

# Best Practices in Math to Support Academic Language Development and Conceptual Understanding

Jamie Cooper  
Sandy Boe  
Presented to  
ELL Alliance Conference  
2014



# Long Term Target

▣ Our Goal is for every student to graduate with many **options** and be prepared to...

▣ Think: **Creatively** and **Critically**

▣ Know: **Master** Content

▣ Act: **Self-Direct** and Collaborate

▣ Go: **Navigate Locally** and **Globally**



# Setting the Stage

- SIOP
- Best Practices in Math
  - Teacher's Development Group
  - Beaverton: Common Core Math Practices
- Constructing Meaning
- Standards-Based Learning
- High Expectations for ALL and Relationships



Teacher-Growth Goal: Student talk with an emphasis on academic language

# What is Academic Language?

Academic English is a cognitively demanding and relatively decontextualized register (Cummins, 1984). It relies on a broad knowledge of words, concepts, language structures, and interpretation strategies. Skills related to mastery of academic English include summarizing, analyzing, extracting and interpreting meaning, evaluating evidence, composing, and editing. Acquiring academic English is a challenge for English language learners and native speakers. Few children arrive at school competent in this register. For the most part, academic English is learned over the course of schooling through frequent engagement in classroom talk, reading textbooks, and writing. Teachers need to recognize that all students need support to acquire the structures and vocabulary associated with academic English, and they need to know how to provide it.

# Sentence Frames / Signal Words

- Frames & signal words help
- guide students to produce their own language
  - multiple possibilities in blanks
- focus student learning on the academic task

<b>Sequence</b>	
Use the following frames when you draft a paper or prepare to speak:	
<b>To open</b>	<ul style="list-style-type: none"> <li>■ _____ <u>began</u> when _____.</li> <li>■ During the _____, _____.</li> <li>■ For the past _____, (years, months, days), _____.</li> </ul>
<b>To sequence</b>	<ul style="list-style-type: none"> <li>■ Several (years, decades, days) later, _____.</li> <li>■ The next step (phase, stage) was _____.</li> </ul>
<b>To support your ideas</b>	<ul style="list-style-type: none"> <li>■ As _____ continued _____.</li> <li>■ Yet over time, _____.</li> <li>■ The following (year, step, stage), _____.</li> </ul>
<b>To close</b>	<ul style="list-style-type: none"> <li>■ By the end, _____.</li> <li>■ _____ <u>finally</u> _____.</li> </ul>

<b>Proposition and Support</b>	
Use the following frames when you draft a paper or prepare to speak:	
<b>To open</b>	<ul style="list-style-type: none"> <li>■ In regards to _____, I believe _____.</li> <li>■ My opinion on the issue of _____ is _____.</li> <li>■ _____ presents the position that _____.</li> </ul>
<b>To state a position</b>	<ul style="list-style-type: none"> <li>■ _____ proves that _____.</li> <li>■ My views are based on _____.</li> </ul>
<b>To support your ideas</b>	<ul style="list-style-type: none"> <li>■ Many experts claim that _____.</li> <li>■ According to _____, _____.</li> <li>■ Further evidence can be found in _____.</li> </ul>
<b>To close</b>	<ul style="list-style-type: none"> <li>■ There is little doubt that _____.</li> <li>■ _____ urges us to _____.</li> </ul>

# Objectives

## Check for Understanding

**Learning Target**

8.4: I can analyze and solve systems of linear equations.

March 11, 2014

**Behavior Target:** I can communicate and work effectively within a group.

**Objective:** On a sticky note complete a sentence explaining how to tell if a system of equations has one solution, no solution, or infinite solutions.

"A system of equations has one solution if \_\_\_\_\_ no solution if \_\_\_\_\_ and infinite solutions if \_\_\_\_\_"

**Post Day 1**

**Post Day 2**

**Post Day 3**

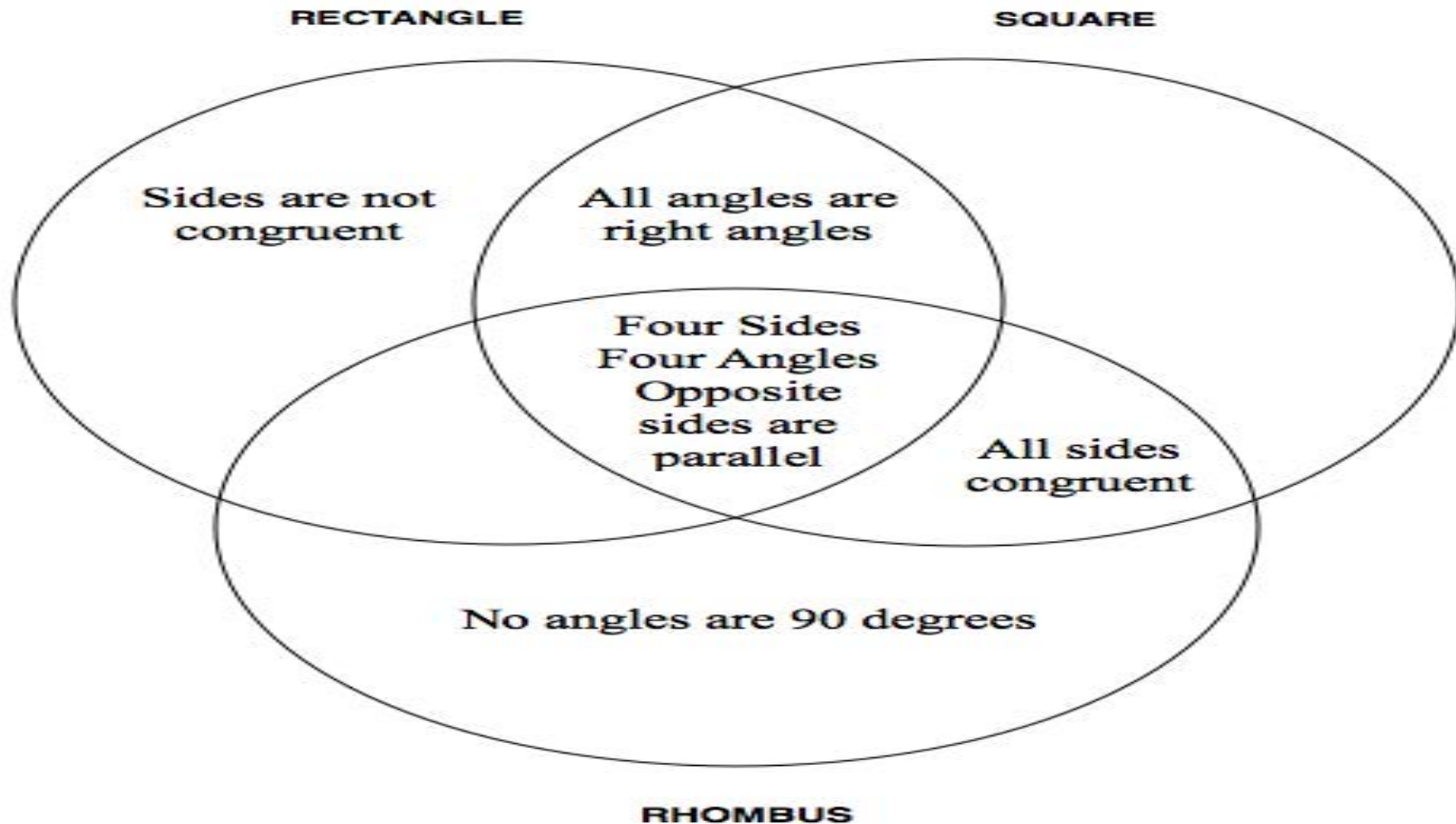
Marco Chavez

A system of equations has one solution if the lines intersect, no solution if the lines are parallel and infinite solutions if the lines are the same line.

On a graph, the solution to a system of equations is where the lines intersect.

The solution to a system of equations can be found when both tables have the same ordered pair.

# Take Language Off the Map



Intermediate:

1. \_\_\_\_\_ and \_\_\_\_\_ are similar in that both \_\_\_\_\_.

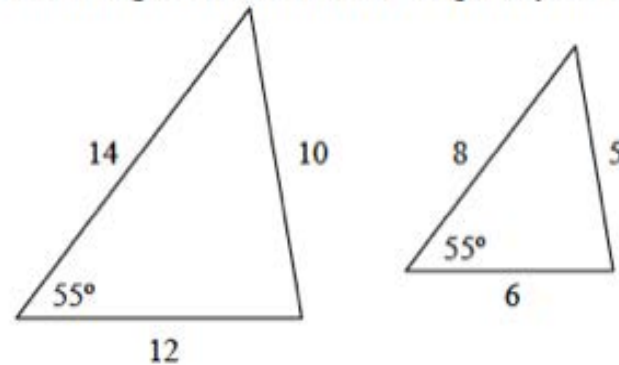
Early Advanced / Advanced:

2. As opposed to \_\_\_\_\_, \_\_\_\_\_ have / don't have \_\_\_\_\_.

# Examples

<b>Corresponding angles:</b>		<b>Vertical angles:</b>	
Corresponding angles are _____		Vertical angles are _____	
<b>Alternate Interior angles:</b>		<b>Alternate Exterior angles:</b>	
Alternate interior angles are _____		Alternate Exterior angles are _____	
<b>Same Side Interior (SSI):</b>		<b>Linear Pair:</b>	
Same side interior angles _____		A linear pair _____	

Are the triangles below similar? Explain your answer.

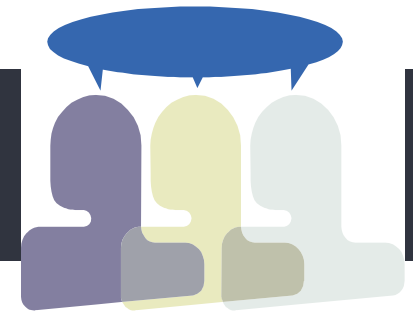


I believe that these two triangles \_\_\_\_\_  
 based on the fact that \_\_\_\_\_  
 Further evidence can be found by \_\_\_\_\_  
 \_\_\_\_\_. This proves that  
 \_\_\_\_\_. Because they \_\_\_\_\_  
 \_\_\_\_\_ the two criteria of similar triangles, \_\_\_\_\_  
 and \_\_\_\_\_.

Angle 1 and Angle 5 are equal because they are corresponding.



# Student Talk



▣ What percentage of the school day are students engaged in academic discourse?

**Research suggests  
as little as 2-4%**

Arreaga-Mayer &  
Perdomo-Rivera

- ▣ Choral Response
- ▣ Partner Talk
- ▣ Group work
- ▣ Justify thinking
- ▣ Think-pair-share
- ▣ Sentence Frames
- ▣ Chalk Talk
- ▣ Write Around
- ▣ Stickers Notes
- ▣ Fancy Words

# Rubric

<b>Observables</b>	<b>Rating (1-2-3)</b>	<b>Comments</b>
Teacher expectations and strategies engage students in rigorous work.	1 - 2 - 3	
Teachers uses strategies that capitalize on learning needs of students	1 - 2 - 3	
Teacher sets expectation and provides support for a variety of engagement strategies and structures that facilitate participation and meaning making by students.	1 - 2 - 3	
Students have the opportunity to engage in quality talk and student talk reflects knowledge and ways of thinking associate with content. Students provide evidence to support thinking.	1 - 2 - 3	

# Review Rubric & Share with Partner

## Evidence

In regards to \_\_\_\_\_, I believe \_\_\_\_\_ due to the fact that \_\_\_\_\_.

Further evidence of \_\_\_\_\_ is when students/teacher did \_\_\_\_\_.

**Highly Proficient**  
I could teach it!  
*There is evidence of understanding beyond the learning target. Work is thoughtfully organized and complete.*

**Proficient**  
I got it!  
*There is evidence of accurate understanding. Work is substantially accurate.*

**Nearly Proficient**  
I almost got it!  
*There is evidence of understanding, but some work is not fully accurate.*

**Working Toward**  
I'm working on it!  
*Some evidence of understanding, but major areas still need effort.*

**8.06: I can understand and apply the Pythagorean theorem.**

In addition to being proficient on the long-term target, I can demonstrate one or more of the following...

- Consistently utilizes efficient strategies to accurately solve problems in familiar situations.
- Applies understanding of long-term learning targets to unfamiliar situations and/or to solve complex problems.
- Uses precise and relevant communication to justify mathematical thinking.
- Connects knowledge to other learning targets and/or advanced problem sets.

For Example:  
I can explain the difference between rational and irrational numbers.  
I can derive the distance formula for two ordered pairs.

I can explain a proof of the Pythagorean theorem and its converse.

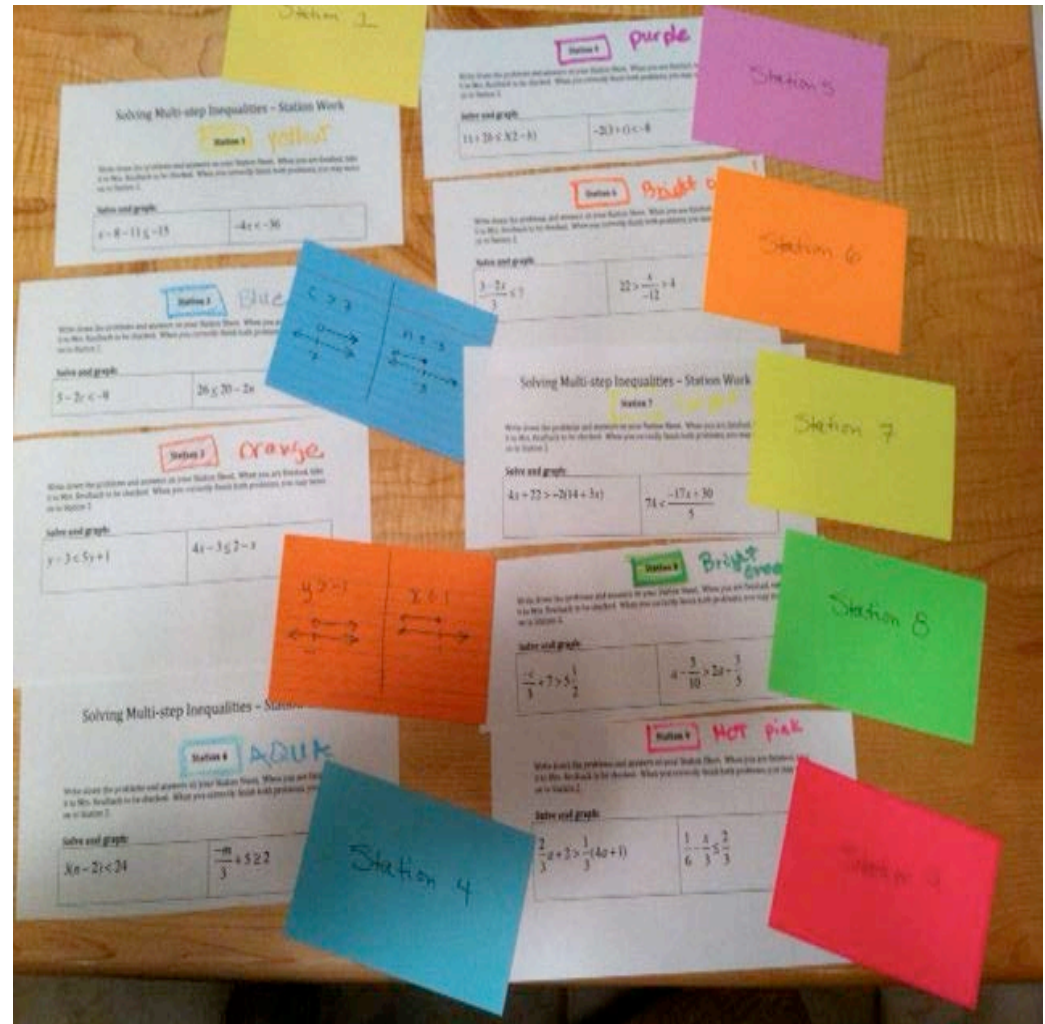
- I can apply the Pythagorean Theorem to find unknown lengths of two and three-dimensional figures.
- I can apply the Pythagorean Theorem to find the distance between two points on a coordinate system.
- I can identify irrational numbers.
- I can estimate, compare and order irrational numbers on a number line and explain the reasonableness of my solution.
- I can evaluate perfect square roots up to 225 and perfect cube roots up to 216.

I am beginning to or occasionally demonstrate proficiency of one or more of the following concepts:

- Estimating, comparing and ordering irrational numbers on a number line.
- Explaining the reasonableness of my estimation, comparison or ordering of irrational numbers.
- Explaining a proof of the Pythagorean Theorem.
- Explaining a proof of the converse of the Pythagorean Theorem.
- Applying the Pythagorean Theorem to find unknown lengths.
- Applying the Pythagorean Theorem to find the distance between two points.
- Identifying irrational numbers.
- Evaluating perfect square roots or perfect cubes up to 225.

I have not completed the work necessary for me to demonstrate proficiency.

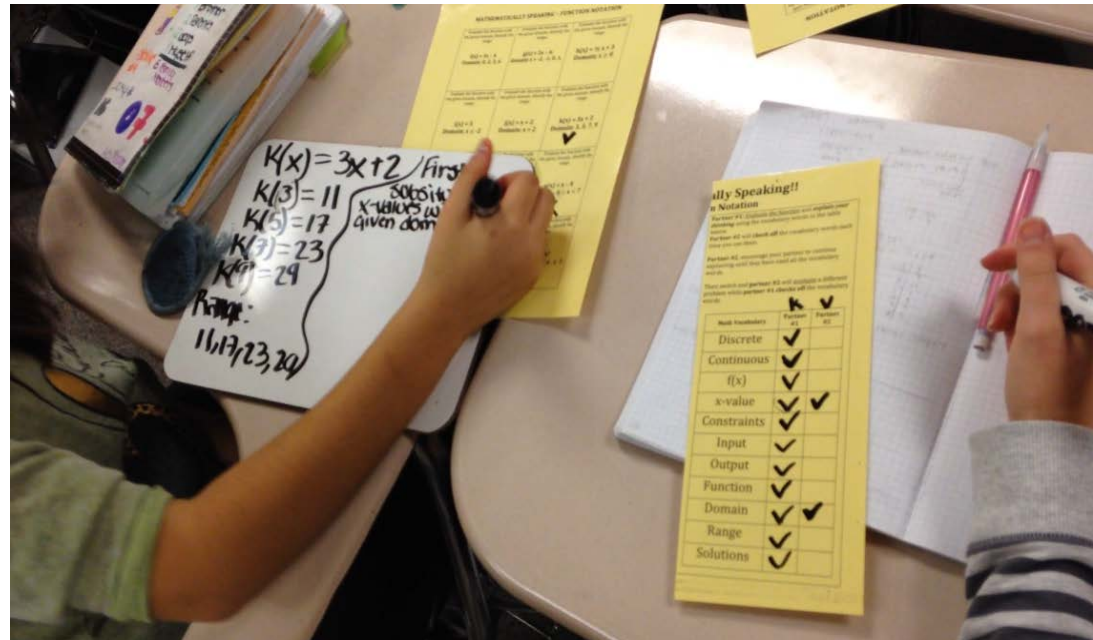
# Stations



- Targeted Practice
- At Own Pace
- Immediate Feedback
- Engaging
- Ownership of Learning

# White Boards

- ▣ Quick assessment
- ▣ All participate
- ▣ Highly motivating



# Practice and Application

11.26.11

Question: Which company should Kelly go with, if she only wants to purchase 15 songs?

\*Jamz Co = charges \$1.00 per song  
 Rockin Co = charges \$0.50 per song and a \$10.00 membership fee

This is Direct Variation because  $k$  is constant and it goes through the origin

Amount of Songs	Cost of PC	Cost of J
0	\$10	\$0
2	\$11	\$2
4	\$12	\$4
6	\$13	\$6
8	\$14	\$8
10	\$15	\$10
12	\$16	\$12
14	\$17	\$14
16	\$18	\$16
18	\$19	\$18
20	\$20	\$20

Equation:  
 Jamz Co  $y = \$1.00x$   
 Rockin Co  $y = \$0.50x + \$10.00x$

Table: **Rockin Co**

X	Y
0	10
5	12.50
10	15
15	17.50
20	20

Table: **Jamz Co**

X	Y
0	0
5	5
10	10
15	15
20	20

Graph:

Explanation:  
 I believe the best company Kelly should go with would be Jamz Company... because according to my table at 15 (Jamz company) she'll only pay \$15 and she shouldn't go with Rockin' company because she'll have to pay more (\$17.50) instead of paying less (\$15)  
 Jamz Co for 15 songs = \$15  
 Rockin Co for 15 songs = \$17.50

(Jamz Co. is a direct variation line because it goes through the origin and is linear)

Amount of Songs	Cost of PC	Cost of J
0	\$10	\$0
2	\$11	\$2
4	\$12	\$4
6	\$13	\$6
8	\$14	\$8
10	\$15	\$10
12	\$16	\$12
14	\$17	\$14
16	\$18	\$16
18	\$19	\$18
20	\$20	\$20

Rockin' Co  
 $y = \frac{1}{2}x + 10$   
 $20 = \frac{1}{2}(20) + 10$   
 $20 = 10 + 10$   
 $20 = 20$

Jamz Co  
 $y = x$   
 $20 = 1(20)$   
 $20 = 20$

equations

Graph:

If you are going to get less than 20 songs, go with Jamz Co. But if you're going to get more than 20 songs, go with Rockin' Co.

$y$  is how much it costs  
 $x$  is the number of songs

What we did to find the same cost from both companies, Rockin' Co and Jamz Co, was to make a table. We decided to go up by twos because it would be faster. As we went on, the answer was \$20 for 20 songs.

When finding the equation, for Rockin' Co, the y-intercept was \$10 for a membership, and the slope was .50 for each song. And the equation for Jamz Co was \$1 for each song.

LINDA AUSTIN  
 NICOLE KARELY  
 11.26.11

# Formative Assessment: Thumbs Up/Down Fist to Five



I can do this!



I'm getting there.



I need help!



- Use throughout lesson to check for understanding
- Allows all students to respond
- Quick assessment
- Call on students to elaborate based on hand responses
- Feedback to teacher and student-Not graded

# Writing Support

2. I can use a table or a graph of a linear relationship to find a solution to a problem by locating either the \_\_\_\_\_ value or the \_\_\_\_\_ value on the table or graph and looking at the number \_\_\_\_\_. In a graph you can find the second number by \_\_\_\_\_. In a table you can find the second number by \_\_\_\_\_.

The solution to a linear equation represents a point on a graph or in a table that includes two numbers, ( \_\_\_\_\_, \_\_\_\_\_ ). The first number represents an \_\_\_\_\_ value and the second number represents a \_\_\_\_\_ value.

I can use an equation to solve a problem by \_\_\_\_\_ a number for one of the \_\_\_\_\_, and then \_\_\_\_\_ to find the value of the second \_\_\_\_\_.

Adapted by Jamie Cooper from Connected Math "Moving Straight Ahead" Investigation 2 Reflection.

<p>To understand the problem, I....</p>	<ul style="list-style-type: none"> <li><input type="radio"/> read for</li> <li><input type="radio"/> looked at</li> <li><input type="radio"/> thought about</li> <li><input type="radio"/> considered the</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> signal words.</li> <li><input type="checkbox"/> numerical expressions.</li> <li><input type="checkbox"/> key ideas.</li> <li><input type="checkbox"/> familiar content.</li> </ul>	<hr/> <hr/> <hr/> <hr/>
---	--	--	-------------------------



# Writing Support

$$3x + 2y = 10$$

$$\begin{array}{r} -3x \\ -3x \end{array}$$

$$\frac{2y = -3x + 10}{2} \quad \frac{-3x + 10}{2}$$

$$y = -\frac{3}{2}x + 5$$

$$5. \quad 4x + y = 12$$

$$\begin{array}{r} -4x \\ -4x \end{array}$$

$$y = -4x + 12$$

$$6. \quad A = \frac{bh}{2}$$

$$\frac{A2}{b} = \frac{bh}{b}$$

$$\frac{2A}{b} = h$$

7. Evaluate the function for given the domain. State the range.

$$f(x) = 3x - 4 \quad \text{Domain: } 0, 2, 3, 6$$

$$f(0) = -4$$

$$f(2) = +2$$

$$f(3) = 5$$

$$f(6) = 14$$

Use the following vocabulary words to explain your work.

Discrete	Input	Output
Value(s) of x	Domain	Range
Constraints	Function	Solutions

The function  $f(x) = 3x - 4$  has discrete domains or x values. The constraints to this function were 0, 2, 3, 6. These were also the discrete inputs. After computing the ranges I found that the only solutions were  $f(0) = -4$ ,  $f(2) = 2$ ,  $f(3) = 5$ ,  $f(6) = 14$ . Therefore those were the outputs.

# Feedback

Jamie Cooper

Math Teacher

[jamie\\_cooper@beaverton.k12.or.us](mailto:jamie_cooper@beaverton.k12.or.us)

Sandy Boe

ELL TOSA

[sandra\\_boe@beaverton.k12.or.us](mailto:sandra_boe@beaverton.k12.or.us)

