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"And I'm calling on our nation's governors and state education chiefs to develop standards and assessments that don't simply measure whether students can fill in a bubble on a test, but whether they possess 21st Century skills like problem solving and critical thinking and entrepreneurship and creativity."

President Obama, 1 March 2009

Using GeoGebra to Model Four Representations of Linear Equations

David Pugh, EdD & much material from Dr. Alan Schoenfeld, UC Berkley
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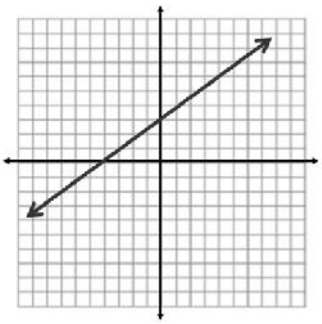
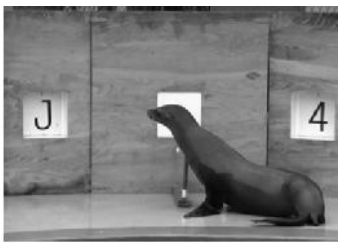
My "Principal" Lesson

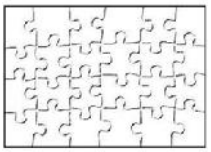


Are You Smarter Than a Sea Lion?



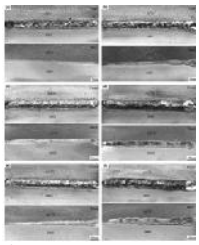
Typical Student Beliefs
Schoenfeld

- Students who have understood the mathematics they have studied will be able to solve any assigned problem in five minutes or less.



Typical Student Beliefs
Schoenfeld

- The mathematics learned in school has little or nothing to do with the real world.



Typical Student Beliefs
Schoenfeld

- Ordinary students cannot expect to understand mathematics; they expect simply to memorize steps and apply them to a problem.

- Go to Broadway
- South 3 blocks
- Turn Right
- West 1 block
- On your left.

The bottom line

Doyle, W. (1988). Work in mathematics classes: The context of students' thinking during instruction. *Educational Psychologist, 23*(2), 167-180.

Although students often accomplish a large amount of work, they seldom appear to be faced with tasks in which they are required to struggle with meaning. Of course, they often struggle with the meaning of work: What are they supposed to do, when do they have to finish, what is the answer to the fifth problem? But, meaning itself is seldom at the heart of the work they accomplish.

What is Math?

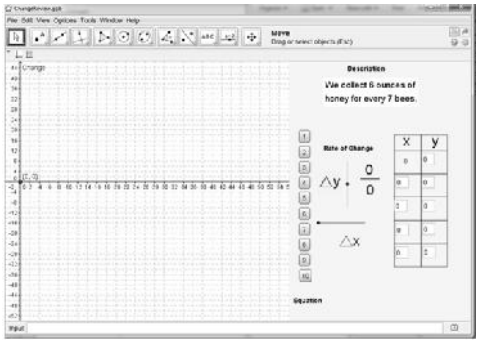
Schoenfeld, A. H. (1988). When good teaching leads to bad results: The disasters of "well-taught mathematics courses". *Educational Psychologist, 23*, 145-166.

"If the 'bottom line' is error-free and mechanical performance, students come to believe that that is what mathematics is all about."

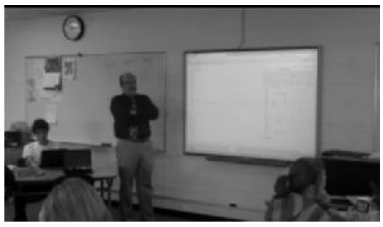
The Practices in CCSS-M

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments…
- Model with mathematics
- Use appropriate tools strategically
- Attend to Precision
- Look for and make use of structure
- Look for and express regularity in repeated reasoning.

Using GeoGebra



How My Students Responded

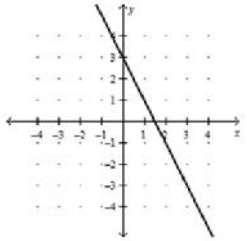


KNOW INTERACT CREATE

Know / Do	Interact	Create
Something that could be asked on a multiple choice test. What the student needs to know in order to do the interact piece.	Something that could be answered with a short answer or paragraph. Which one? Why?	Something the student does without help from the teacher. Students with questions will be directed back to the interact section.

Presentation 33
Pugh: Using GeoGebra to Model Four Representations of Linear Equations

KNOW



The slope of the line is:

a. $m = 2$
b. $m = -2$
c. $m = -\frac{1}{2}$
d. $m = \frac{1}{2}$

Khan Academy

YouTube

Thatquiz

GeoGebra

KNOW

1. Over a 10 day period, the amount of propane in a tank that stores propane for heating a home decreases from 461 gallons to 439 gallons. What is the rate of change (slope) of the gas in the tank?

a. $\frac{2}{11}$ b. $\frac{11}{2}$ c. $-\frac{11}{2}$ d. $\frac{2}{11}$

2. At a speed of 45 yards per minute, a 125-pound swimmer burns 110 calories in 35 minutes. Which data table could model the number of calories burned?

a.

x	y
0	0
49	55
88	110

b.

x	y
0	0
55	19
110	38

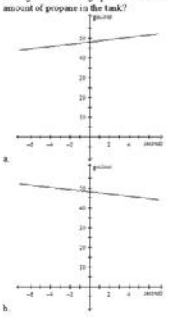
c.

x	y
0	0
55	−19
110	−38

d.

x	y
0	0
19	55
38	110

3. Over a 24 second period, the amount of jet fuel in an airplane's tank increases from 48 gallons to 62 gallons. Which graph could model the amount of propane in the tank?



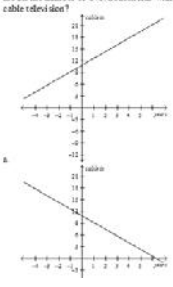
KNOW

1. According to the data table below, what is the average rate of change (slope) of the students at Harrison High School during this time period?

Students at Harrison High School	
Years from now	Students
0	700
9	1147

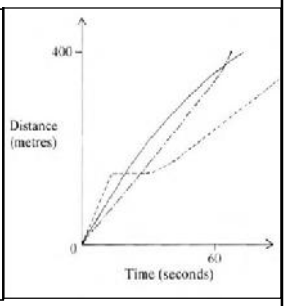
a. $\frac{3}{149}$
b. $\frac{3}{149}$
c. $\frac{149}{3}$
d. $\frac{149}{3}$

4. In 1974, there were 10.8 million U.S. households with cable television. In 1998, there were 48.8 million U.S. households with cable television. Over that time period, which graph could model the number of U.S. households with cable television?



INTERACT

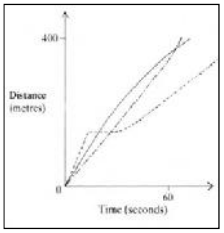
This is a rough sketch of 3 runners' progress in a 400 meter hurdle race. Imagine that you are the race commentator. Describe what's happening as carefully as you can. You do not need to measure anything accurately.



INTERACT

Match each line in the graph with a column from the spreadsheet data.

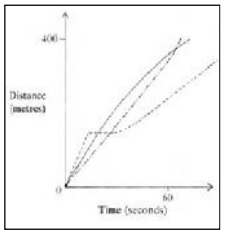
Find the speed of each runner between 10 & 15 seconds and between 55 and 60 seconds.



Time	Distance A	B	C
0	0	0	0
5	30	35	35
10	60	70	50
15	90	105	75
20	120	105	100
25	150	105	125
30	180	135	150
35	205	145	175
40	234	165	200
45	255	185	225
50	280	205	250
55	310	225	285
60	340	245	320
65	365	265	355
70	390	285	400

INTERACT

You are a coach for the three runners in this race. Write two bullet points for each runner to improve their race.



Time	Distance A	B	C
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5	30	35	35
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15	90	105	75
20	120	105	100
25	150	105	125
30	180	135	150
35	205	145	175
40	234	165	200
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CREATE

Record notes about your travel to school for 4 days. Pick two that have significant differences.

For each of the two trips you choose, make a graph, data spreadsheet, and describe in a paragraph.

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Scale Factor & Similarity

Create – Choose one of the three projects

Price Comparison

Choose a product that comes in at least three sizes. Compare the scale factor of the area or volume to the scale factor of the prices. Write a report on your findings. Paragraph headings for the report are:
Introduction: What did you choose. Why did you choose it?
Hypothesis statement: What do you think the outcome will be?
Methodology: What did you do. Where did you get your data? How did you verify measurements?
Data: What did you find out? Make a table comparing the scale factors.
Conclusion: What is the better buy? When would the worse buy be a good option?

Report must be typed and printed. You may use a report format or a powerpoint format with each paragraph represented by a slide.

Car Scale Drawing

Scale Factor & Similarity

Know / Do

Watch this video on similarity and proportions.

Get the packet from the files.

Complete the worksheet on scale factors and similarity.

Create a spreadsheet to find scale factors, and use the spreadsheet to check your work on the worksheet. Watch this video for directions.

Complete the worksheet on scale factor, area, and volume.

Scale Factor & Similarity

Create – Choose one of the three projects

Car Scale Drawing
Choose your favorite car. (A field trip to a car dealership could be arranged.) Take at least 15 measurements, then use a spreadsheet to convert the measurements to a smaller scale. Using the smaller scale, make a poster-sized perspective drawing of your car. Color it with pencils or markers.

Building Model
Choose a room in the ALC building. Take at least 15 measurements and use a spreadsheet to convert them to a small scale. Use cardboard or foam board to create a 3-D model of the building.

Scale Factor & Similarity

Interact

Find the diameter and price of similar pizzas from the same pizza place. Make a presentation that clearly shows the scale factor of the diameter, the scale factor of the area, and the scale factor of the price of each pizza. Come to a conclusion of which pizza is a better buy.

Make a scale drawing. The drawing must be clearly labeled and include the scale factor used.

Choose one:

- Find a picture and create an enlargement using graph paper or lined poster board.
- Choose a room in the school and create a scale drawing of the room using graph paper or lined poster board.