Promoting Gender Awareness (and Reasoning) in the Mathematics Classroom

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Contents of today's session

- Introductions
- Teachers' influence on gender attitudes
- Inspiring students by introducing the utility value of mathematics
- Activity: solving proportions
- Scenario: classrooms that give students mathematical authority

Activity: Introductions

With your neighbors, introduce yourselves to one another.

- Describe your responsibilities in mathematics education.
- What do you hope to learn from today's session?

Why do we want to encourage women & girls to pursue STEM?

- Diverse populations bring diverse perspectives –
- *Diversity Trumps Ability (Page, 2007)*
- If all of our students have the same backgrounds, they can't work as efficiently to solve problems.

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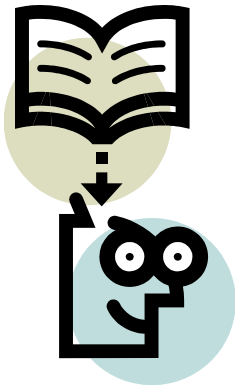
Research on language and gender

- Consider: How can teachers ensure gender equity in classrooms?



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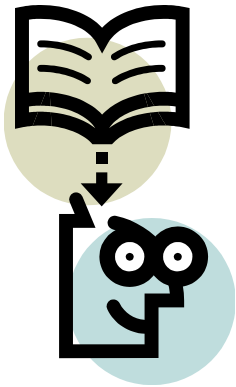
Research on language and gender

- Consider: How can teachers ensure gender equity in classrooms?
- With a partner, discuss strategies you've used or seen others use. Be prepared to share a few ideas with the group.



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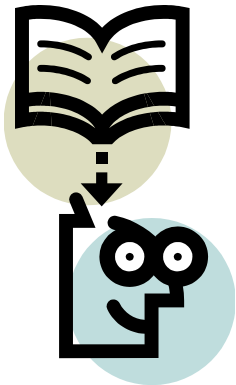
Research on language and gender

- Consider: How can teachers ensure gender equity in classrooms?
- With a partner, discuss strategies you've used or seen others use. Be prepared to share a few ideas with the group.
- Read the article *Good Morning Boys and Girls!* (Bigler, 2005)



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What does research say?

- Strategies that teachers use (with good intentions) may increase gender stereotyping.
- Gender labeling leads students to infer that teachers are intentionally highlighting differences due to gender.
- Teachers should avoid labeling by gender.
- Classrooms should be organized by educationally relevant groups whose membership can change.

(Bigler, 2005)

Meeting the needs of all learners

Organizing and addressing students by characteristics that are within their control meets

- NCTM Equity Principle
- Horizon Research Characteristics for Effective Classrooms – culture.

The Leaky Pipeline

- Only half as many female freshmen plan to pursue STEM major as their male counterparts (NSF, 2009)
- But they leave these majors at the same rate (USDE NCES 2000).
- One of the main reasons cited for why women do not choose STEM careers is lack of interest, in which **the utility value**, that is perceived significance, of mathematics plays an important role (Sian, Hoon Teoh, 2010).

Classroom Examples

- Students in calculus are usually required to be there by their major/degree program
- They don't necessarily know ***why*** they need to know calculus
- Answer "*Why do I need to know this?*" on their own!

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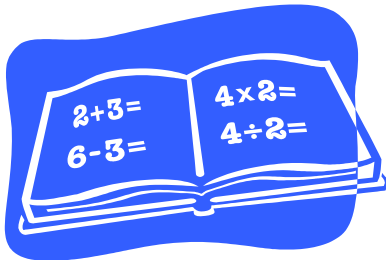
Utility Value Activity

- PowerPoint presentation demonstrating uses of mathematics in biology, national security, political science & economics

- Each example was from *research literature*

- Homework assignment



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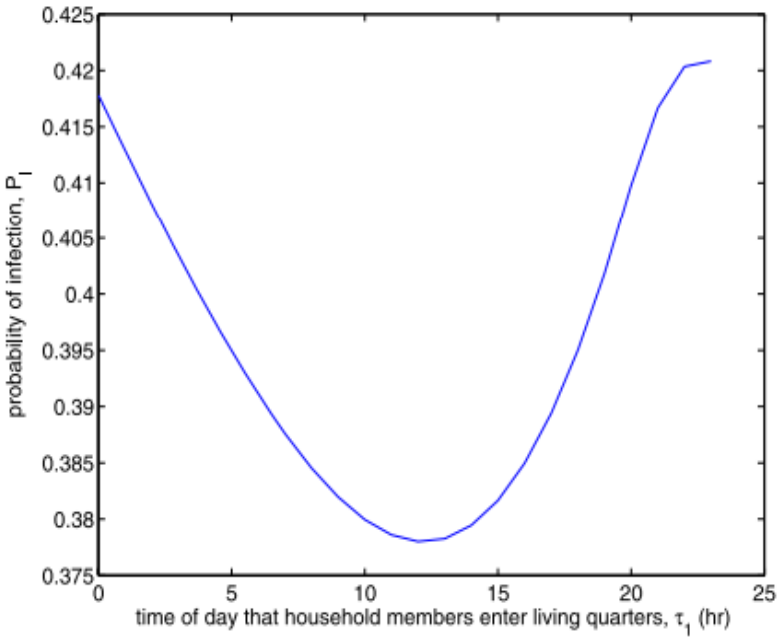
Spread of Disease

Quantifying Routes of Transmission for Pandemic Influenza

How much influenza transmission is due to different transmission modes?



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National Security

Analyzing a Bioterror Attack on the Food Supply: The Case of Botulinum Toxin in Milk

- Hypothetical
- Disaster Response
- Majors: Business, Biology…

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Social Justice

Africa's Poverty Trap

- $dk/dt = sAf(k) - (n + d)k.$

- Modeled negative growth in income per capita during 1980-2000
- Majors: Economics, Political Science, Public policy,…

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Political Science

What effect does my vote really have?

The Mathematics and Statistics of Voting Power

- Electoral College (two-stage elections)
- Weighted elections
- Various voting systems used in US

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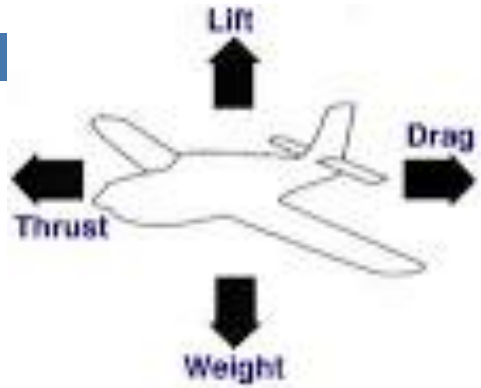
Pilot's Math – Renate McLaughlin



- PhD in Mathematics
- Pilot's License
- Speaks to High School Students about the mathematics of flying
- Private pilots do not have crews of experts
- 'Safe Envelope' of weight & balance conditions for each aircraft (published in operating handbook)

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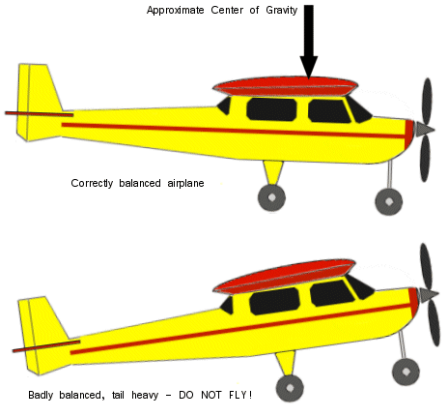
Airplane Center of Gravity

You have full fuel on board. The pilot weighs 130 lbs. One passenger on board weight 230 lbs. Baggage area contains 150 lbs of luggage.

a) *Can you take the passenger and all luggage without exceeding maximum allowable weight?*

b) *Can this passenger sit in the front seat?*

The rear seat?



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Food Sciences – Nancy Powers Siler

- Worked in a hospital while earning her BS
- Became interested in assessing nutritional status and calculating diet prescriptions
- Now teaches students how to calculate nutritional values of formula feedings

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Foodservice Management (Elem.)

Cooking for large groups requires knowledge of conversions & basic math skills

- If there are 28 slices of bread per loaf, how many loaves of bread are needed to prepare 100 sandwiches?
- There are 32 tablespoons of butter in a pound. How many pounds are needed to butter both slices of bread for 100 sandwiches, using approximately 1.5 teaspoons per slice?

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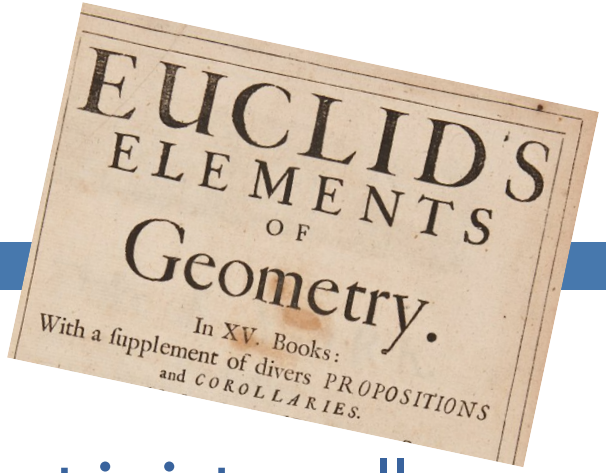
Energy, Protein & Fluid Estimations (Middle)

Determining correct energy, protein and fluid needs of clients

- Estimate the recommended calorie, protein and fluid levels for the following people: (given formulas)
  - Male, 27 years, 5'11", 200 lbs
  - Female, 33 years, 5'3", 130 lbs
  - Male, 81 years, 5'10", 180 lbs
  - Female, 83 years, 5'2", 110 lbs

Mathematical Authority


EUCLID'S
ELEMENTS
OF
Geometry.
In XV. Books:
With a ſupplement of divers PROPOSITIONS
and COROLLARIES.

- Mathematics rests on a structure that is internally derived and verified.

- What characterizes classrooms where the authority structure reflects the premise of mathematical authority?

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What authority do students expect?

- Some students don't believe they are capable of doing mathematics

  Feel that they *need* to mimic the teacher

What authority do students expect?

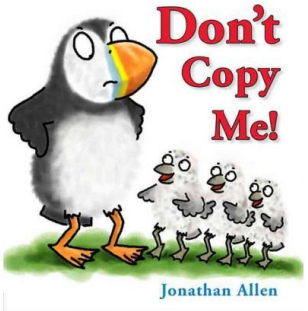
- Some students don't believe they are capable of doing mathematics

  Feel that they *need* to mimic the teacher

- Some students are unwilling to try difficult mathematics

  Believe the teacher is the expert and

  should be mimicked.



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Strategies to promote mathematical authority

- **Student-student** mathematical interactions

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- Construct **viable arguments** and critique the reasoning of others

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- **Persist** in problem solving

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Strategies to promote mathematical authority

- **Student-student** mathematical interactions
- Construct **viable arguments** and critique the reasoning of others
- **Persist** in problem solving
- Valuing student approaches, while holding high standards for all students to use multiple forms of **representation**

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Problem of the Day

There are two pitchers of lemonade.

Pitcher A was made from
8 cups of water and 4 cups of lemon concentrate.

Pitcher B was made from
10 cups of water and 6 cups of lemon concentrate.

Which of the lemonade mixtures
will taste stronger, or will they taste the same?
Support your answer.

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Ratio Tables

Mixture A		Divide by 2	Multiply by 4
Water	8	4	16
Lemon	4	2	8
Total	12	6	24

Mixture B		Divide by 2	Multiply by 3
Water	10	5	15
Lemon	6	3	9
Total	16	8	24

Ratio Tables

Mixture A		Divide by 2	Multiply by 4
Water	8	4	16
Lemon	4	2	**8**
Total	12	6	24

Mixture B		Divide by 2	Multiply by 3
Water	10	5	15
Lemon	6	3	**9**
Total	16	8	24

Ratio Tables

Mixture A		Divide by 2	Multiply by 4	Multiply by 5
Water	8	4	16	40
Lemon	4	2	8	20
Total	12	6	24	60

Mixture B		Divide by 2	Multiply by 3	Multiply by 4
Water	10	5	15	40
Lemon	6	3	9	24
Total	16	8	24	64

Ratio Tables

Mixture A		Divide by 2	Multiply by 4	**Multiply by 5**
Water	8	4	16	40
Lemon	4	2	8	**20**
Total	12	6	24	60

Mixture B		Divide by 2	Multiply by 3	**Multiply by 4**
Water	10	5	15	40
Lemon	6	3	9	**24**
Total	16	8	24	64

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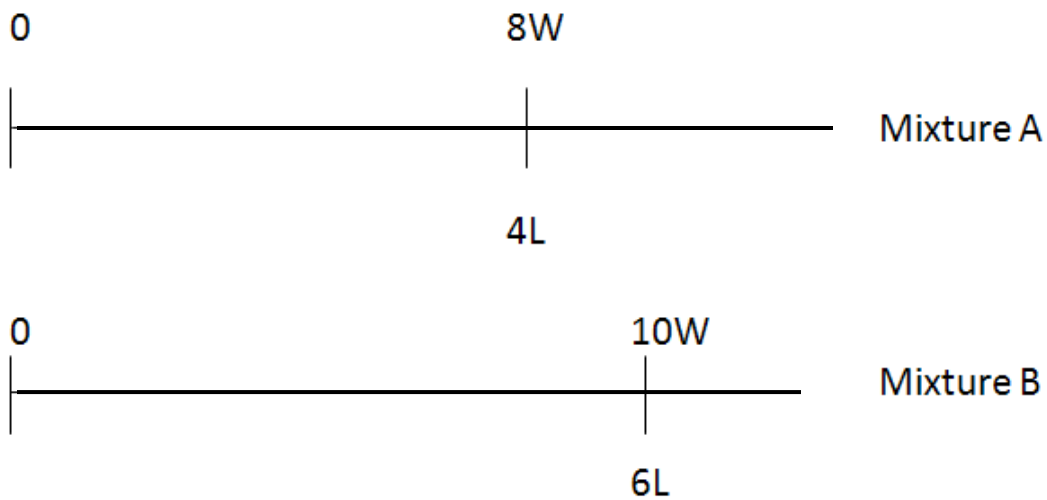
Double number lines



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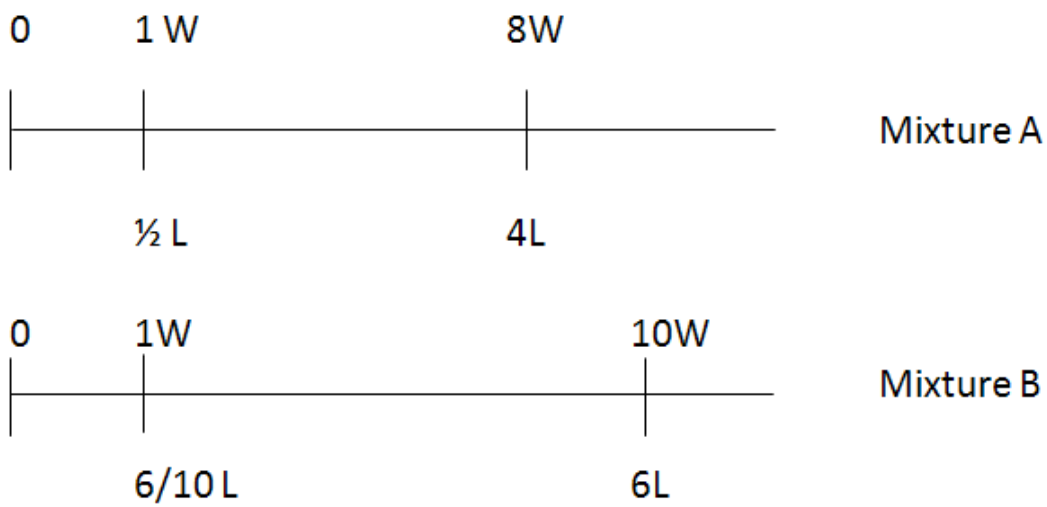


Proportion

Mixture A

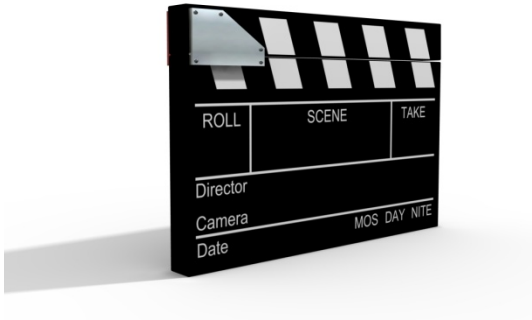
$$\frac{4 \text{ lemon}}{12 \text{ cups}} = \frac{x}{16 \text{ cups}}$$

$$x = 5\ 1/3 \text{ lemon}$$

Since mixture B has 6 cups of lemon in 16 cups of liquid, it is lemonier

Role play: Teacher-student pairs

- Practice fostering mathematical authority
- One person takes the role of teacher and the other plays the student
- (Make sure you have different colored papers)



What did you learn?

- What kinds of questions from the teacher helped the student to take the mathematical authority?
- What kind of questions from the teacher prevented student mathematical authority?
- What was necessary from the student?

What did you learn?

- What kinds of questions from the teacher helped the student to take the mathematical authority?
- What kind of questions from the teacher prevented student mathematical authority?
- What was necessary from the student?

- Try again, knowing what you know, switching roles!

Why sow diversity?

- Fairness: top paying jobs are in STEM fields
- Tapping the full potential of today's students (tomorrow's workforce)
- Improve critical thinking and informed citizenship

"The more familiar and humanized STEM subjects become to students, the more likely they are to picture themselves in these fields—and the more likely diversity will increase."

"Planting Seeds, Growing Diversity"
from the Spring 2011 issue of Teaching Tolerance

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Thank You!

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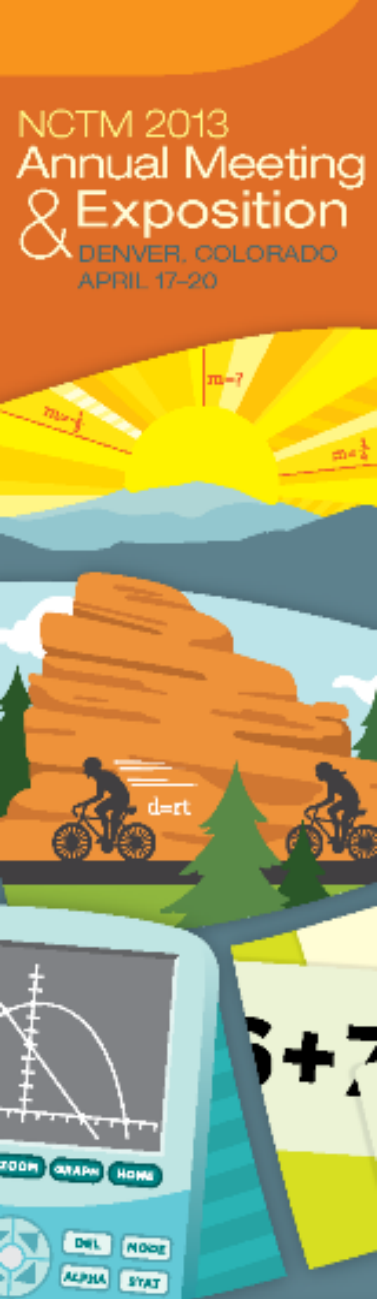

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