests**

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- ▶ **Rewards for participation**

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# *Motivating students*

- ▶ **Suitable ConcepTests**
- ▶ **Rewards for participation**
- ▶ **Noncompetitive grading**
- ▶ **Conceptual exam questions**

*Is it any good?*

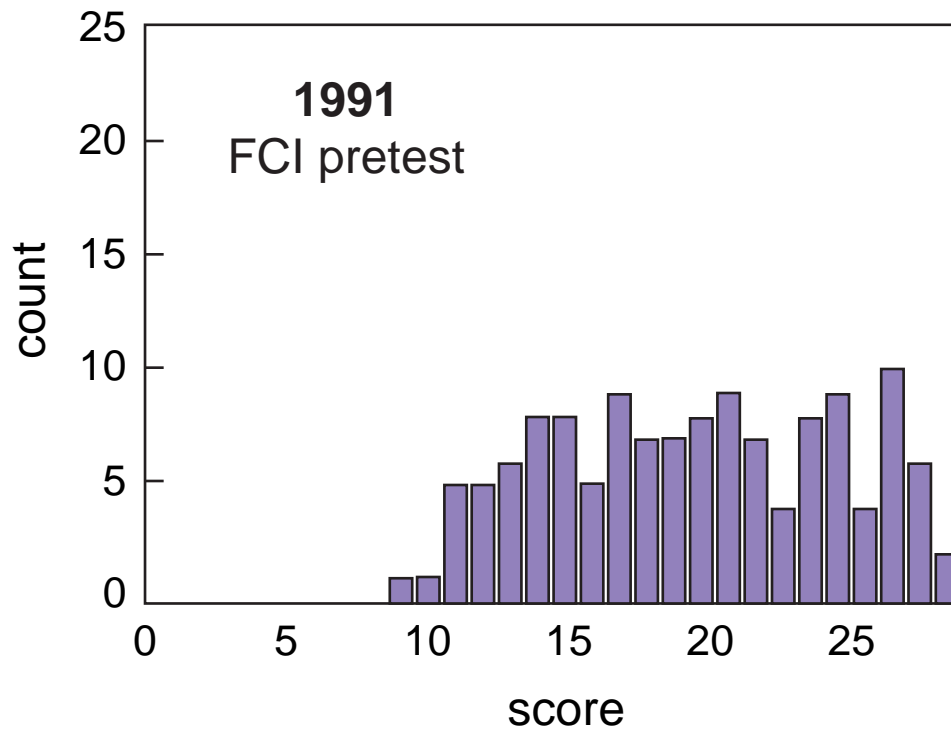
*Is it any good?*

▶ **Results**

# *Is it any good?*

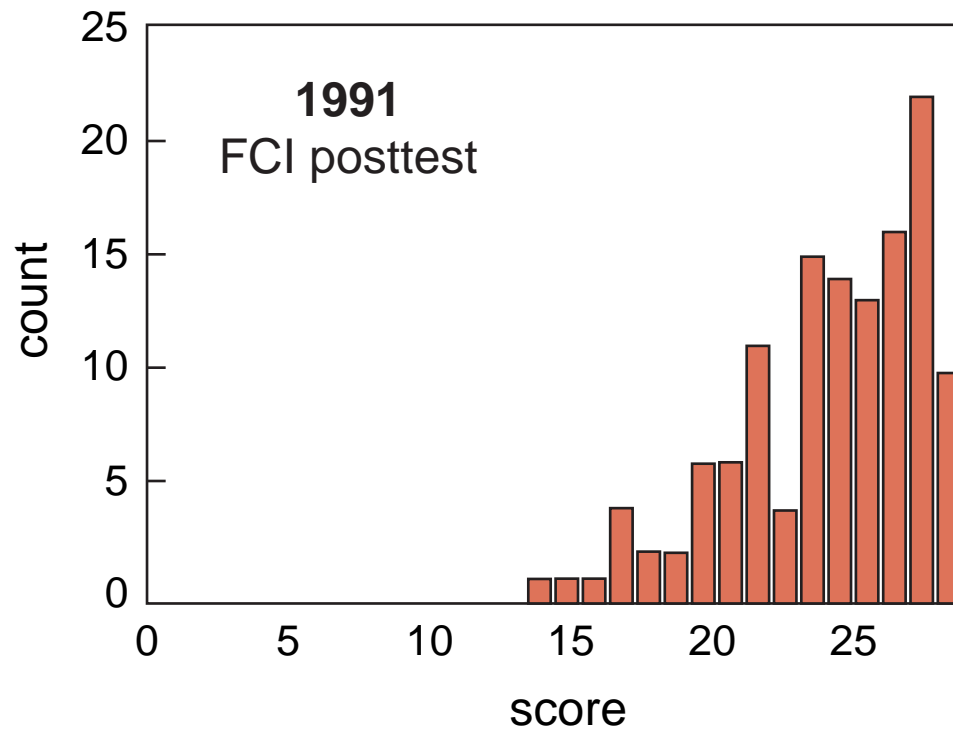
- ▶ **Results**
- ▶ **Student Reactions**

# Results

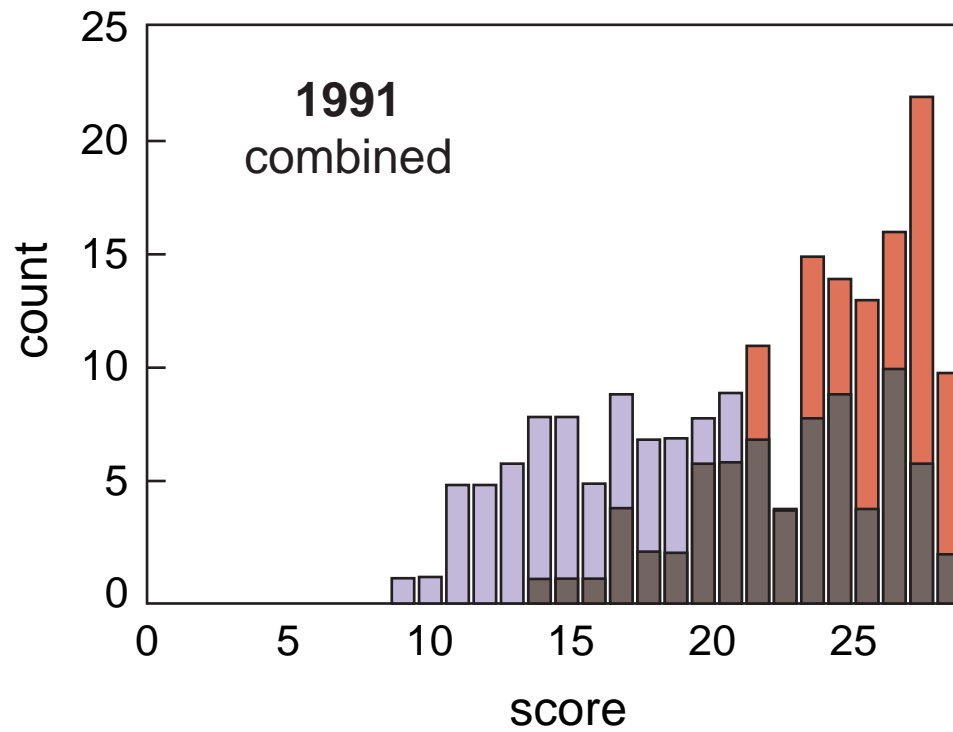




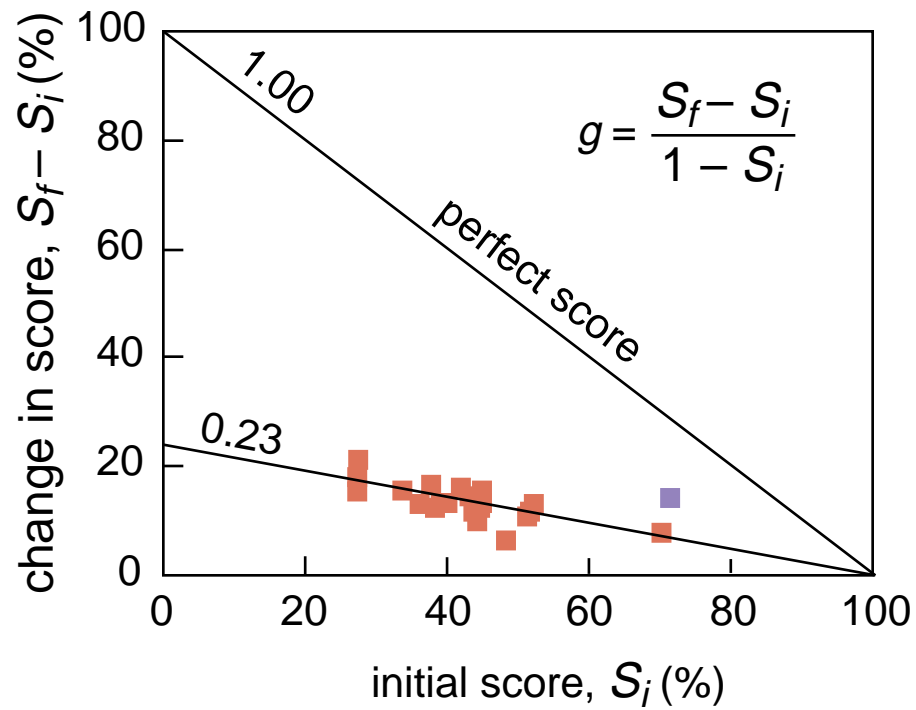
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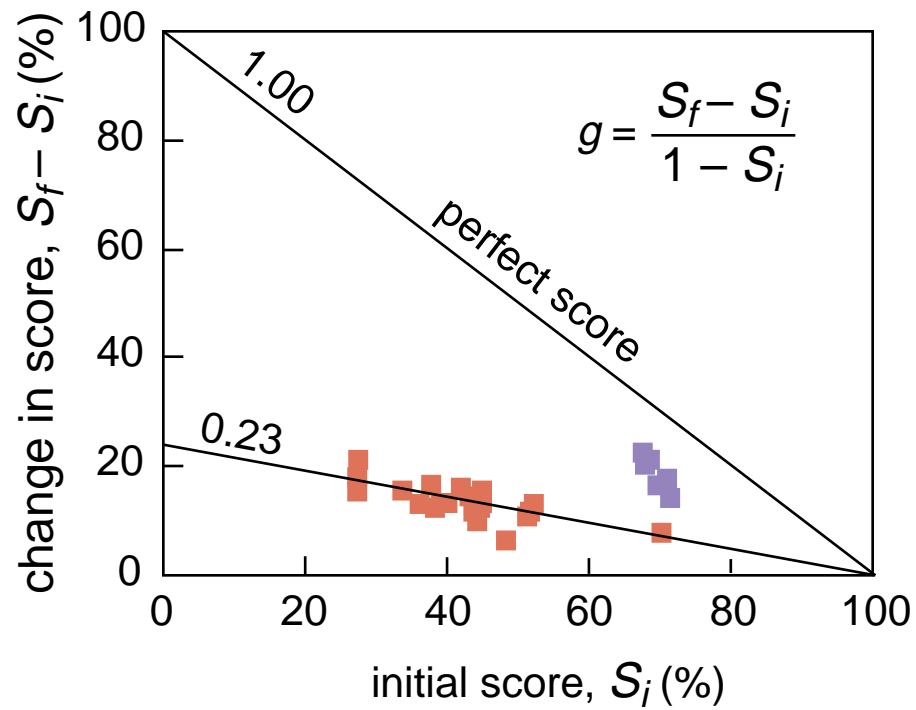
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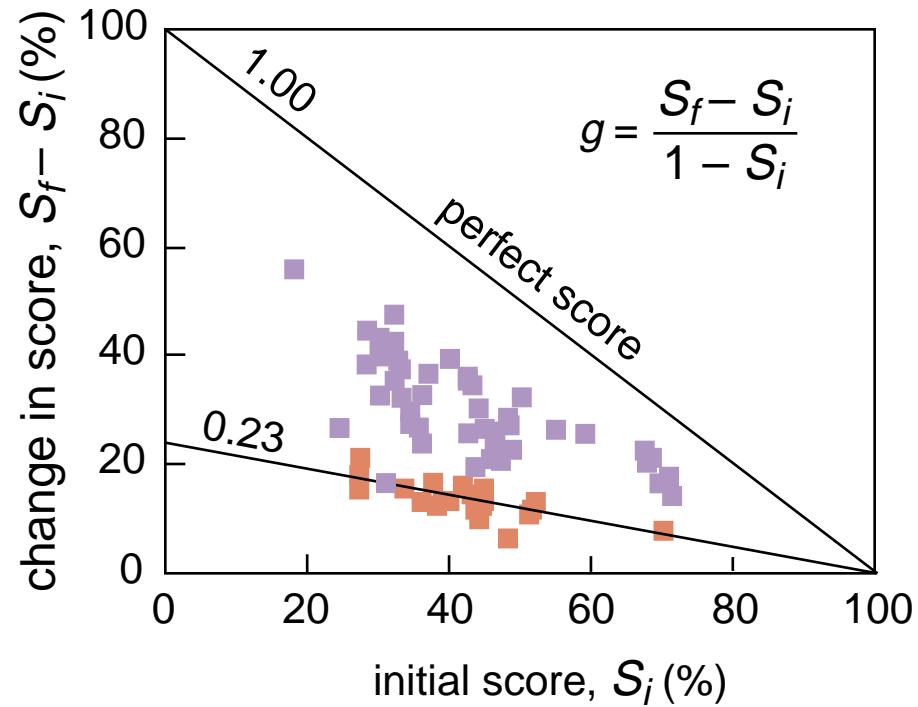
# Results



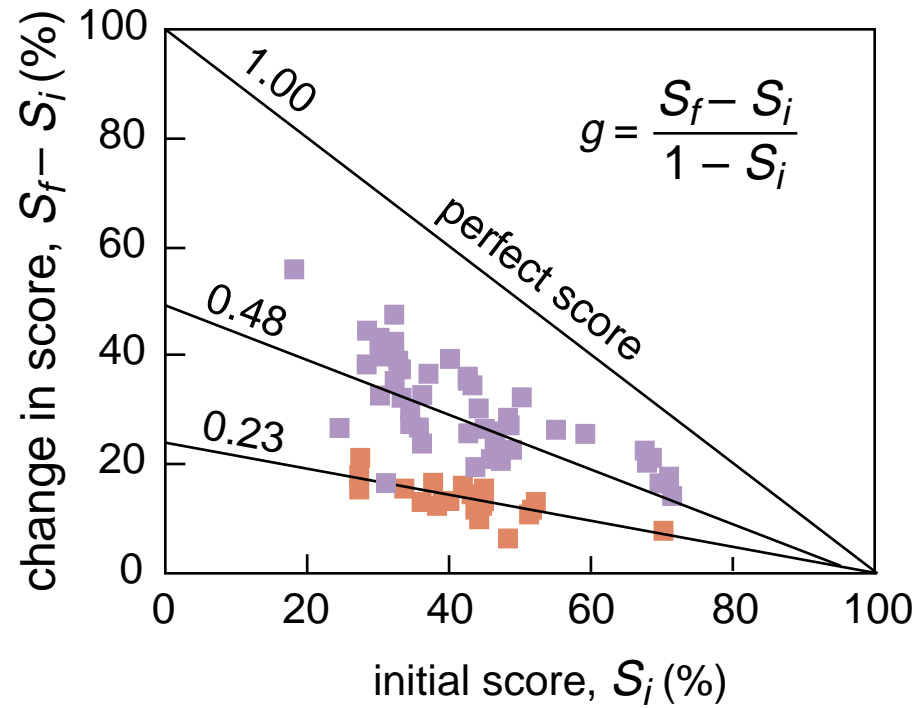
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# Results



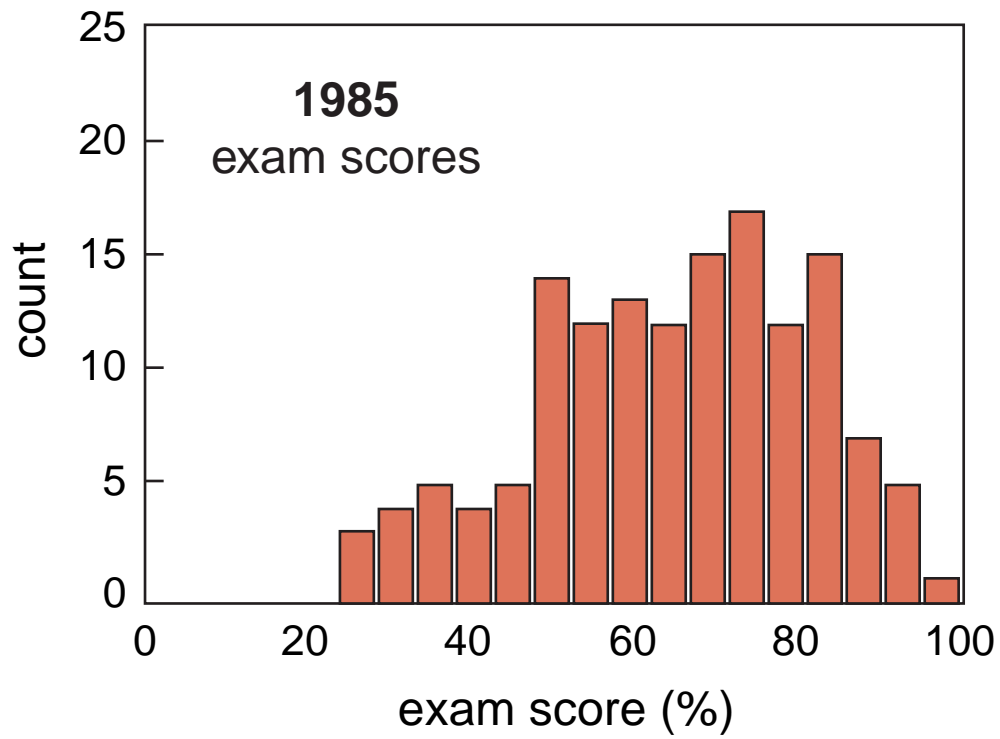
# Results



# *Results*

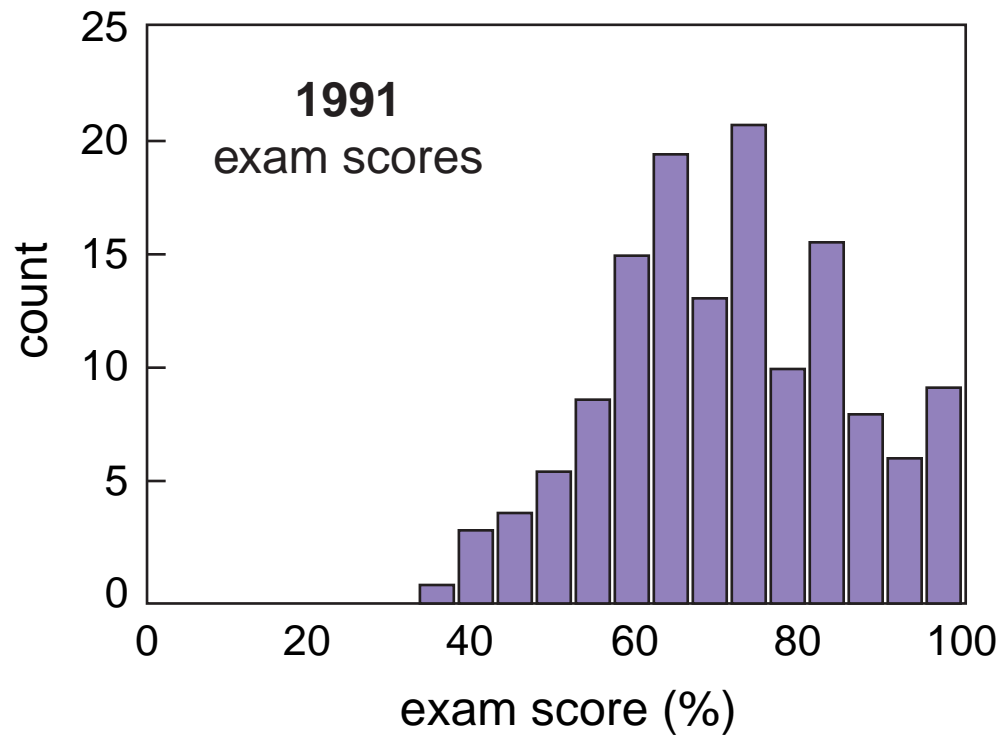
**What about problem solving...?**

# Results

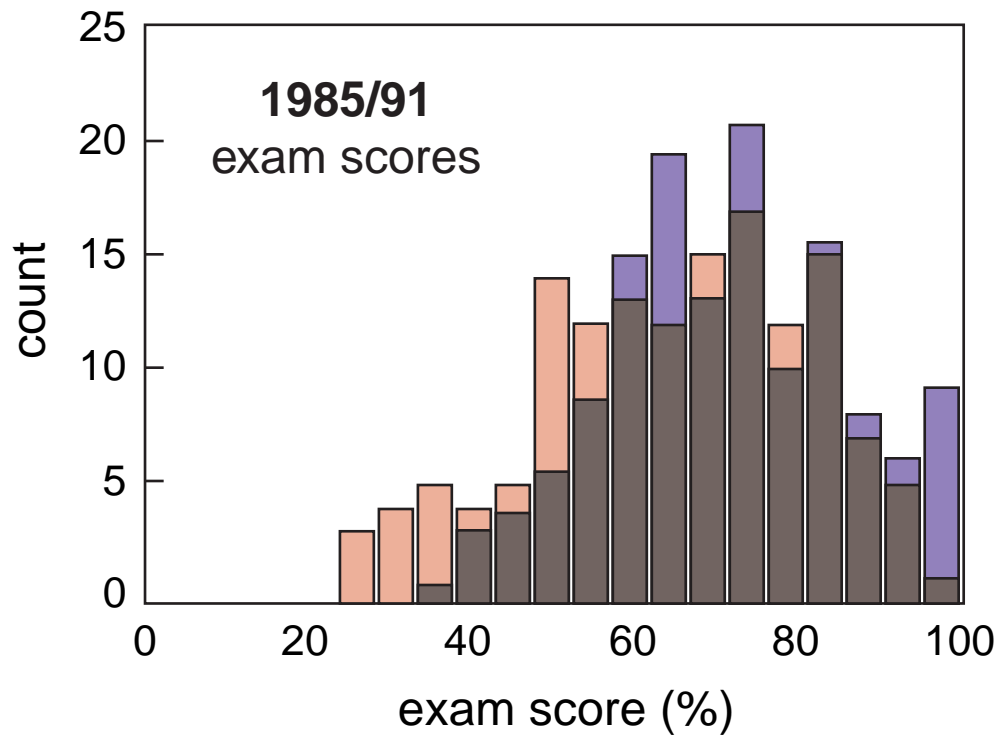




# Results



# Results



## *Why it works for students*

- ▶ **focuses students on understanding**

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## *Why it works for students*

- ▶ focuses students on understanding
- ▶ gets students thinking

## *Why it works for students*

- ▶ focuses students on understanding
- ▶ gets students thinking
- ▶ uncovers misunderstandings

## *Why it works for students*

- ▶ **focuses students on understanding**
- ▶ **gets students thinking**
- ▶ **uncovers misunderstandings**
- ▶ **builds confidence**

# *Why it works for instructors*

✓

✓

✓

✓

## *Why it works for instructors*

- ▶ **modification, not drastic change**

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## *Why it works for instructors*

- ▶ **modification, not drastic change**
- ▶ **adaptable**

## *Why it works for instructors*

- ▶ **modification, not drastic change**
- ▶ **adaptable**
- ▶ **resources (<http://galileo.harvard.edu>)**

# *Results*

**So better understanding leads to better  
problem solving!**

# *Results*

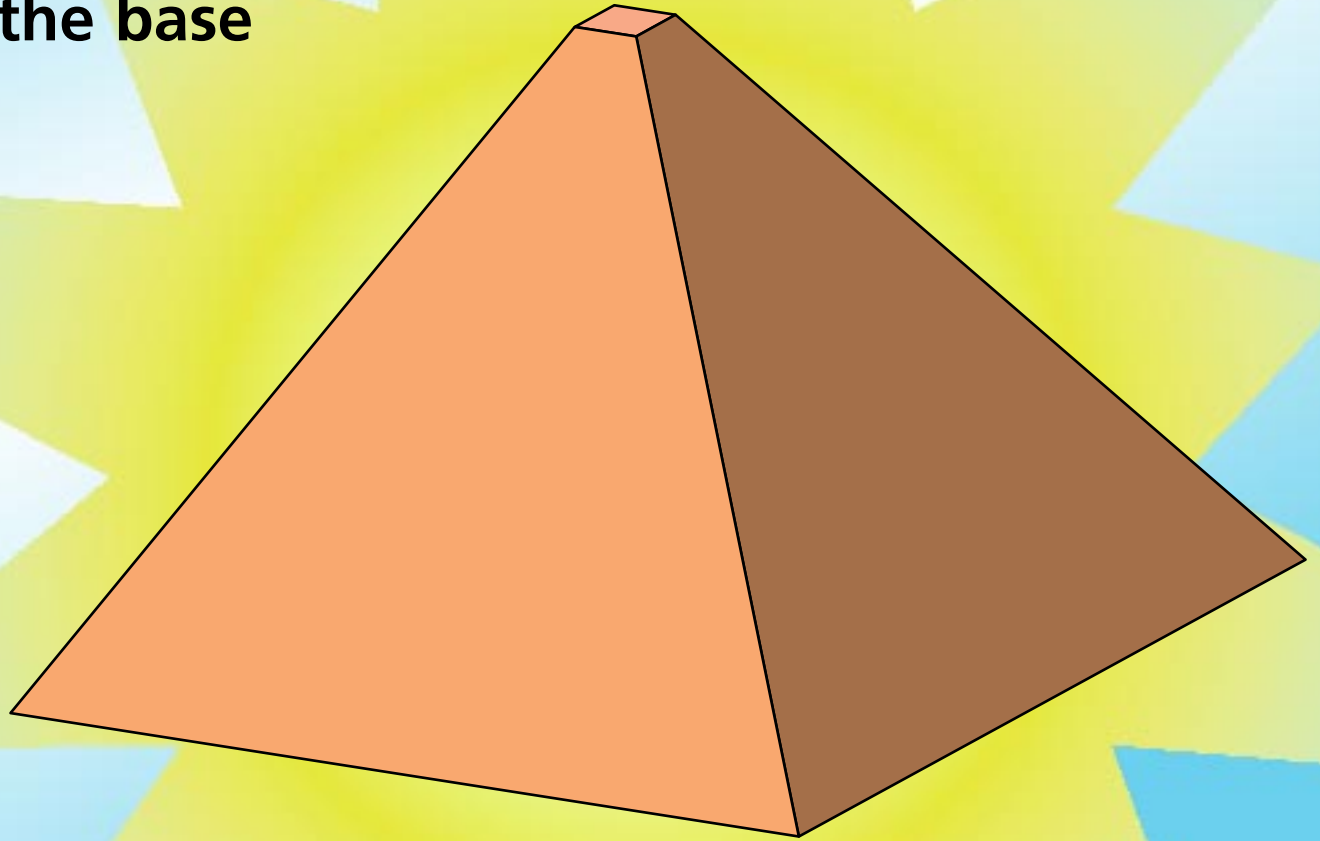
**So better understanding leads to better problem solving!**

**(but “good” problem solving doesn’t always indicate understanding!)**



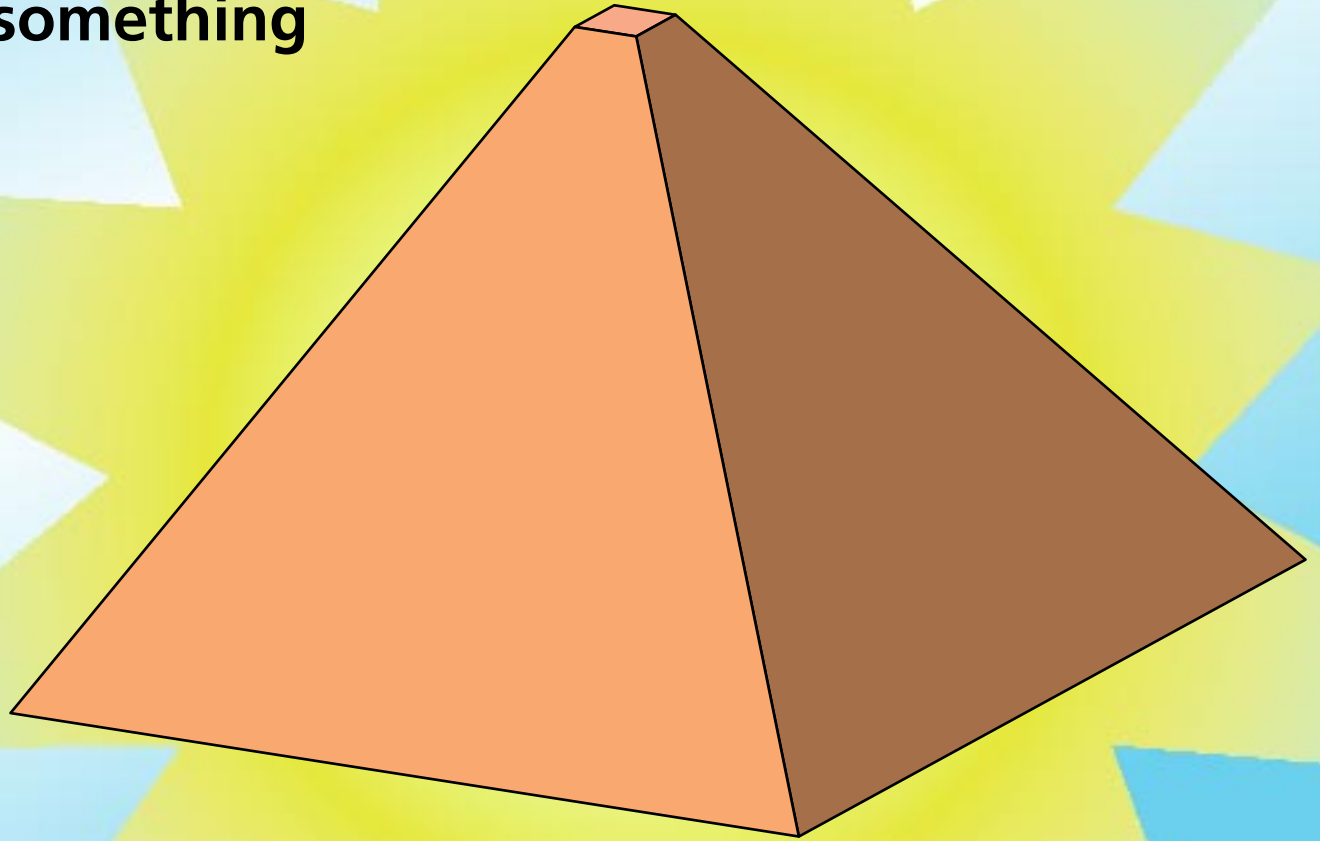
# *Conclusion*

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



# *Conclusion*

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



# *Conclusion*

## **Challenges:**

- ▶ **skepticism**
- ▶ **growing pains**



# *Conclusion*

## Rewards:

- ▶ engagement
- ▶ improved understanding
- ▶ class is fun!

## **Funding**

**National Science Foundation**

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

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