Reframing the Conversation: Guiding Mathematical Discourse Using Sentence Frames

Barbara Kuehl Mathematics Vision Project

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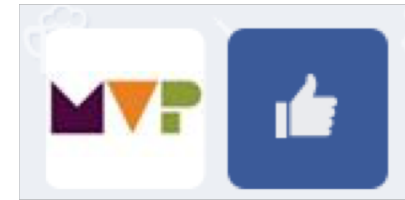
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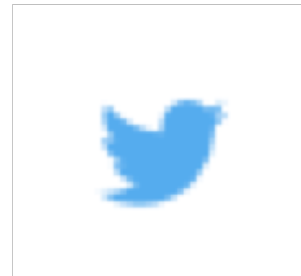
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Algebra II

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tudents learn
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ow they learn it."

Deborah Ball, PhD

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Barb's Session is first.
Session 74
Thursday, 1:30pm to 2:30pm
Title: **Reframing the Conversation: Supporting Academic Language and Mathematics Learning**
Location: 4 C3 Washington State Convention Center

Janet's Session is last.
Session 181
Friday, 11:00 AM - 12 PM
Title: **Multiple Representations and Perseverance, A Tool for When the Going Gets Tough**
Location: 4 C3 Washington State Convention Center

Oh no! Scott and Travis are presenting at the same time. That's like having to choose between two of your favorite desserts on Thanksgiving!

Scott
Session 171
Friday, 9:45am to 11am
Title: **Taking Trig to Task**

Location: 609 Washington State Convention Center

Travis
Session 172
Friday 9:45am to 11am
Title: **Tasks That Connect Progressions and Practices**
Location: 4 C1 Washington State Convention Center

More great MVP sessions!

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Supporting English Learners: The Right Pedagogical Approach

For all students, a large part of learning mathematics is learning the language of mathematics and using mathematics terminology meaningfully within academic conversations and written work. Understandably, students who are simultaneously learning the English language and mathematics need extra support. Hands-on and authentic, problem-based instruction works best for English learners, and mathematics pedagogy fits well with this approach.

Making Mathematics Accessible to English Learners, A Guidebook for Teachers, 2009 WestEd,

Carr, Carrol, Cremer, Gale, Lagunoff, Sexton

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Problems with Traditional Instruction

When instruction focuses on having students simply manipulate mathematical expressions and practice algorithms, it avoids the important cognitive challenges of understanding word problems and discussing mathematical ideas. This type of approach is generally not effective for any learner, but it is especially problematic for English learners because it does not involve them in the mathematical thinking and talking that support both language development and mathematics learning. The ultimate consequence is that English learners become marginalized in mathematics education and do not have the opportunity to become mathematically literate or choose a math-oriented career. (pg 5)

Making Mathematics Accessible to English Learners, A Guidebook for Teachers, 2009 WestEd, Carr, Carrol, Cremer, Gale, Lagunoff, Sexton

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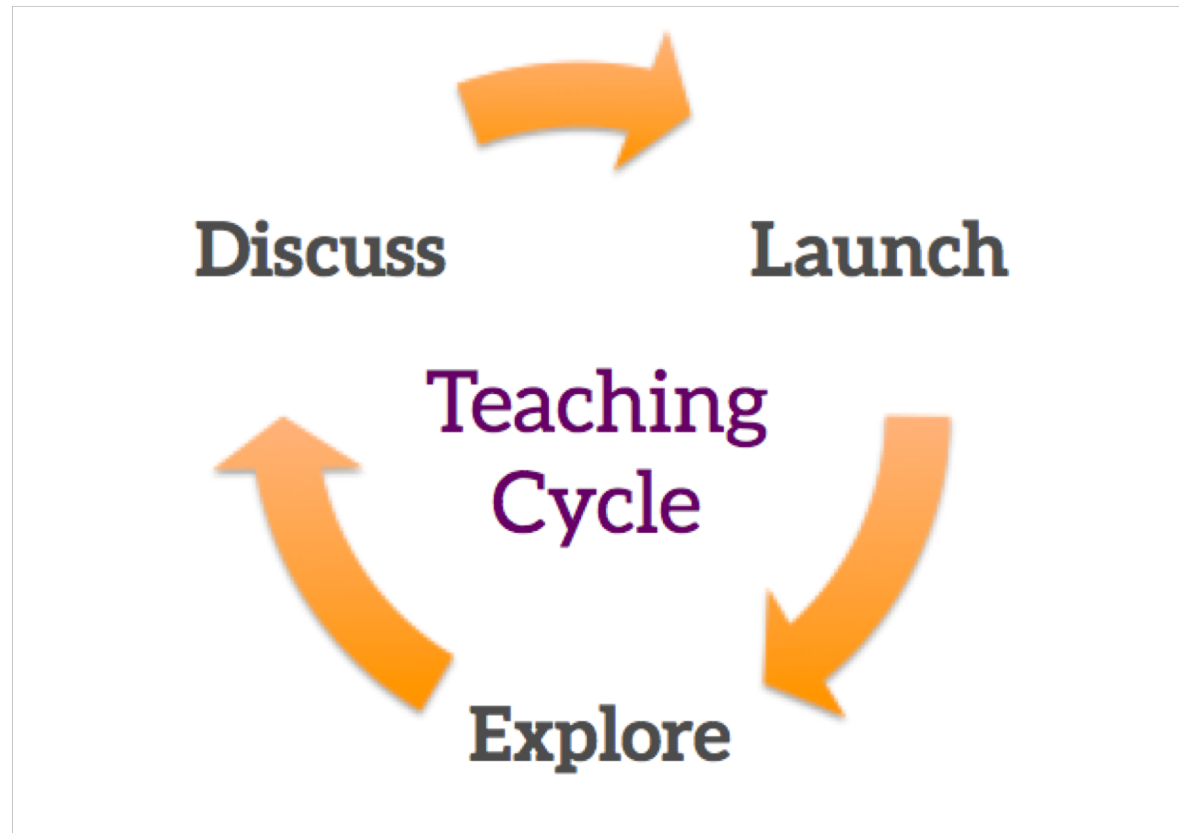
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Multiple representations support language production
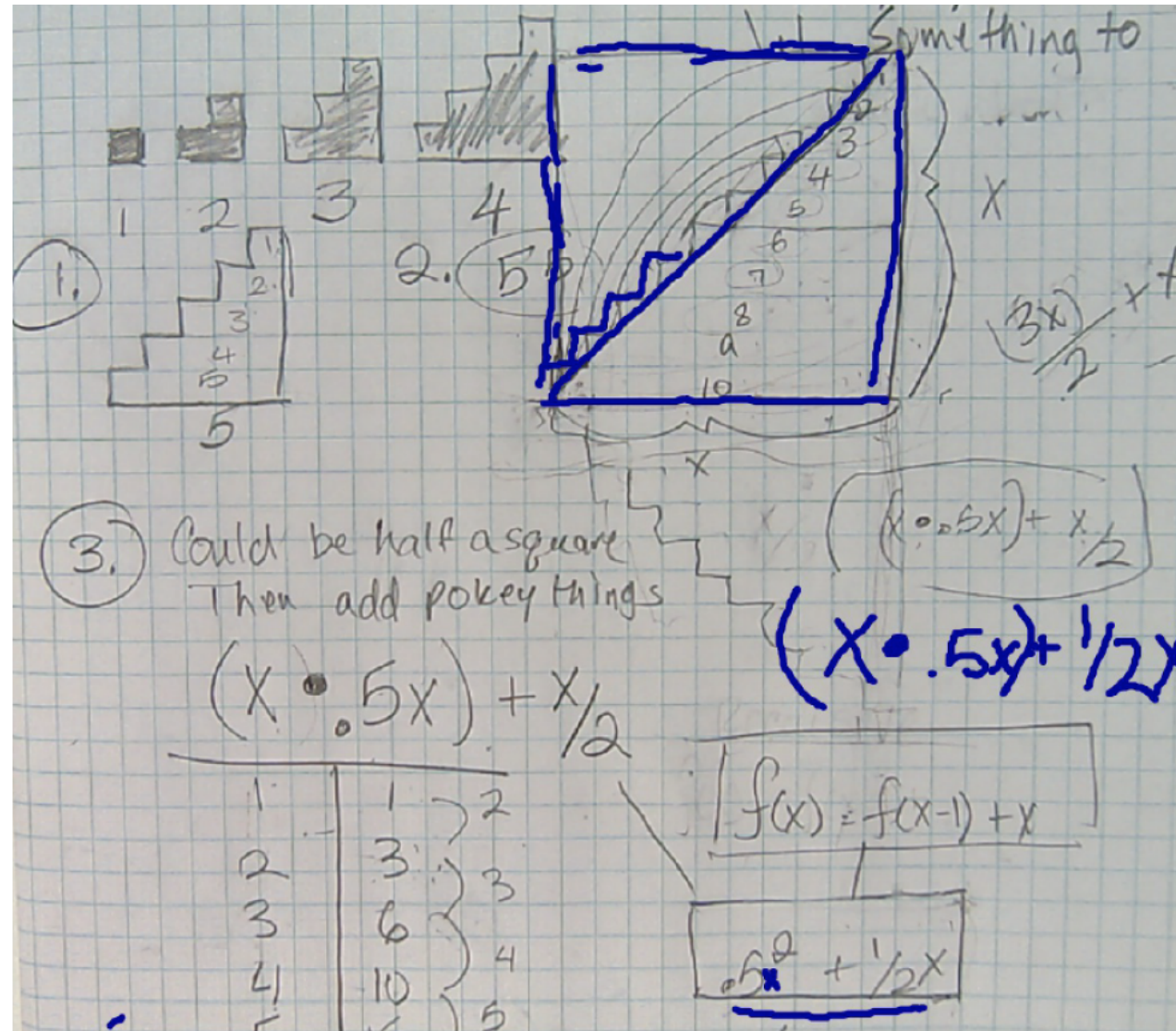
A FRAMEWORK for a Lesson or Task: The Teaching Cycle
Comprehensive Mathematics Instruction Framework

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The general purpose of sentence frames:

- Provide opportunities for increased language production, both oral and written
- Support the improvement of academic language use with models and structure

Activating background knowledge

- When I look at a table, I recognize a linear function if _____.
- When I look at a graph, I recognize a linear function if _____.
- When I look at an equation, I recognize a linear function if _____.

I Rule!

Essential Question: How are quadratic functions different than linear functions?

- SMP 4: Model with mathematics.
- SMP 8: Look for and express regularity in repeated reasoning.

1.2 I Rule!

A Solidify Understanding Task

Marco has started a new blog about sports at Imagination High School (mascot: the fighting unicorns) that he has decided to call "I Site".

He created a logo for the web site that looks like this:

He is working on creating the logo in various sizes to be placed on different pages on the website. Marco developed the following designs:
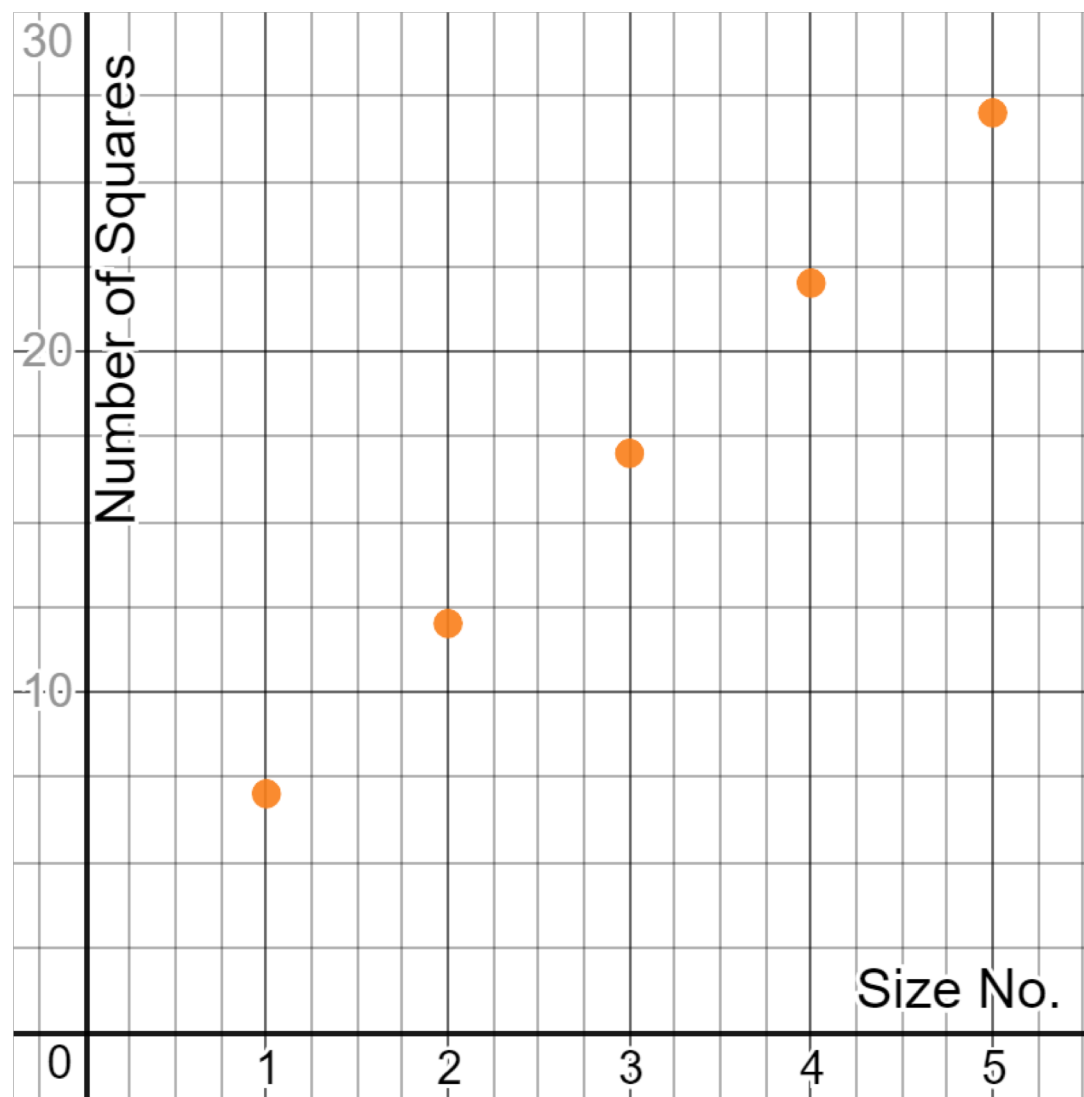
Size 1   Size 2   Size 3   Size 4

Maybe you saw this:

Size 1   Size 2   Size 3   Size 4
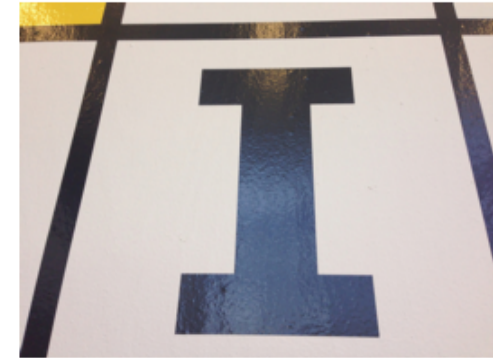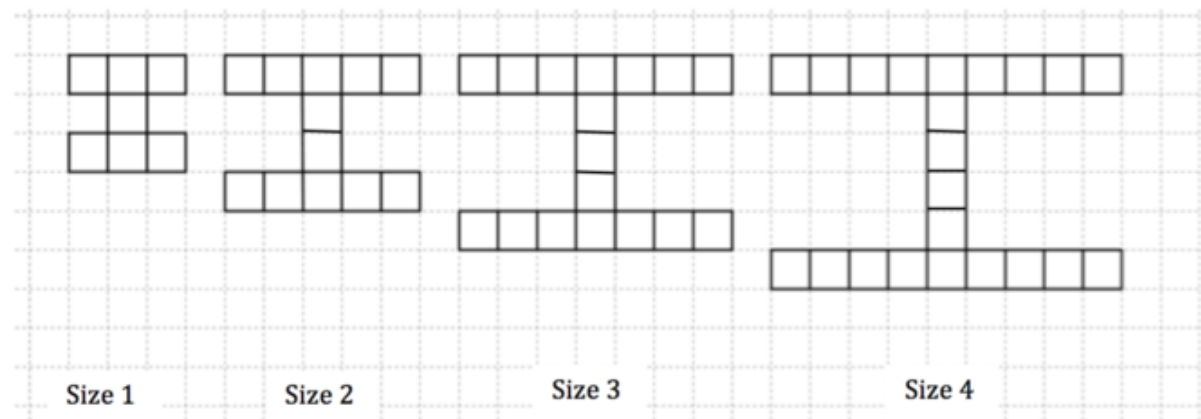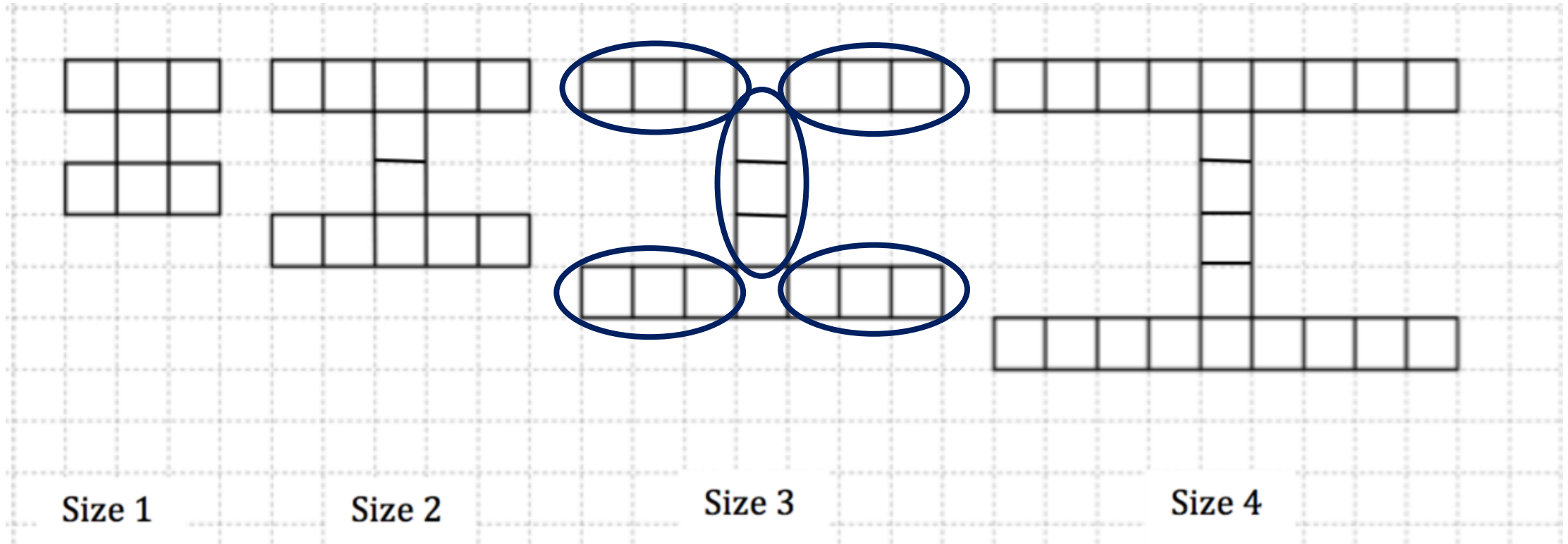
5 groups of size 3 with 2 more, 5 groups of n with 2 more $f(n) = 5n + 2.$

Maybe you saw this:

Size #	Number of Squares	First Difference
1	7	
2	12	5
3	17	5
4	22	5
5	27	5
n		

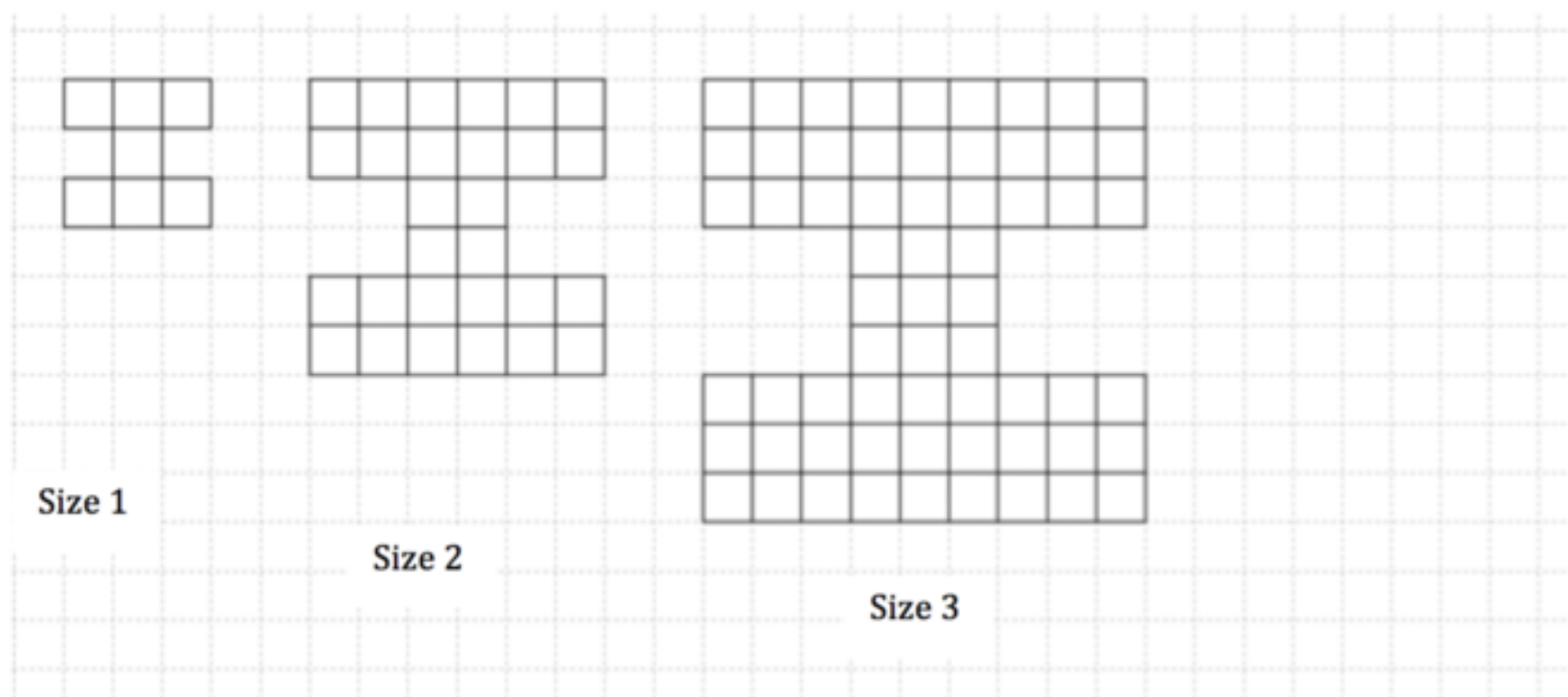The number of square grows by 5 each time $\qquad f(1) = 7, f(n) = f(n-1) + 5$

Maybe you tried this:

Justify

- I know that this pattern is a _____ function because _____ and _____.

Marco decides to experiment with making his logo "blockier" so that it looks stronger.

Here's what he came up with:
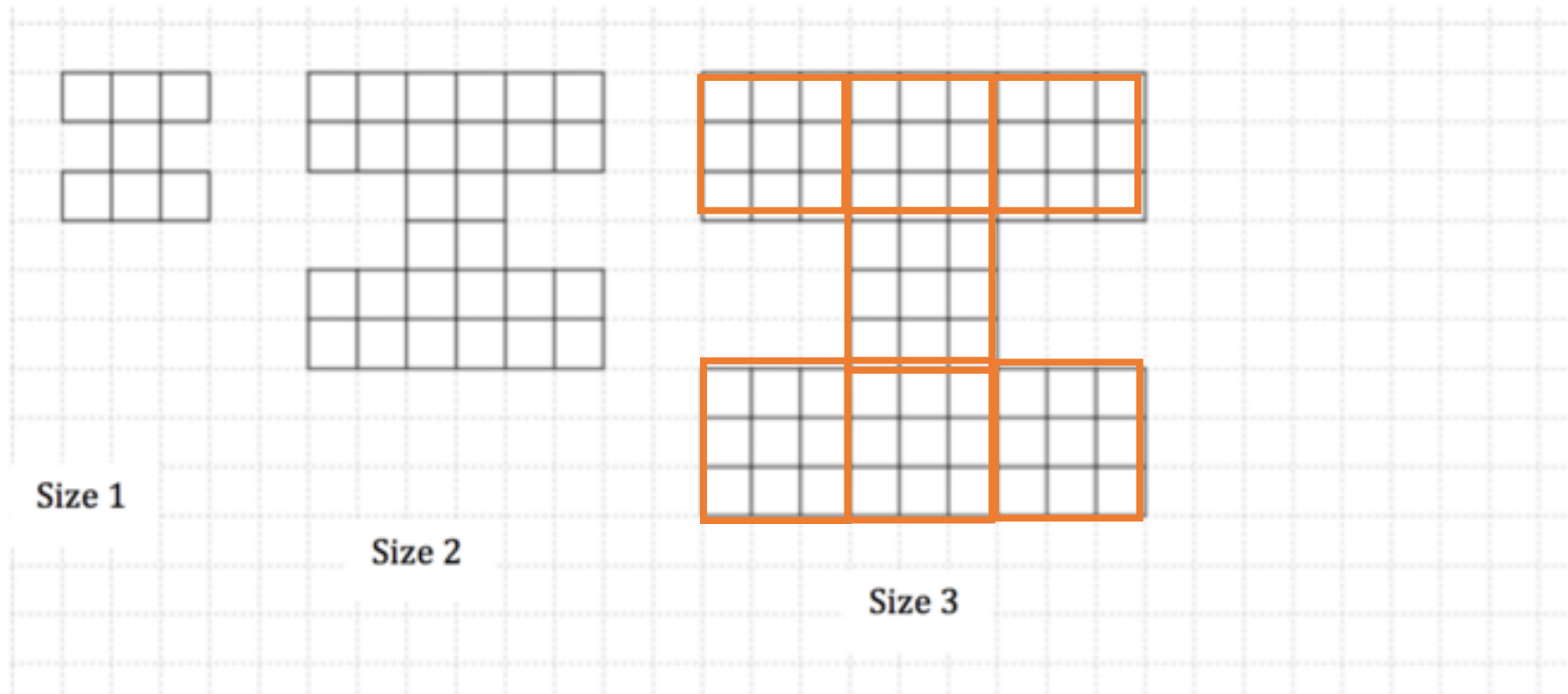

Size 1

Size 2

Size 3

Structured Partner Talk

What do you notice about the new diagram?

Partner A: One thing I notice about the new diagram that is the same as the old diagram is _____.

Partner B: One thing I notice about the new diagram that is different from the old diagram is
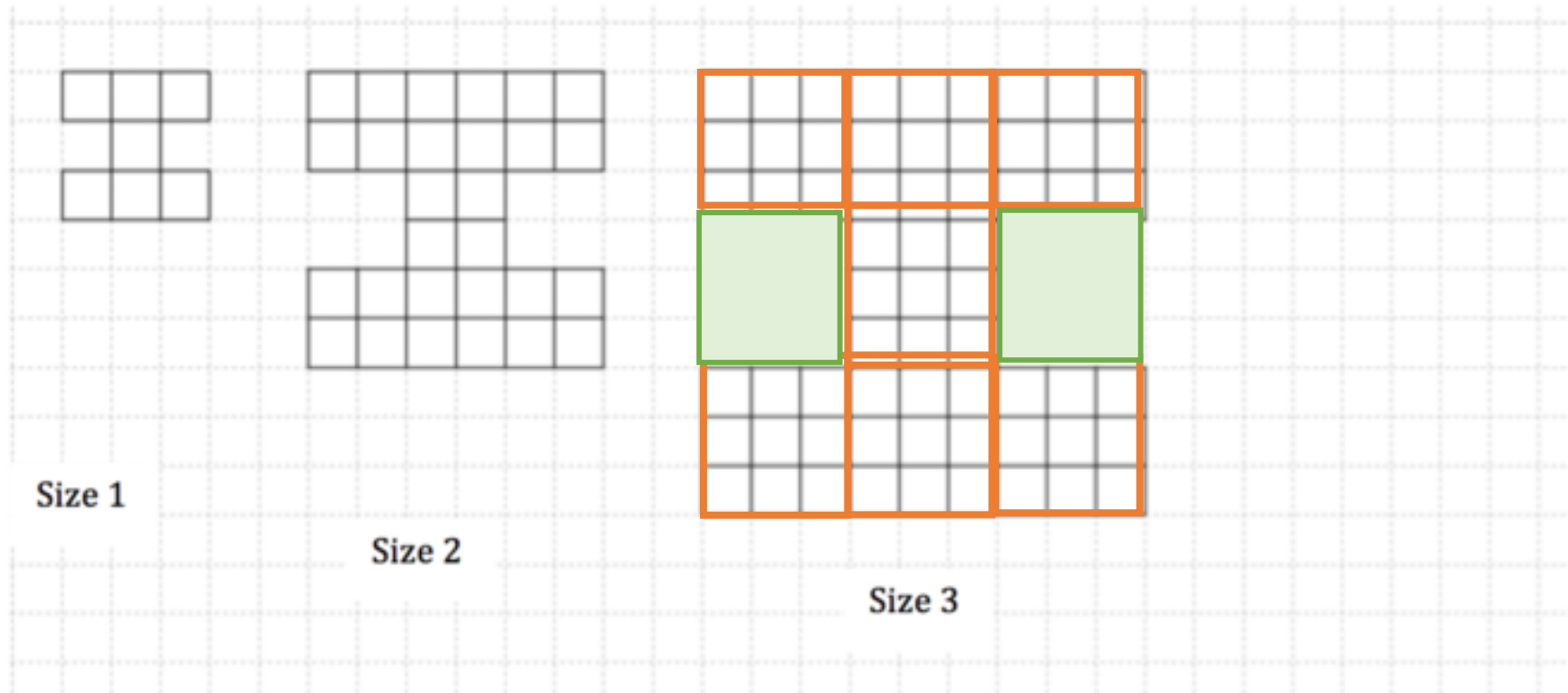
_____.

Switch!

Maybe you saw this:

Size 1

Size 2

Size 3

In figure 3, there are 7 big squares that are 3x3, so there are 7 squares that are n x n
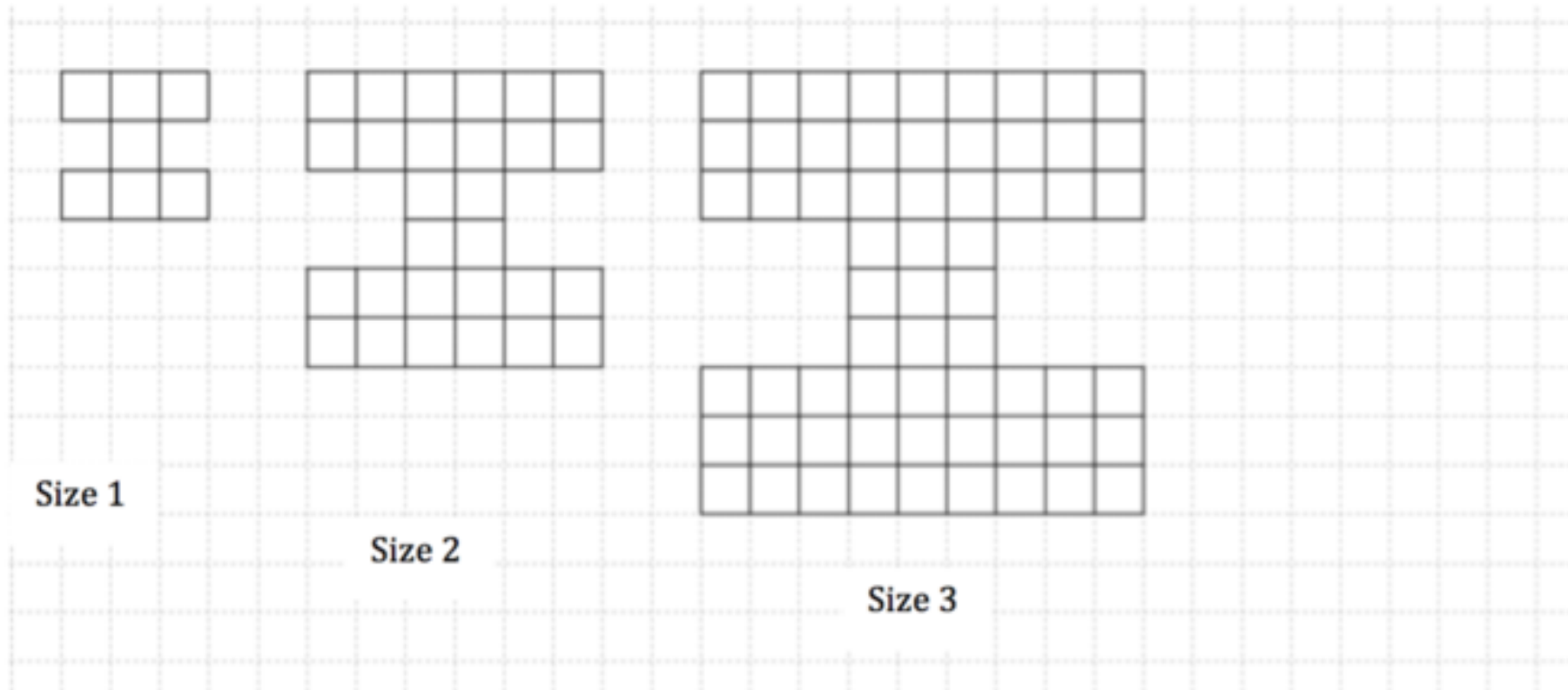
$$f(n) = 7n^2.$$

Maybe you saw this:

Size 1

Size 2

Size 3

The whole diagram is made up of 9 squares, but
2 of them are "missing"

$$f(n) = 9n^2 - 2n^2$$

Maybe you saw this:
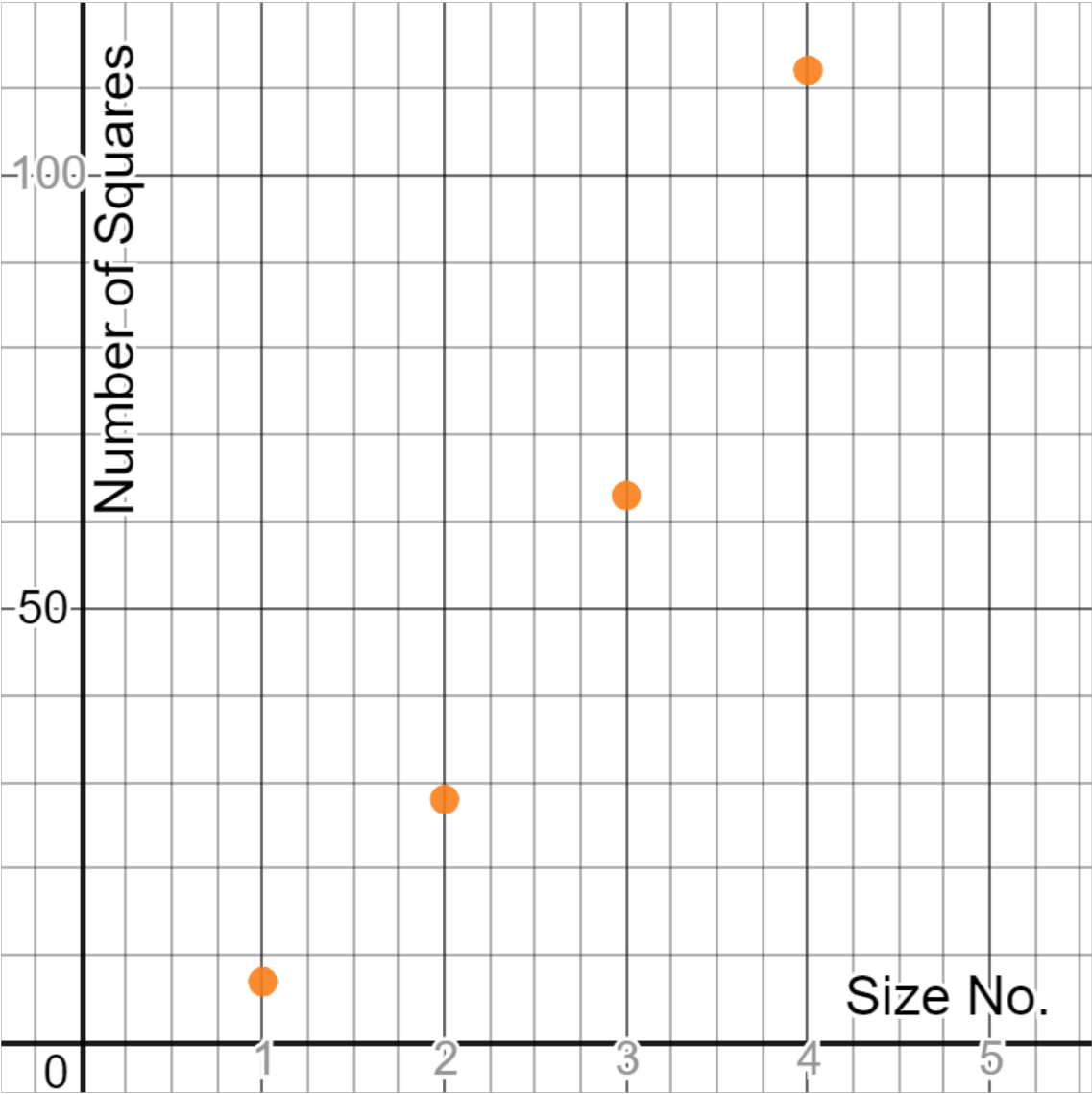

Size 1

Size 2

Size 3

The whole diagram is made up of 9 squares, but
2 of them are "missing"

Maybe you tried this:

Size #	Number of Squares	First Difference	Second Difference
1	7		
2	28	21	
3	63	35	14
4	112	49	14
5	175	63	14
n			

Maybe you did this:

Supporting engagement in the SMP's

4. Model with mathematics.

- I chose to represent _____ using _____, because _____.
- My model is usable when _____, but not when _____.
- The connection I see between the _____ representation and the _____ representation is _____.
- Although I estimated _____, my solution is reasonable because _____.
- To model this situation mathematically, the assumption that I made was _____.
- I used _____ to represent _____ in the problem.

7. Look for and make use of structure.

- I notice that in each case, _____ is changing and _____ is staying the same.
- This problem is similar to _____, because _____. It is different than _____ because _____.
- I noticed a pattern in _____ and I used it to _____.
- Because I see _____, I can apply _____.

# Promoting Discourse

- I agree with _____ because _____.
- I respectfully disagree with _____ because _____.
- I would like to extend _____ by adding _____.

Formative Assessment – Exit Ticket

- One way that linear and quadratic functions are alike is that linear functions and quadratic functions both _____.

- One way that linear and quadratic functions are different is that linear functions _____ while quadratic functions _____.

- One thing I wonder about quadratic functions is

  _____.

Reinforcing Vocabulary

Definition:

Quadratic Function

It's not a quadratic function if:

Equations:

Tables:

Graphs:

Contexts:

Other:
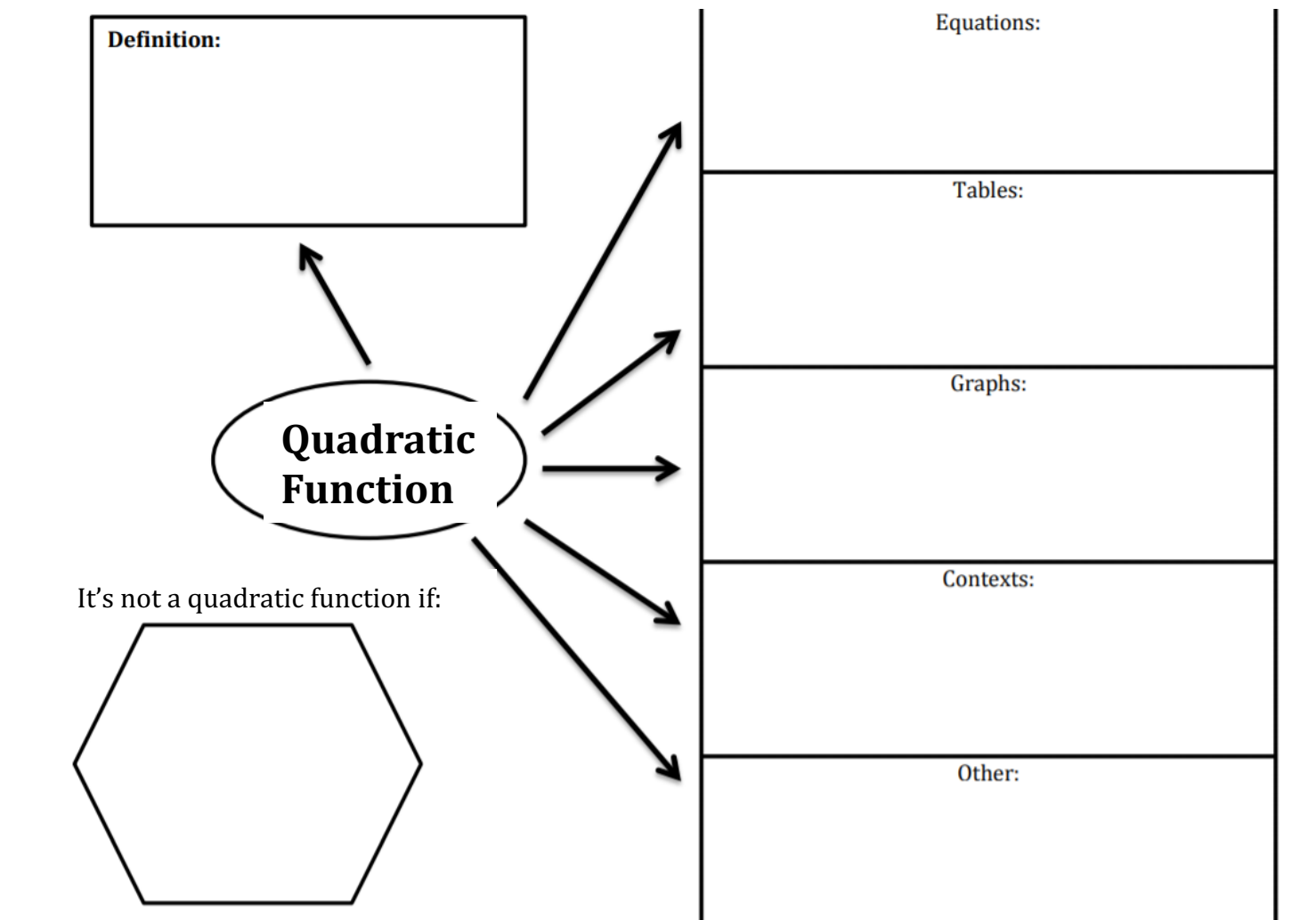
Stronger and clearer each time

- Provide multiple opportunities for students to refine and revise their thinking and their language, both orally and in writing.
- One possibility is to ask students to:
  - Start with a graphic organizer
  - Write a paragraph explaining the content of the organizer
  - Read the paragraph to a peer for feedback on both the language and the mathematics
  - Revise the paragraph and submit to the teacher.

Best Instruction Practices for English Learners:

- Provide a rich, meaning-centered context for students to use language, with many visual representations, hands-on activities, and language supports.

- Provide ample opportunities for high-quality interaction between English learners and native English speakers that encourage English learners to share their knowledge and experience, hear other students rephrase what the teacher said, and apply new language.

- Use high-frequency vocabulary that students know and gradually introduce more academic vocabulary as they progress in the lesson and their language skills.

- Integrate listening, speaking, reading, and writing skills across instruction, and assist English learners to make a bridge between oral and written language.

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Vocabulary Development – Research

The mathematics teacher needs to consider whether to introduce new words before, while, or after covering a mathematics concept, keeping in mind that learning new words naturally progresses from informal to formal understanding. Typically, new words are introduced, in context, during the lesson. Informally, the teacher starts with students' own definitions, explanations, examples, or drawings for a new concept. The new word can then be formally associated with the concept.

Making Mathematics Accessible to English Learners, A Guidebook for Teachers, 2009 WestEd, Carr, Carrol, Cremer, Gale, Lagunoff, Sexton

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