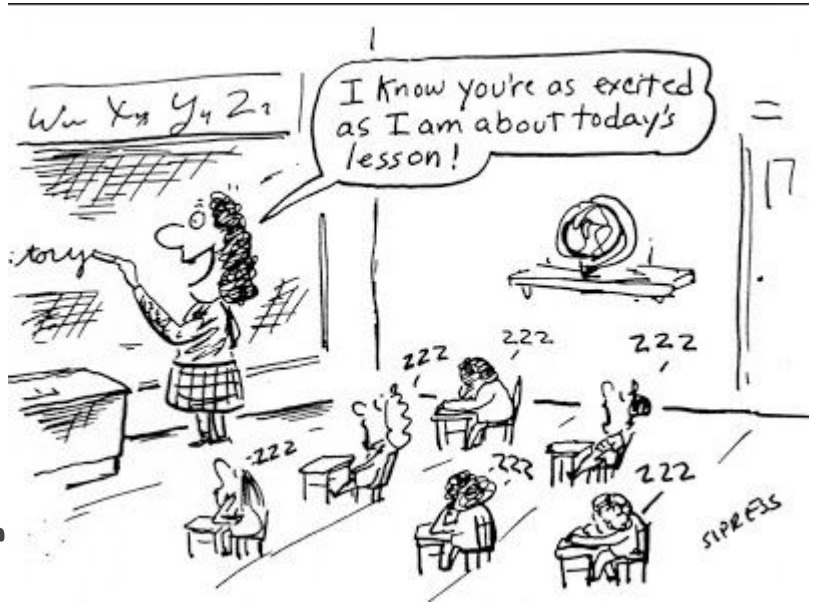
How To Stop Lecturing and Start Teaching

Tatiana Yudovina
Hawken School, Gates Mills, OH
tyudo@hawken.edu

Where I Teach

- Hawken School, an independent private school in suburb of Cleveland
- 85-minute blocks (4 per day)
- Typical class size: 18
- All students have laptops
- Algebra 1 through AP Statistics and AP Calculus

Why Change



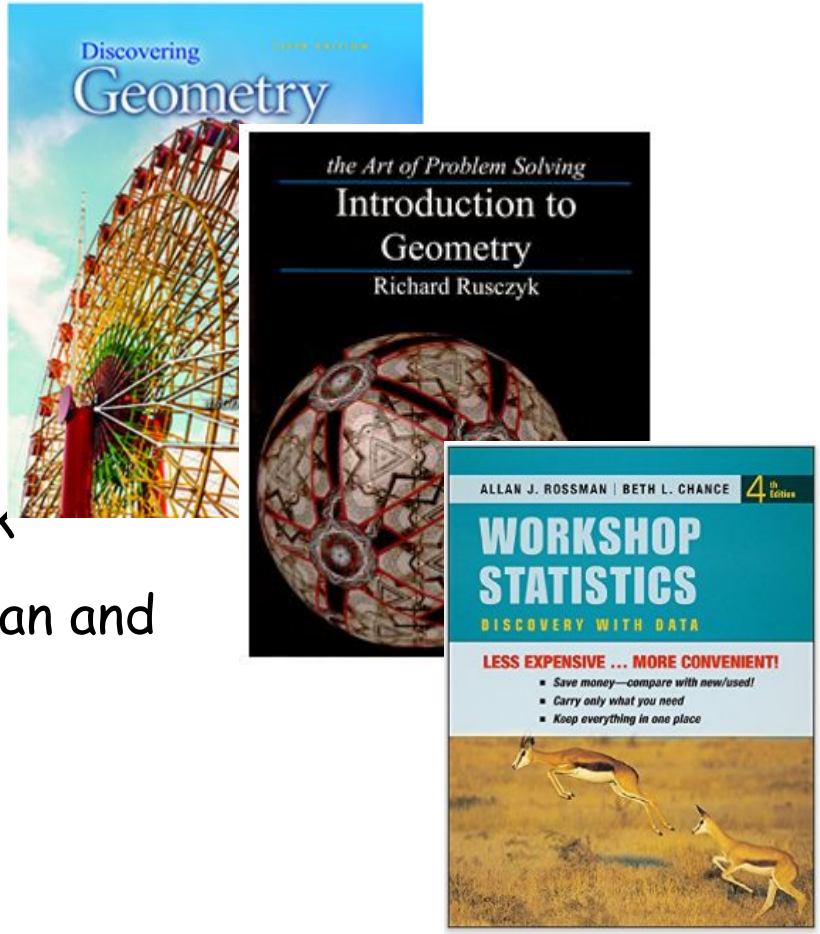
- It is more fun for students
- It is more fun for the teacher
- There is scientific evidence that it works:

Active learning increases student performance in science, engineering, and mathematics by Scott Freeman et al., *Proceedings of the National Academy of Sciences*, vol. 111 no. 23, 2014

http://www.pnas.org/content/111/23/8410.abstract

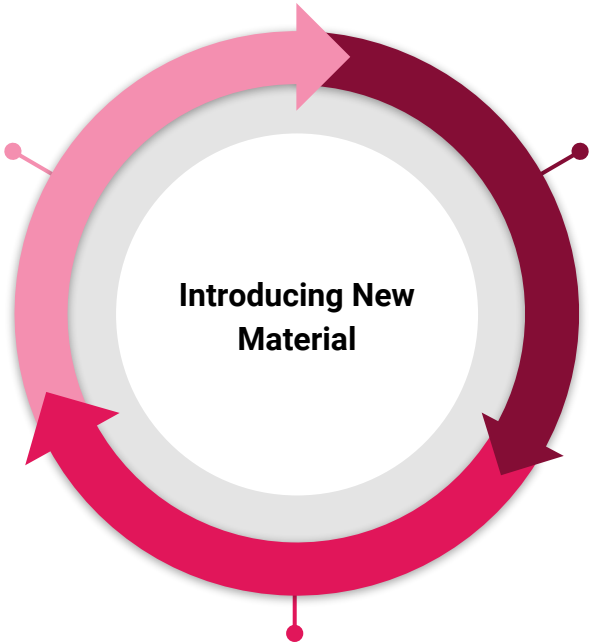
Inspiration

- Discovering Geometry by Michael Serra
- The Art of Problem Solving Textbook series by Richard Rusczyk
- Workshop Statistics by Alan Rossman and Beth Chance
- The Harkness Method



Three-phase process

Phase 3
Challenge problems in class



Phase 1
“Discover” concepts in class

Phase 2
Basic practice at home

Chapter 17. The Man With Two Faces.

Where you will find out that Voldemort has lived inside Professor Quirrell's body all along and Harry Potter will kill Quirrell by touching him.

Introducing a New Idea

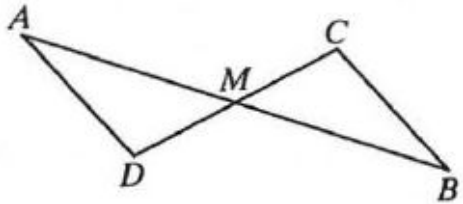
4-3 *Using Congruent Triangles*

Our goal in the preceding section was to prove that two triangles are congruent. Our goal in this section is to deduce information about segments or angles once we have shown that they are corresponding parts of congruent triangles.

Example 1

Given: $\overline{AB}$ and $\overline{CD}$ bisect each other at M.

Prove: $\overline{AD} \parallel \overline{BC}$



Plan for Proof: You can prove $\overline{AD} \parallel \overline{BC}$ if you can show that alternate interior angles $\angle A$ and $\angle B$ are congruent. You will know that $\angle A$ and $\angle B$ are congruent if they are corresponding parts of congruent triangles. The diagram suggests that you try to prove $\triangle AMD \cong \triangle BMC$.

Introducing a New Idea

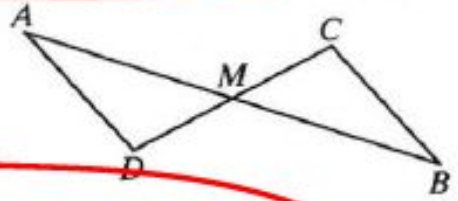
4-3 *Using Congruent Triangles* Spoiler!

Our goal in the preceding section was to prove that two triangles are congruent. Our goal in this section is to deduce information about segments or angles once we have shown that they are corresponding parts of congruent triangles.

Example 1

Given: $\overline{AB}$ and $\overline{CD}$ bisect each other at M.

Prove: $\overline{AD} \parallel \overline{BC}$



Plan for Proof: You can prove $\overline{AD} \parallel \overline{BC}$ if you can show that alternate interior angles $\angle A$ and $\angle B$ are congruent. You will know that $\angle A$ and $\angle B$ are congruent if they are corresponding parts of congruent triangles. The diagram suggests that you try to prove $\triangle AMD \cong \triangle BMC$.

example to follow

Introducing a New Idea

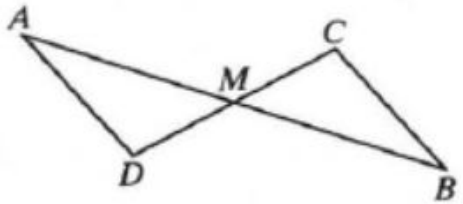
4-3 *Using Congruent Triangles*

Problem 1

Example 1

Given: $\overline{AB}$ and $\overline{CD}$ bisect each other at M.

Prove: $\overline{AD} \parallel \overline{BC}$

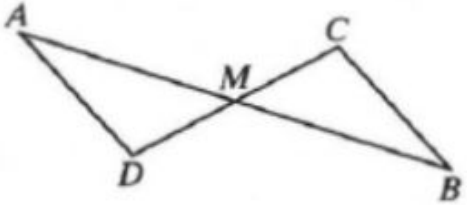


Introducing a New Idea

Problem 1

Example 1

Given: $\overline{AB}$ and $\overline{CD}$ bisect each other at M.



1. What relationships do you see in the diagram?

2. How do you know that the triangles are congruent?

3. How can you use the congruent triangles to explain your other observations?

Technology

- Geogebra Applets

  Introducing $\int_1^t f(x)\,dx$ http://tube.geogebra.org/m/1895997

  Parallel Lines https://www.geogebra.org/m/J4G6GgPP

- Desmos or other Graphing Calculator

- Computer Algebra Systems

Try It Yourself: The Rules

Note all bold or highlighted words - these are important terms

Check your answers before moving on:

- Compare within group
- Compare with other groups
- Ask the teacher
- Lookup online (reliable sources)

Don't google too soon!

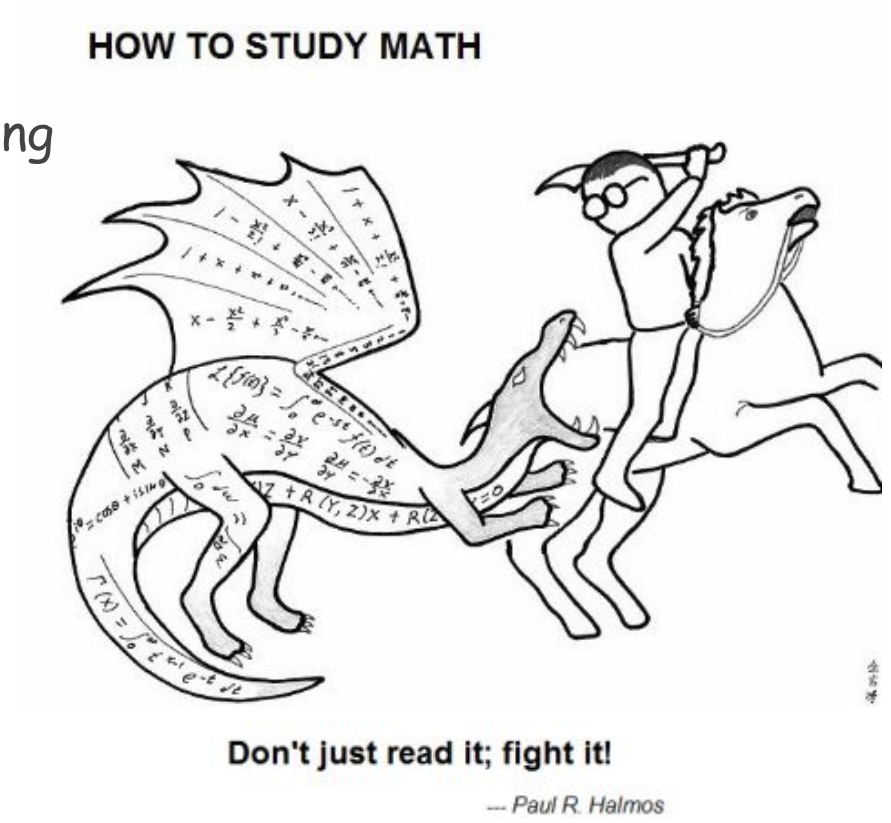
Use technology to check answers and avoid tedium

Students who appreciate it:

Josef H.: “math last year was very unlike any math class I had taken before. Because most of the class was hands on learning, it really required me to think outside the box and figure out how things relate to each other on my own or with the group that I worked with. That was certainly a hardship that I had to overcome because it forced me to not just memorize equations or memorize my notes from a class but I was able to understand how each topic related to each other, which I think is much more important facet of learning. “

Challenges

- Some students strongly resist working independently, especially at first.
- Some go through quickly without checking correctness.
- Some just want to get through the course.
- It takes time to put together the materials.
- Keeping fast students busy
- Keeping slow students caught up.



https://tinyurl.com/stoplecture

Questions?

Tatiana Yudovina
Hawken School, Gates Mills, OH
tyudo@hawken.edu