



Engaging the Teacher:
**Focusing on K-8 Mathematics to
Support Multiplicative Reasoning
and Problem Solving**

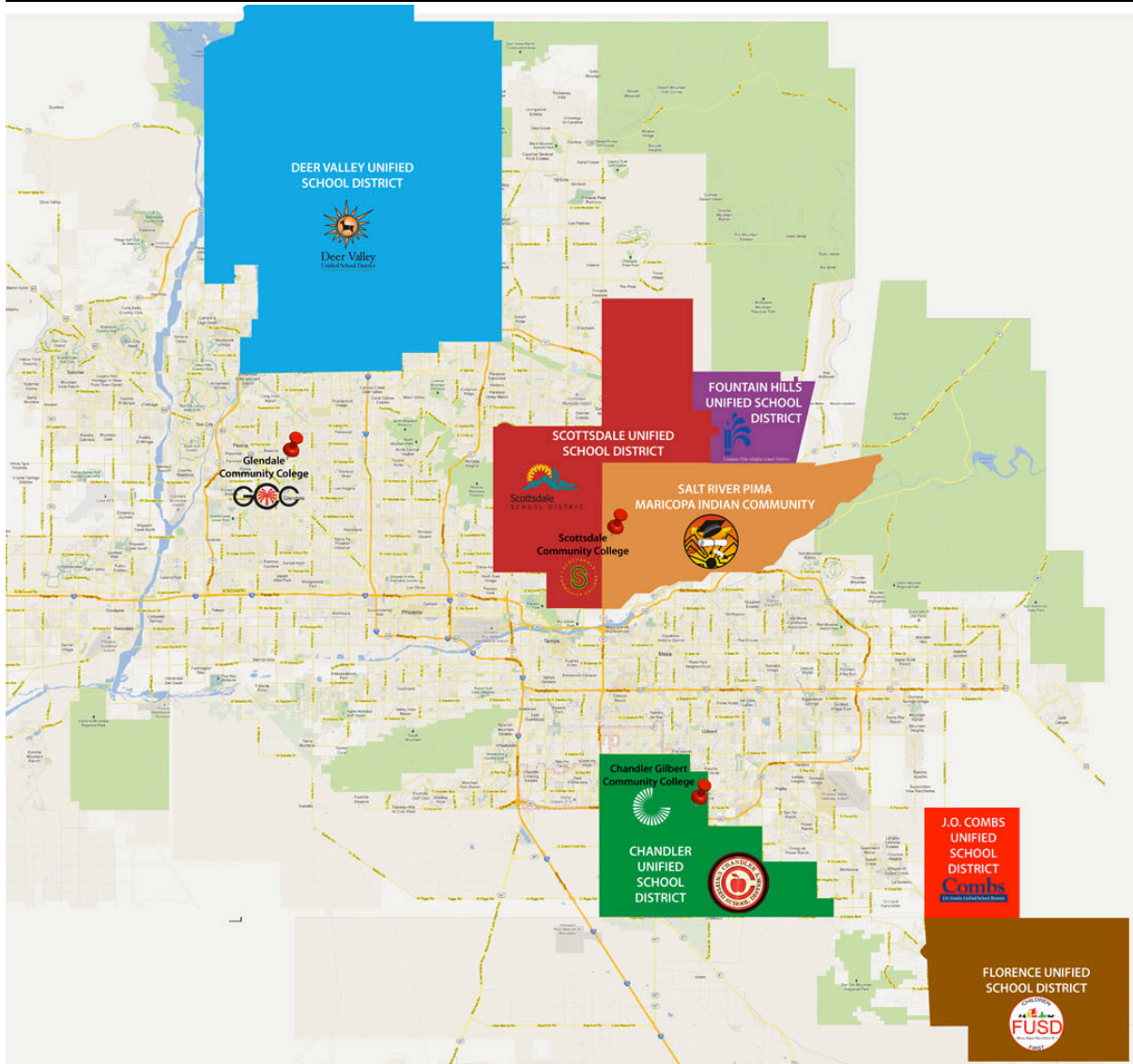
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NSF Grant
#1103080

Arizona Mathematics Partnership

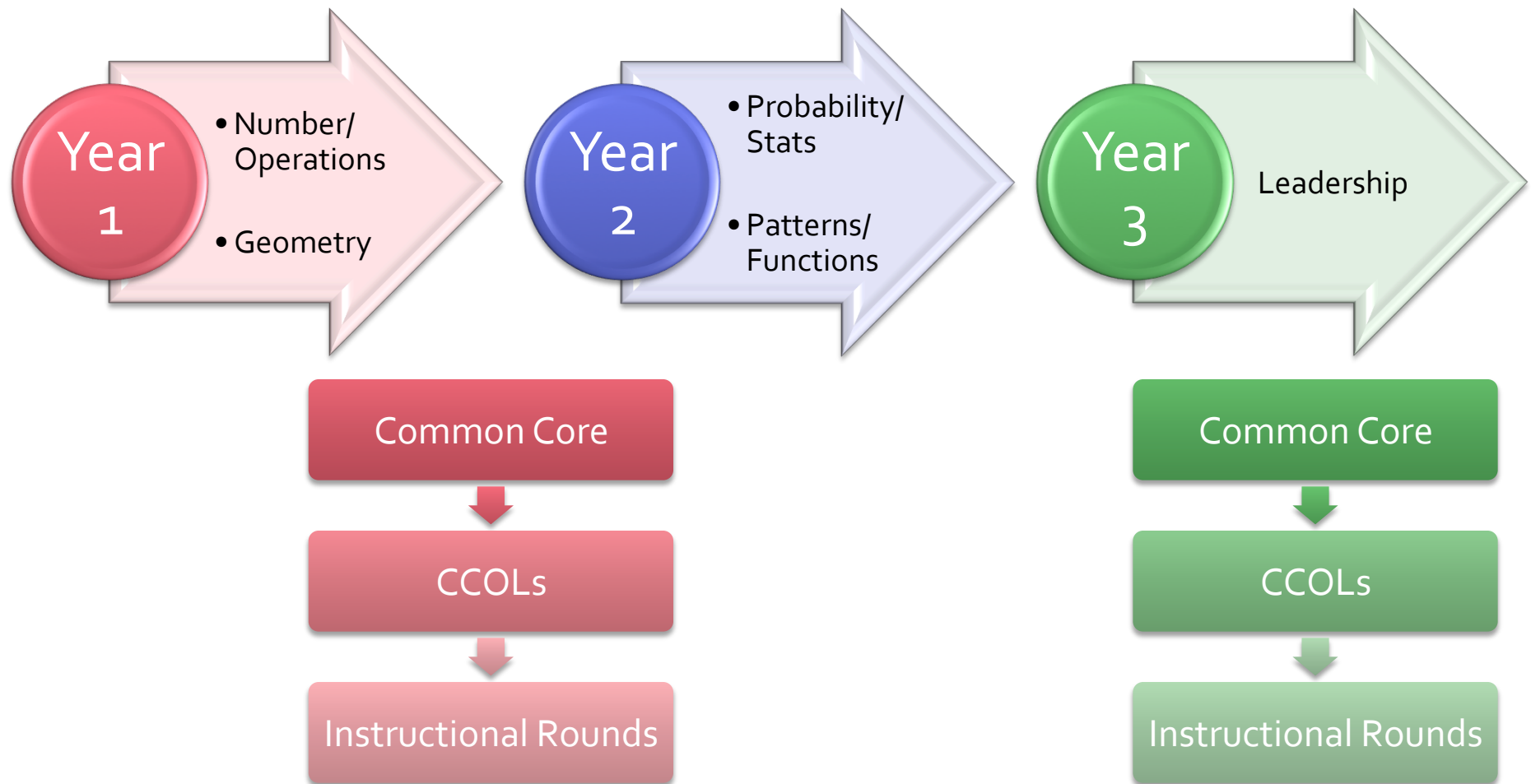


- 3 community colleges
- 7 school districts
- 300+ middle school math teachers
- Focus on professional development (100 hrs)
 - Summer Institutes
 - Saturday Workshops
 - CCOLs
- Improve developmental ed in CCs
- Research in math education

Professional Development



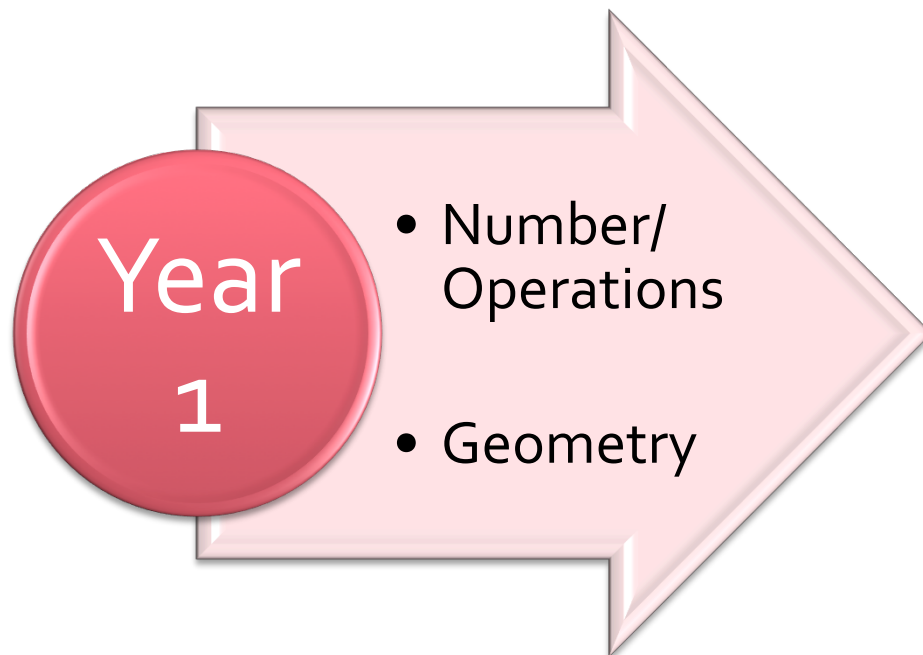
Institutes/Workshops



Professional Development

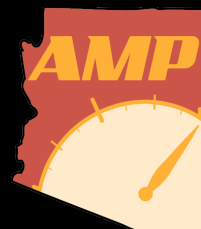


Institutes/Workshops



Common Threads...

- Multiplicative versus Additive Reasoning
- Proportional Reasoning



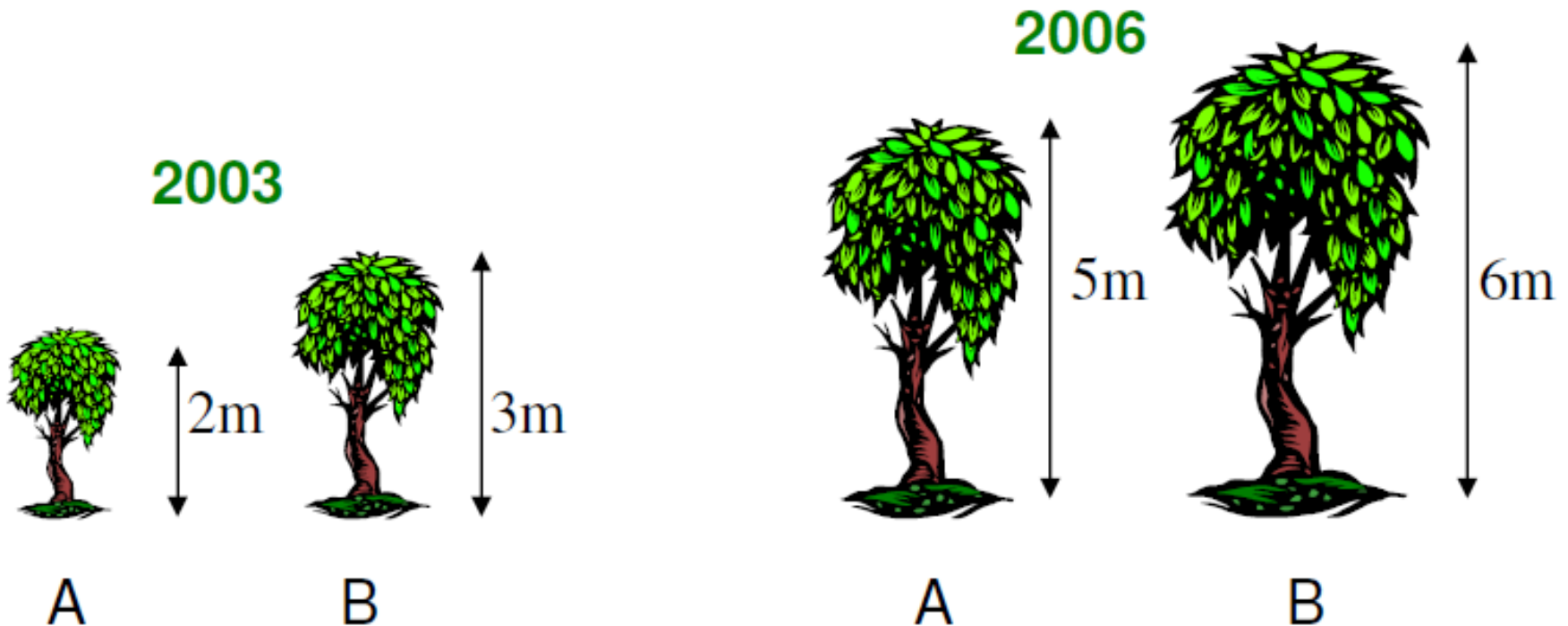
Multiplication

What does it mean to multiply?

- 3×2
- $\frac{1}{4} \times 6$
- $\frac{3}{4} \times \frac{1}{2}$

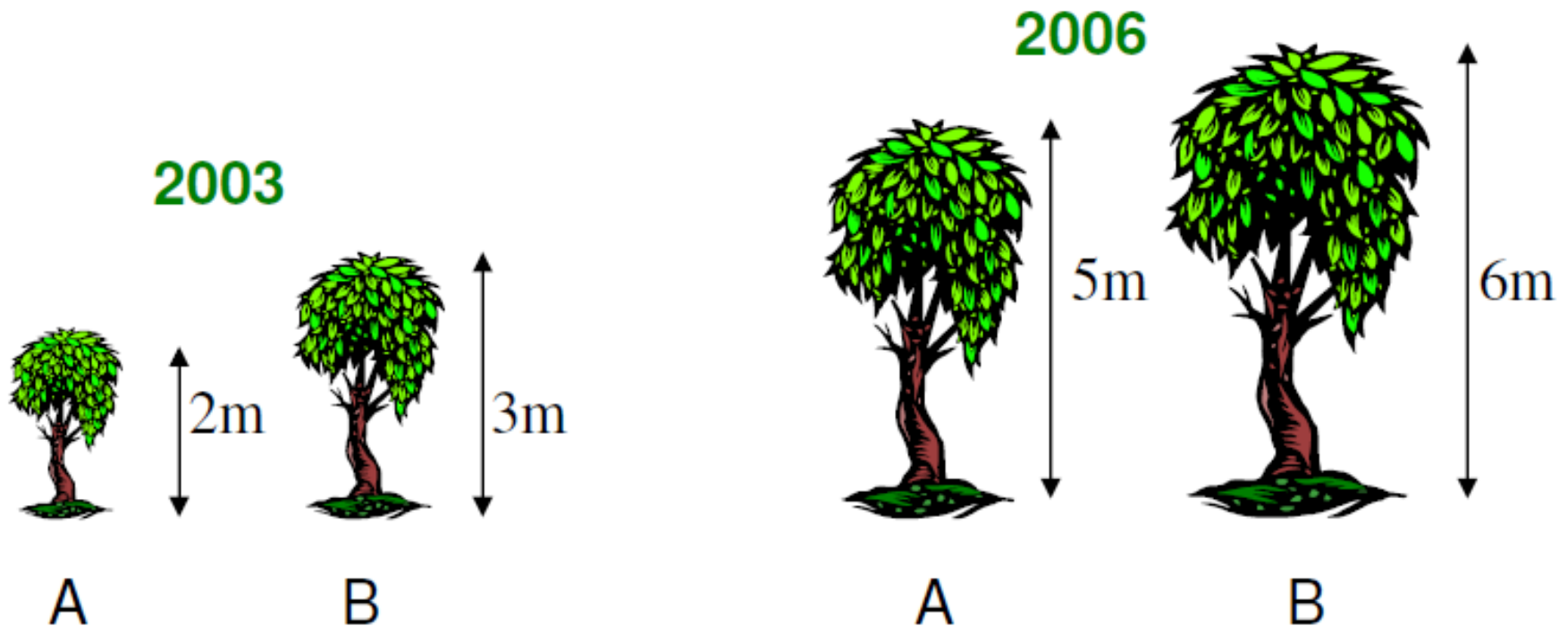


An Introductory Problem



Which tree, A or B, grew more?
Explain your reasoning.

An Introductory Problem



Focus on the 2006 situation. How much taller is Tree B than Tree A?

An Interesting Problem



Sue and Julie were running around a track equally fast. Sue started before Julie. When Sue had run 9 laps, Julie had run 3 laps. How far had Sue run when Julie had run 15 laps?



Cramer, K. & Post, T. (1993, February). Making connections: A Case for Proportionality. *Arithmetic Teacher*, 60(6), 342-346.

Proportional Reasoning



Sue and Julie were running around a track equally fast. Sue started before Julie. When Sue had run 9 laps, Julie had run 3 laps. How far had Sue run when Julie had run 15 laps?

$$\frac{9}{3} = \frac{x}{15}$$

$$3x = 9 \cdot 15$$

$$3x = 135$$

$$x = 45$$

What is the Mathematics?



ADDITIVE RELATIONSHIP

- The number of laps that Sue runs is always 6 greater than the number of laps that Julie runs.
- The runners are running at the same speed.

MULTIPLICATIVE RELATIONSHIP

- The number of laps that Sue runs is always 3 times as large as the number of laps that Julie runs.
- The runners are not running at the same speed!

Make the important
mathematics explicit!



Proportional Reasoning

Sue and Julie were running around a track equally fast. Sue started before Julie. When Sue had run 9 laps, Julie had run 3 laps. How far had Sue run when Julie had run 15 laps?

$$\frac{9}{3} = \frac{x}{15}$$

$$3x = 9 \cdot 15$$

$$3x = 135$$

$$x = 45$$

3000% Drop?



Suppose you pay \$8,000 per year for health insurance. You are informed that your health insurance costs will drop by 3000%. What does this mean?



■ RISING PREMIUMS

Year	Single	Family
2000	\$2,471	\$6,438
2001	\$2,689	\$7,061
2002	\$3,083	\$8,003
2003	\$3,383	\$9,068
2004	\$3,695	\$9,950
2005	\$4,024	\$10,880
2006	\$4,242	\$11,480
2007	\$4,479	\$12,106
2008	\$4,704	\$12,680
2009	\$4,824	\$13,375

Source: Kaiser Family Foundation; Health Research & Educational Trust



3000% Drop?



ANDREA MITCHELL REPORTS

LIVE

S&P 1144.24

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DEVELOPING NOW

TOP STORIES

PRES. OBAMA: OUR PROPOSAL IS PAID FOR

radioviceonline.com

A screenshot of a news broadcast. At the top, a white banner contains the text 'ANDREA MITCHELL REPORTS' on the left, 'LIVE' in a red box in the center, and 'S&P 1144.24' and the 'msnbc' logo on the right. The main image shows President Barack Obama speaking at a podium with two microphones. He is wearing a light blue shirt and a purple tie. Behind him is a large crowd of people, some of whom are clapping. At the bottom of the screen, there is a blue banner with a white arrow pointing right, containing the text 'DEVELOPING NOW'. Below this is another blue banner with a white arrow pointing right, containing the text 'TOP STORIES'. To the right of these banners is a dark grey box with the text 'PRES. OBAMA: OUR PROPOSAL IS PAID FOR' in white. At the bottom right, there is a white banner with the text 'radioviceonline.com' in black.

Multiplication Problem



You have subscribed to Verizon broadband internet access. Your contract calls for a rate of \$0.002 per kilobyte of use while in Canada (that is, the data transfer rate is \$0.002 per kilobyte). How much will you pay for 35896 kilobytes of use? Explain how our meaning of multiplication plays a role in this problem.



Verizon Customer Service



Multiplicative or Additive?



TEXT OF BALLOT - TEXTO DE LA BOLETA

PROPOSITION 406 / PROPOSICIÓN 406

TRANSACTION PRIVILEGE TAX INCREASE FOR POLICE, FIRE, COURT AND PROSECUTOR OFFICE SERVICES OF THE TOWN

Official Title: Increase the transaction privilege tax to 1.75%, of which .25% shall be for police, fire, court and prosecutor office services of the Town.

Descriptive Title: Pursuant to A.R.S. § 42-6006, the Town of Gilbert, Arizona seeks voter approval of an increase in the transaction privilege tax by .25% to be used for police, fire, court and prosecutor office services of the Town.

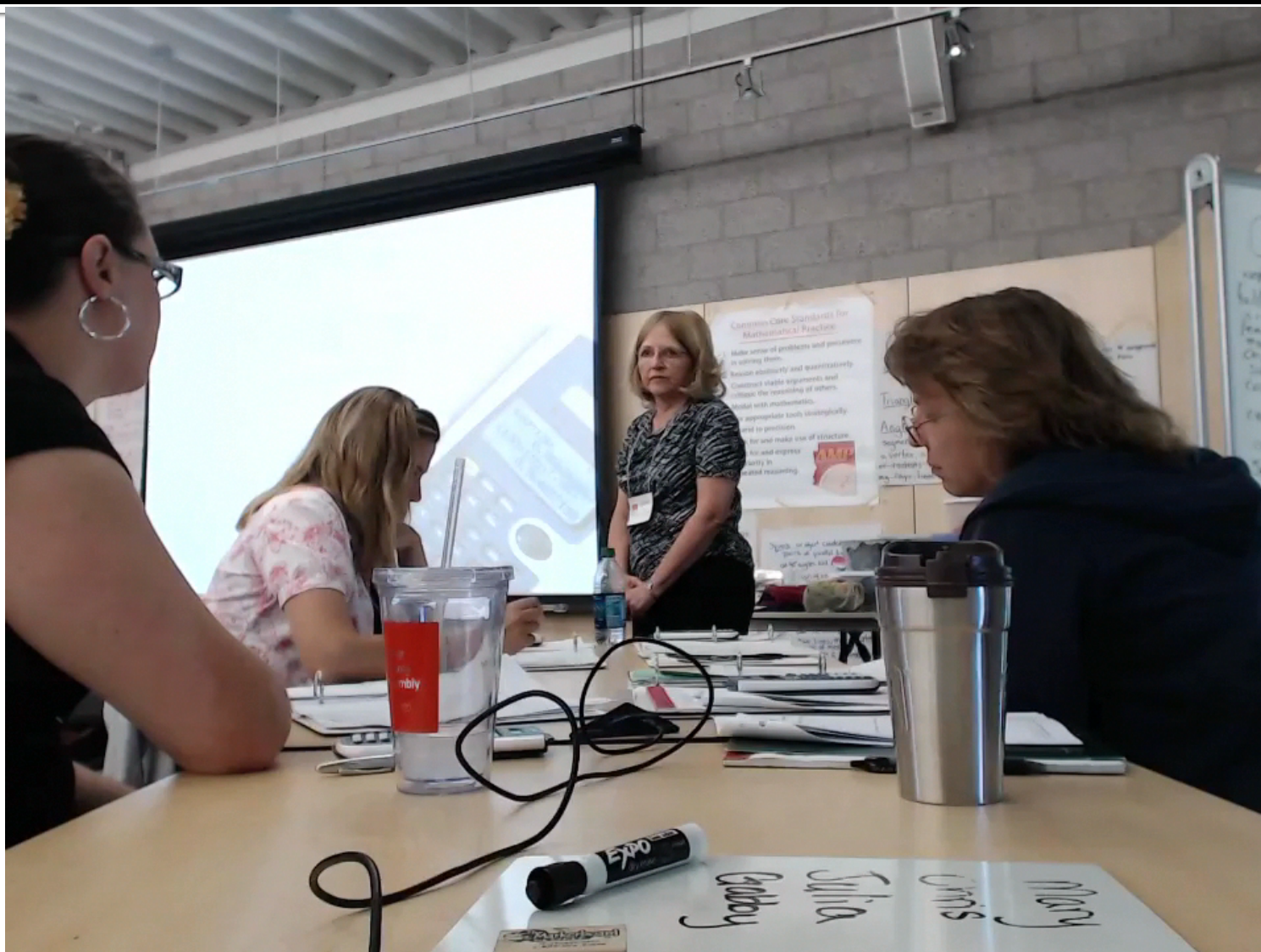
Proposition 406:

Shall an ordinance amending the Municipal Code of Gilbert, Arizona, Chapter 58 Taxation, Article II Transaction Privilege Tax, be adopted to increase the existing transaction privilege tax of 1.50% to 1.75%, of which the .25% increase shall be for police, fire, court and prosecutor office services?

A "YES" vote shall have the effect of increasing the transaction privilege tax from 1.50% to 1.75% and restricting the use of .25% to police, fire, court and prosecutor office services of the Town.

A "NO" vote shall have the effect of maintaining the existing transaction privilege tax at its current level.

Multiplicative or Additive?



Broomsticks Activity



You have three broomsticks:

The **RED** broomstick is 3 feet long

The **YELLOW** broomstick is 4 feet long

The **GREEN** broomstick is 6 feet long



Broomsticks Activity



How much longer is the **green** broomstick than the **red**?

Additive: 3 feet longer

Multiplicative: 2 times longer
(increase of 100%)



Broomsticks Activity



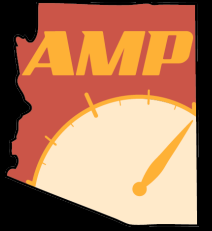
How much longer is the **yellow** broomstick than the **red**?

Additive: 1 foot longer

Multiplicative: $\frac{4}{3}$ times longer
(increase of $\sim 33\%$)



Bank Accounts



Which bank account grew more in one year?

- Account A grew from \$100 to \$145.
- Account B grew from \$50 to \$76.

Bank Accounts



- Consider a bank account that grew from \$95 to \$120 over THREE years.
 - Use an additive comparison for these two numbers. What does your answer mean?
 - Use a multiplicative comparison for these two numbers. What does your answer mean?
- If the terms of growth remained constant,
 - What is the annual additive growth for this account? What does your number mean?
 - What is the annual multiplicative growth (factor) for this account? What does your number mean?

What's next?



- Where could you go next?
- What other mathematical ideas can be built upon multiplicative thinking?

Thank you!



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