Developing Academic Language and Engaging English Learners in Mathematics

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- "First and foremost, ***every mathematics teacher must also be a language teacher***. In addition to having profound mathematical understanding, she must be cognizant of the language she uses in her instruction, anticipate the language needs of her students, and work with her students to identify any language misconceptions."
- (Lager, 2006, p. 193; *emphasis added*)

An Instance to Consider

- **Which point lies on the line defined by $3x + 6y = 2$**

  a. $(0, 2)$

  b. $(0, 6)$

  c. $(1, -\frac{1}{6})$

  d. $(1, -\frac{1}{3})$

Introductions

- **Helen Barney, Yorba Middle School, Orange, CA**
  - **80% Latino, 40% English Learners**
  - **63% Free/Reduced Lunch**
- **Mark Ellis, CSU Fullerton, CA**
  - **National Board Certified Teacher**
  - **Middle School Mathematics teacher educator**
- **Teachers Assisting Students to Excel in Learning Mathematics (TASEL-M), NSF Award #0227303**

You Cannot Assume…

- **This morning the temperature was -15. Now the temperature has increased by 9 degrees. What is the current temperature?**

Simplify Language, Not Math Content

- Change unfamiliar non-math words
  - A certain apparel firm… → Adrian's company…
- Change passive verb forms to active
  - If a marble is taken from the bag… → If you take a marble from the bag…
- Remove or reword relative clauses
  - Find the total number of newspapers that Lee delivers in 5 days. → How many newspapers does Lee deliver in 5 days?

(Abedi & Lord, 2001, p. 221)

Developing Academic Language

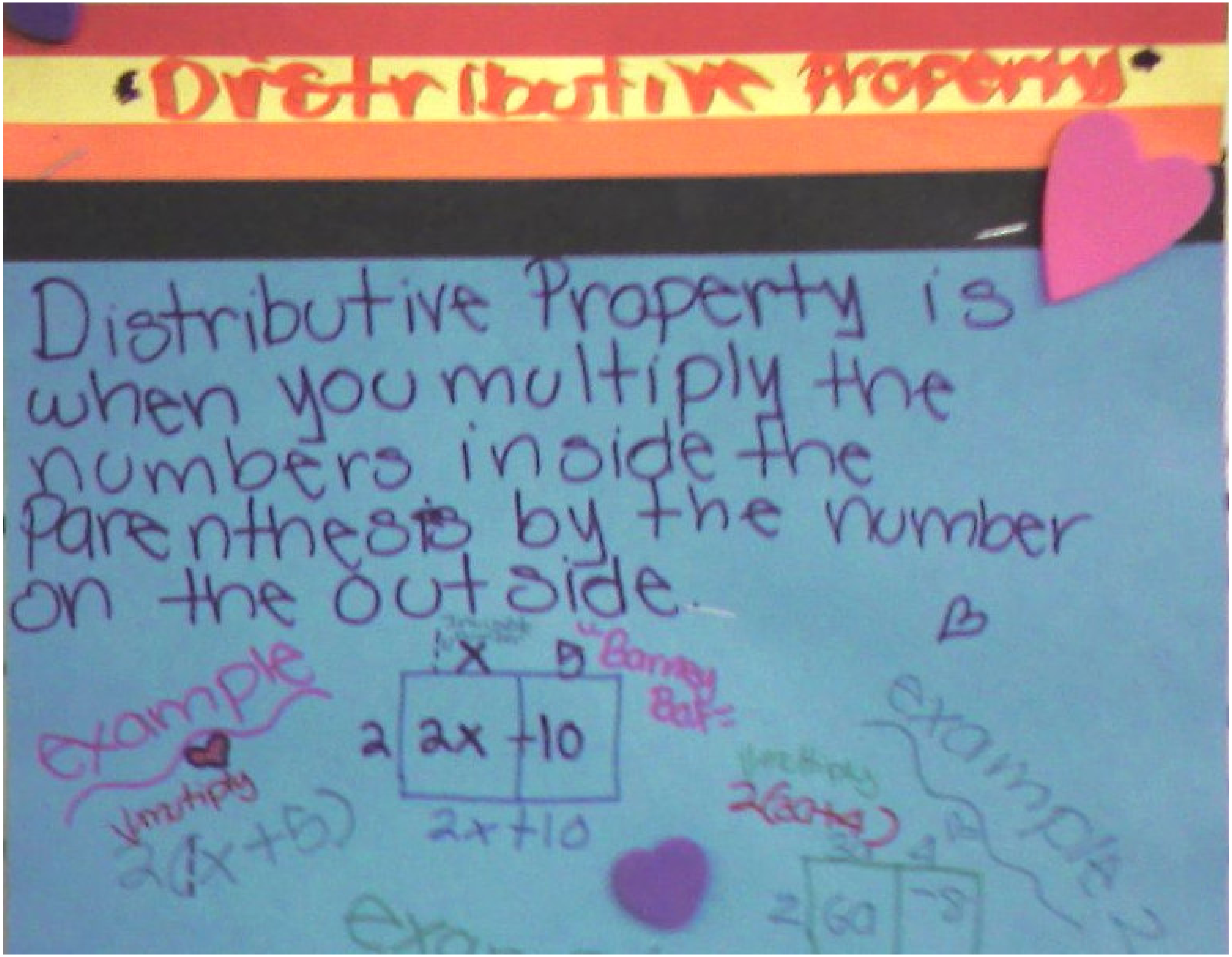
- Levels of vocabulary knowledge
  1. I never saw/heard it before.
  2. I've heard it but don't know what it means.
  3. I recognize it in context. It has something to do with…
  4. I know it and can use it confidently.
- Students need structured opportunities to develop the understanding to know and to use academic language.

(Dale & O'Rourke, 1986; Marzano, 2004)

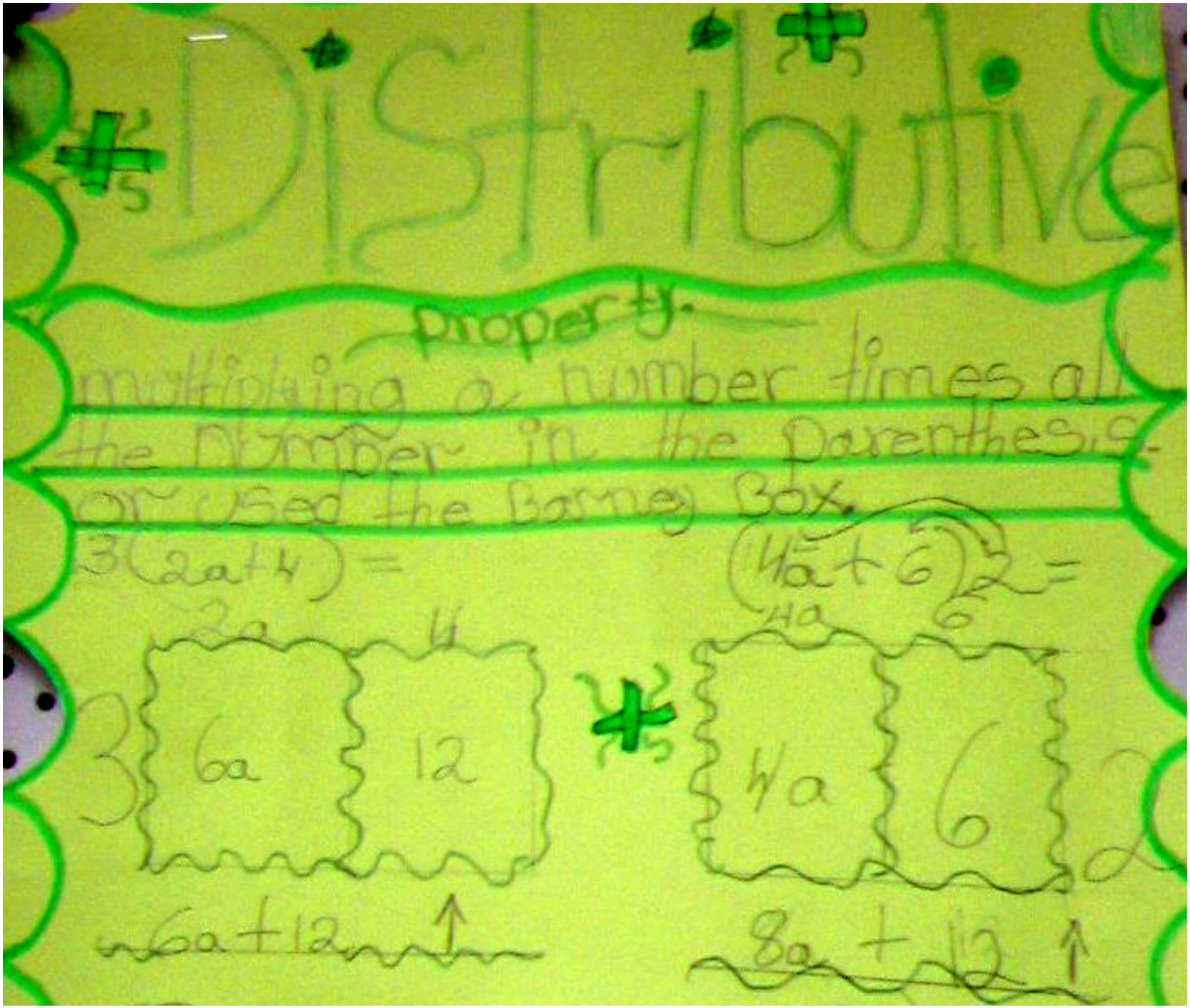
Example: Developing Vocabulary about Properties of Arithmetic

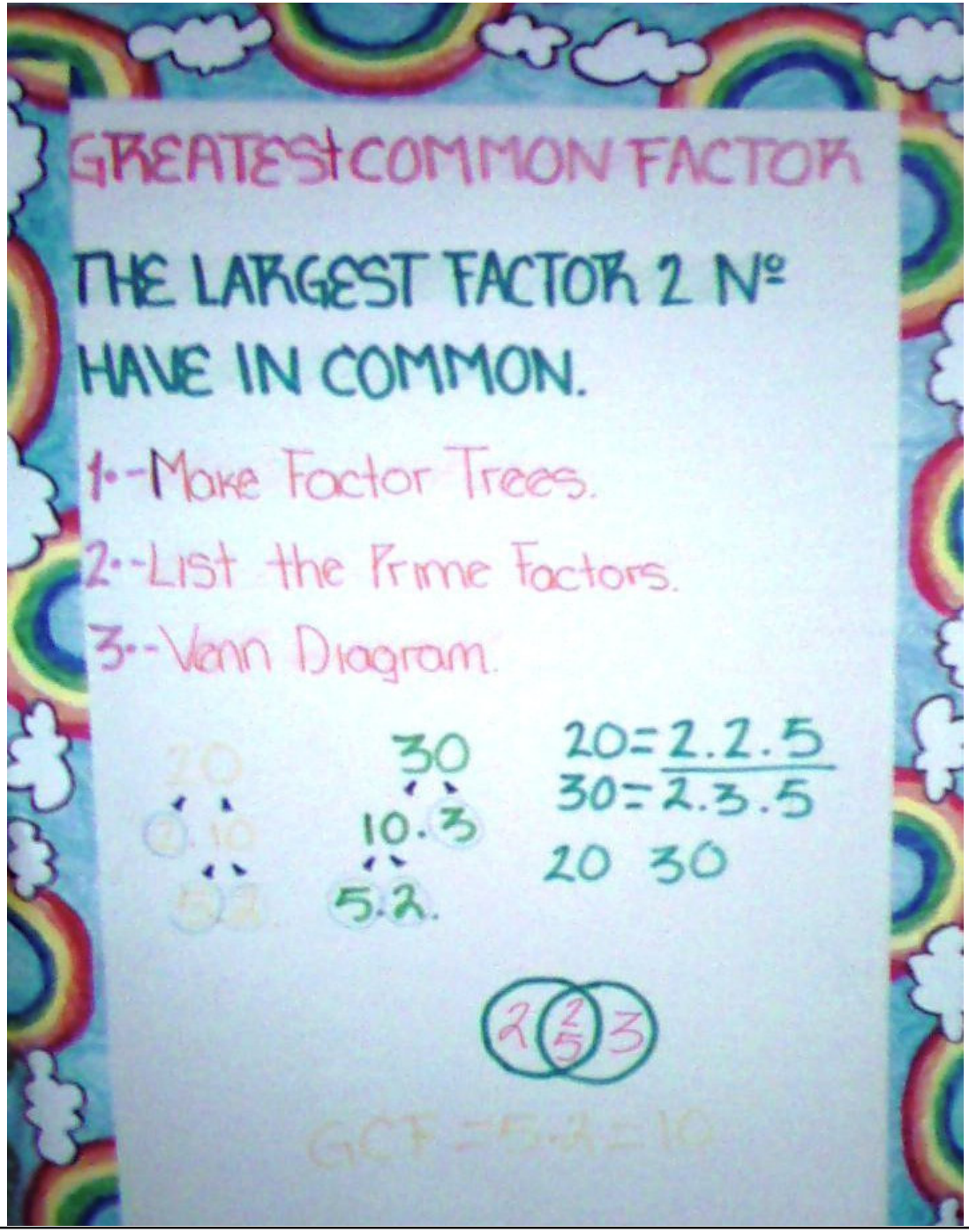
Strategies used over several lessons:

1. Contextualizing terms
   - Give explanation or description with some guided student involvement
   - NOT a formal definition
2. Student-created vocabulary posters
   - Students construct their own explanations
     - May include verbal, symbolic, and visual examples
     - Check against prior examples, non-examples
     - Revise, in student language, to correct misunderstandings



Distributive Property
Distributive Property is when you multiply the numbers inside the parenthesis by the number on the outside.
example
multiply
2(x+5)
x 5
2 2x +10
2x+10
example 2


Distributive
Property
multiplying a number times all the number in the Parenthesis or used the Barney Box.
3(2a+4) =
2a
4
3
6a
12
6a+12
(4a+6)2 =
4a
6
2
4a
6
8a + 12


GREATEST COMMON FACTOR
THE LARGEST FACTOR 2 Nº HAVE IN COMMON.
1.-Make Factor Trees.
2.-List the Prime Factors.
3.-Venn Diagram.
30
10.3
5.2.
20=2.2.5
30=2.3.5
20 30
2
2
5
3

Content Conversation

- Communicate with a peer about mathematics
- Earn "points" for each correct use of key terms

Solving Equations Vocabulary

- Variable
- Inverse operation
- Isolate
- Equal
- Coefficient
- Constant

1. $3x + 4 = x - 6$
2. $-2x + 3 = 4x - 9$

Reflect on this Approach

- How is it different from traditional vocabulary instruction?
- What may be challenging to implement?
- What resources or support would you need to fully implement this process?

Characteristics of Lessons that Engage and Support ELLs (and all students)

- Building Background
  - Draw on (or build) common experience or shared knowledge
- Comprehensible Input
  - Make clear what is being asked using verbal and visual cues
- Interaction
  - Students work together purposefully
  - Students choose the language of communication
- Application
  - Problems have meaning in some context
  - Students engaging in listening, speaking, reading and writing math

(Haynes, 2004)

Solving Word Problems Using Visual Models - 1

TRY THIS:

- **At the local school, there are 685 students. 3/5 of the students are boys. How many girls attend the school?**

Solving Word Problems Using Visual Models - 2

TRY THIS:

- **John Bigfoot has 7½ square yards of tanned moose hide. How many complete pairs of mooseskin shoes can he make if each shoe requires 1/9 square yard of mooseskin?**

Language and the Transition to Algebra

- "Modeling problem situations requires translating from everyday language to algebraic expressions, including the reorganization and reinterpretation of problem information." (Lager, p. 167)

Scaffolding for Understanding Linear Systems

Day 1 (addition/subtraction method)

- 2 pens + 2 notebooks = $7 $\quad$ 2p + 2n = 7
- 2 pens = $2 $\quad$ 2p = 2

- Price per pen _____ Price per book_____

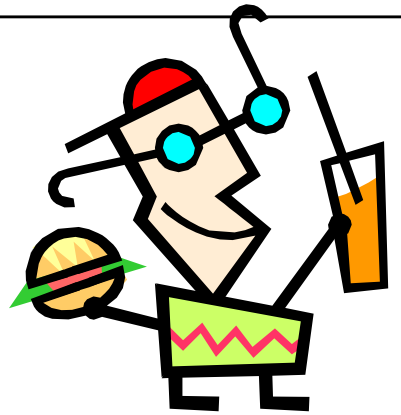
- 3 pens + 5 notebooks = $31 $\quad$ 3p + 5n = 31
- 3 pens + 4 notebooks = $26 $\quad$ 3p + 4n = 26

- Price per pen _____ Price per book_____

- 5 pens + 5 books = $35 $\quad$ 5p + 5b = 35
- 5 pens + 2 books = $17 $\quad$ 5p + 2b = 17

- Price per pen _____ Price per book_____

Scaffolding for Understanding Linear Systems



Day 2 (multiplication method)

- 3 hamburgers + 2 cokes = \$19 — 3h + 2c = 19
- 1 hamburger + 3 cokes = \$11 — 1h + 3c = 11

- Price per hamburger _____ Price per coke _____

- 2 hamburgers + 8 cokes = \$36 — 2h + 8c = 36
- 3 hamburgers + 2 cokes = \$24 — 3h + 2c = 24

- 2 hamburgers + 5 cokes = \$13 — 2h + 5c = 13
- 3 hamburgers + 6 cokes = \$18 — 3h + 6c = 18

Scaffolding for Understanding Linear Systems

Day 3 (substitution method)

- 1 taco = 3 cokes — $t = 3c$
- 1 taco + 2 cokes = \$10 — $t + 2c = 10$

- 1 taco = 4 cokes — $t = 4c$
- 2 tacos + 2 cokes = \$16 — $2t + 2c = 16$

Concluding Thoughts

- Design activities **to** ***introduce vocabulary in context*****.**
- **Engage students in** ***using mathematical language*****.**
- **Embed new** concepts and relationships in ***meaningful problem contexts***.
- Recognize and ***build on students' strengths***.
  - "ELLs already possess skills in translating from their primary language to English. They have already internalized the concept of the variable because they know that there is at least one way to say something in Spanish and a second way in English to refer to the same object or process. However, they need assistance from their mathematics teacher to make explicit and value these connections and to provide them with the appropriate English labels." (Lager, p. 193)

Thank You!!

- Mark Ellis, CSU Fullerton
- Helen Barney, Yorba Middle School

- For a copy of the presentation:
  - faculty.fullerton.edu/mellis

References

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