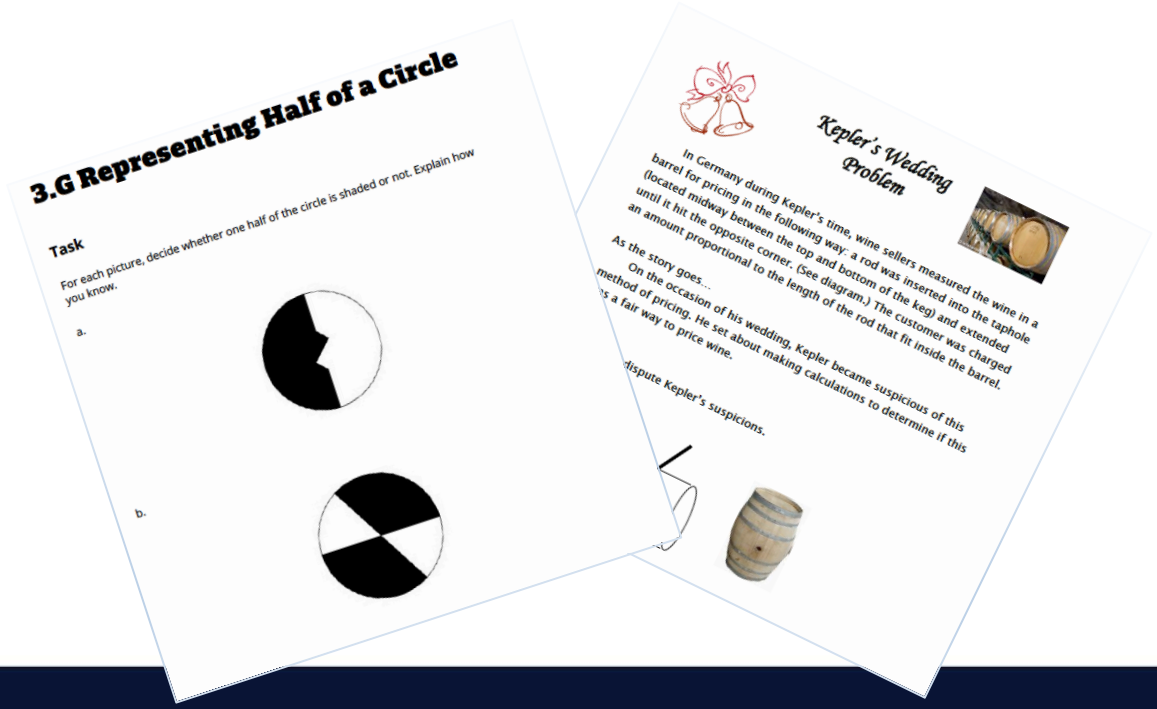
Module 2: Prompting Argumentation

Focus on Tasks



Children must be taught HOW to think not WHAT to think.

- Margaret Mead

Opening Activity

Opening Activity

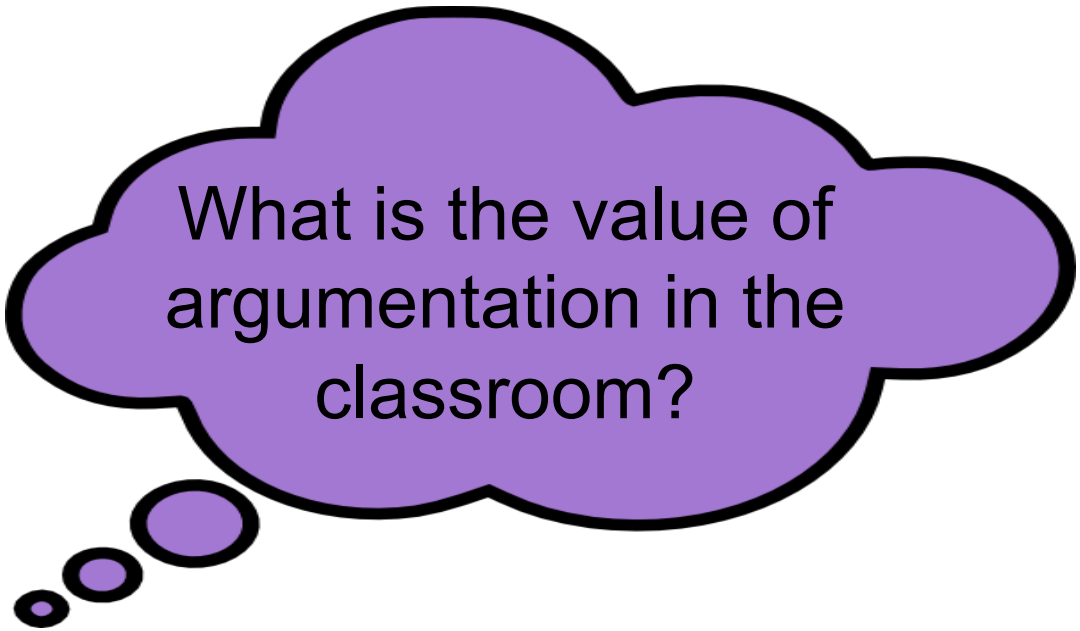
Community Agreements

Module Objectives

Participants will

- Develop a deeper appreciation of argumentation and its potential in the math classroom
- **Analyze and evaluate tasks** to determine how they support argumentation in the math classroom
- **Identify and modify argumentation tasks to** prompt argumentation for a variety of instructional purposes by using three conceptual lenses

Brainstorming

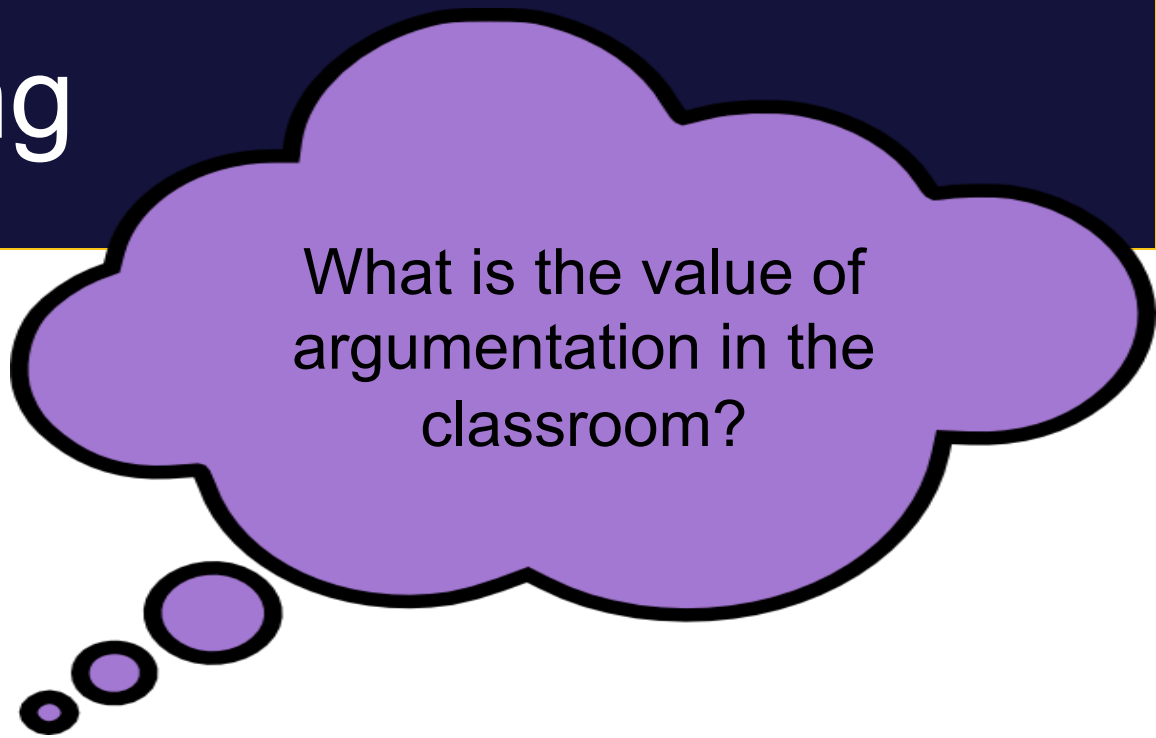


Answer individually…

Then discuss and answer as a small group…

Then, we will share as a whole group.

Brainstorming

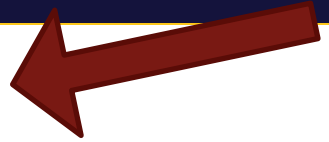


Do our Math Tasks need a Makeover?

High school teacher Dan Meyer shares his critique of typical math tasks and shows classroom-tested math exercises that prompt students to stop and think

https://www.ted.com/talks/dan_meyer_math_curriculum_makeover?language=en TEDxNYED – March, 2010

Lenses for thinking about tasks



Lens 1: Engagement

Does the task engage students in mathematical argumentation?

Lens 2: Student Learning

What do you want the students to learn from the mathematical argumentation task?

Lens 3: Teacher Purpose

What will you learn about students by using the mathematical argumentation task?

Lens 1: Engagement

Does the task engage students in mathematical argumentation?

Questions to consider:

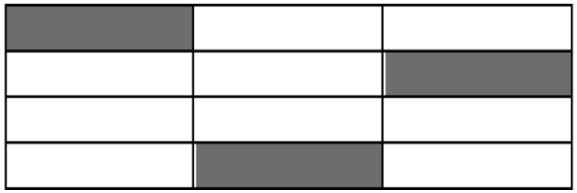
- Does the task promote a mathematical discourse? A conversation? Would this discourse include argumentation?
- Does the task prompt students to articulate a chain of reasoning?
- Does the task prompt students to write or otherwise record their chain or reasoning to show a result, answer, or other claim is true?

Lens 1: How much is shaded?

Does the task engage students in argumentation?

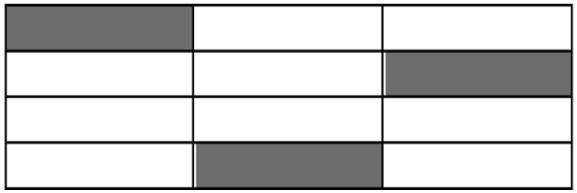
Original

What fraction of the rectangle below is shaded?



Revision

Laura says that $\frac{1}{4}$ of the rectangle is shaded. Do you think she is correct? Explain why or why not.



Lens 1: The DJ Problem

Does the task engage students in argumentation?

Original

In preparation for the Prom, students are researching the costs of two local DJ companies.

Music Makers charges a fee of $200 and an additional $175 per hour.

Dance Partners does not charge an initial fee, but charges $225 per hour.

Which company would be more cost effective for the prom committee?

Revision

In preparation for the Prom, students are researching the costs of two local DJ companies.

Music Makers charges a fee of $200 and an additional $175 per hour.

Dance Partners does not charge an initial fee, but charges $225 per hour.

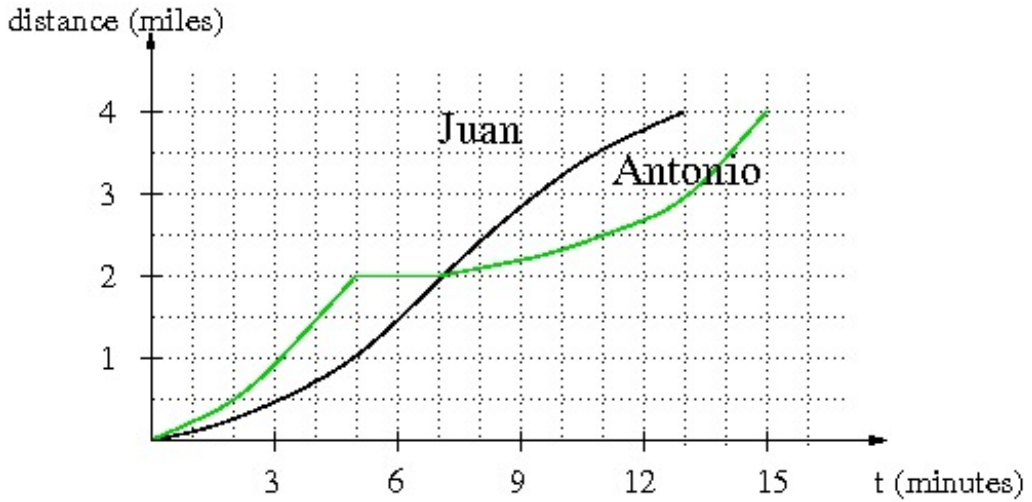
Which company would be more cost effective for the prom committee? Write a mathematical argument to support your decision.

Lens 1: The Race

Does the task engage students in argumentation?

Antonio and Juan are in a 4-mile bike race. The graph below shows the distance of each racer (in miles) as a function of time (in minutes).

(adapted from illustrativemath.org)



Original

Imagine you were watching the race and had to announce it over the radio, write a little story describing the race.

Revision

Imagine you were watching the race. Who wins the race? How do you know?

Suppose you are an announcer. What is happening around minute 5 of the race? Explain how you know.

Lens 1: Your Turn…

Break Out Groups: Elementary & Secondary

1. Examine the tasks on the handout

2. Use Lens 1 to think through each task: *Does the task engage students in mathematical argumentation?*

3. Generate possible revisions for the task so that it is more engaging with respect to argumentation

Lens 1 - Elementary Prompts

1. Fill in the missing value that makes the statement true.

   a) 10 + 5 = 2 + 3 + ___ b) 500 ÷ ___ = 10 c) 25 x 10 x 4 = ____

2. Alexa is training to bike 70 miles. During her first week of training she bikes 12 miles. During her second week she bikes 24 miles, and by her third week she bikes 36 miles. On what week does she bike close to 70 miles?

3. The coordinates of the vertices of figure ABCD are A(4, 3), B(8, 3), C(4, 6) and D(8, 6).
   Is figure ABCD a rectangle?

Lens 1 - Secondary Prompts

1. Solve each of the following:

a) $3x + 5 = 2x - 6$ b) $4x + 3 = 4x - 5$ c) $2x - 10 = 2x - 10$

2. Alexa is training to bike 100 miles. During her first week of training she bikes 12 miles. On her fifth week she bikes 40 miles. Write an equation to represent her training progress and use it to determine on what week she will be able to bike 100 miles.

3. The coordinates of the vertices of parallelogram ABCD are A(-4, -3), B(5, 6), C(8, 3) and D(-1, -6).
Determine the slopes and lengths of the sides to verify that it is a rectangle.

Lenses for thinking about tasks

Lens 1: Engagement

Does the task engage students in mathematical argumentation?

Lens 2: Student Learning

What do you want the students to learn from the mathematical argumentation task?

Lens 3: Teacher Purpose

What will you learn about students by using the mathematical argumentation task?

Lens 2:
Purposes for Argumentation Tasks

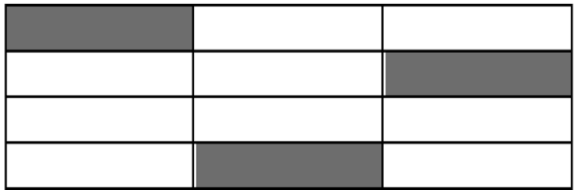
What do you want the students to learn from the argumentation task?

- Does the task help students produce better arguments?
- Does the task help students develop conceptual understanding?
- Does the task help students to mathematize contextualized problems and interpret the meanings of solutions?
- Does the task help students make sense of and compare across multiple approaches and multiple representations?

Lens 2: What do you expect students will learn?

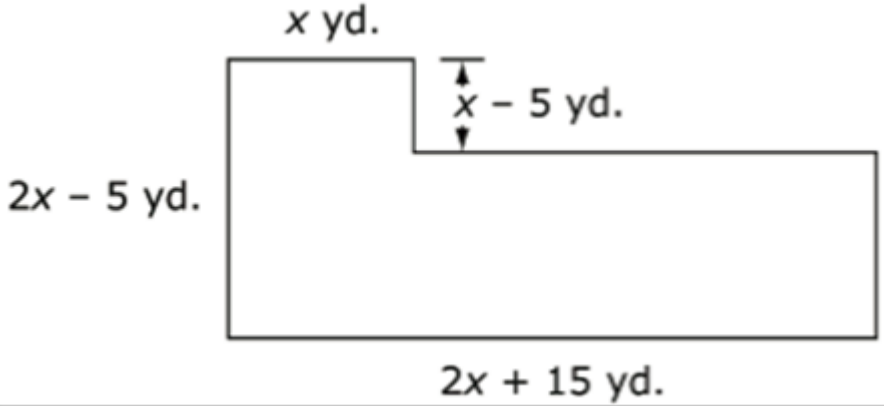
Task A

Laura says that $\frac{1}{4}$ of the rectangle is shaded. Do you think she is correct? Explain why or why not.



Task B

A town council plans to build a public parking lot. The outline below represents the proposed shape of the parking lot.



Write an expression for the area, in square yards, of this proposed parking lot. Explain the reasoning you used to find the expression.

Lens 2: What do you expect students will learn?

Task A

Laura says that $\frac{1}{4}$ of the rectangle is shaded. Do

Targets conceptual understanding - of ¼ and/or equivalence of fractions

Students need to explain how they make sense of what looks like 3/12ths (or three columns shaded with ¼ each) as also being represented by the fraction ¼.

Task B

A town council plans to build a public parking lot. The outline below represents the proposed shape of the

Targets modeling a problem situation and explaining how the model appropriately represents the situation

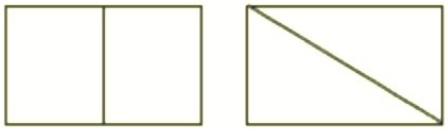
Students need to develop a model for the area and explain how they know they have appropriately accounted for the full parking lot.

Lens 2: What do you expect students will learn?

Task C

Two identical rectangular regions are cut as shown. John compares the area of one of the smaller rectangles to one of the right triangles. He says:

"I think they're the same because the triangle is wider at the bottom, but the rectangle isn't slanty, so the end up the same area."



Is John's argument convincing to you? How could you make it better?

Task D

Implemented as a NUMBER TALK

THINK! What is

$$16 \times 25?$$

When you have one strategy, show me one figure.

Keep thinking!

When you have a second strategy, show two fingers.

Followed by a discussion.

Lens 2: What do you expect students will learn?

Task C

Two identical rectangular regions are cut as shown. John

Targets getting better at argumentation

Students analyze the argument and critique the imprecise "compensation strategy," and offer improvements, which might draw out the definition of a half (potentially addressing conceptual understanding).

Task D

Implemented as a NUMBER TALK

THINK! What is

Targets comparing across multiple approaches and representations

Students offer and compare approaches, potentially arguing the validity of the approach as well as connections with other approaches. (Also can get at conceptual understanding of multiplication.)

Lens 2: Your Turn…

Examine the tasks on the handout. Use Lens 2 to think through each task: ***What do you want the students to learn from the argumentation task?***

Goal: Students produce better arguments

Goal: Students develop conceptual understanding

Goal: Students mathematize problem situations and interpret meanings of solutions in context

Goal: Students make sense of and compare across multiple approaches and multiple representations

Note: More than one purpose/goal may be relevant.

With time, explore modifications to one or more tasks that would help you attend to a different purpose(s).

Lens 2: Task 1

The coordinates of the four vertices of figure ABCD are A(4, 3), B(8, 3), C(4, 6) and D(8, 6). Based on the differences between the coordinate points, Jasmine believes figure ABCD is a square. Do you agree with her? Write a mathematical argument to support your answer.

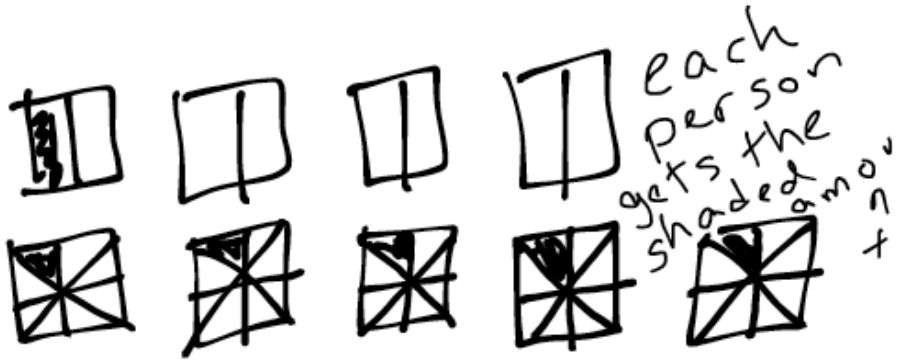
Lens 2: Task 2

Alexa is training to bike 70 miles. During her first week of training she bikes 12 miles. During her second week she bikes 24 miles, and by her third week she bikes 36 miles. If Alexa continues with the same biking pattern each week, when will she be able to bike 70 miles? Write a mathematical argument to support your answer.

Lens 2: Task 3

Jenna shows 9 people sharing 8 brownies this way:

Giselle shows 9 people sharing 8 brownies this way:



Who is right?

Lens 2: Task 4

Kay is squaring numbers. She notices that when she squares a number, the result is *larger* than the original number.

Here are some of her examples:

$3^2 = 9$ $10^2 = 100$ $(-4)^2 = 16$

She conjectures "the square of a number is always larger than the number."

a. Find another example that supports Kay's conjecture.

b. Is this conjecture always true (for all numbers)? If so, explain how you know. If not, revise Kay's conjecture so that it is a true statement.

Lenses for thinking about tasks

Lens 1: Engagement

Does the task engage students in mathematical argumentation?

Lens 2: Student Learning

What do you want the students to learn from the mathematical argumentation task?

Lens 3: Teacher Purpose

What will you learn about students by using the mathematical argumentation task?

Lens 3: Informing Instruction

When would I use this task? Why am I using it? What will I learn from it?

1. Could the task help introduce a concept?
2. Do students have prior knowledge about this topic? Would the task help build on or connect with their prior knowledge? Would I be able to learn about their prior knowledge?
3. Will the task help students to apply or connect their knowledge of one or more topics from a unit or lesson?
4. Will the task help provide information about whether students mastered the targeted skills or concepts?
5. Will the task help provide information about whether students effectively communicate their reasoning and make clear connections between their claims, warrants and evidence?

Lens 3: XXXXXXXX

What do you plan to <u>learn about your students</u> by using the mathematical argumentation task?

- Does the task help you learn about students' prior knowledge about a topic?
- Does the task help you learn about students' ability to apply or connect their knowledge of one or more topics from a lesson, unit or course?
- Does the task help you learn about students' degree of mastery of targeted skills or concepts?
- Does the task help you learn about students' ability to communicate their reasoning effectively and to make clear connections among their claims, warrants and evidence?

Lens 3: Informing Instruction

Lens 3: What will I **learn about students** by using the argumentation task?

Task 1:

The coordinates of the four vertices of figure ABCD are A(4, 3), B(8, 3), C(4, 6) and D(8, 6). Based on the differences between the coordinate points, Jasmine believes figure ABCD is a square. Do you agree with her? Write a mathematical argument to support your answer.

Lens 3: Informing Instruction

Lens 3: What will I **learn about students** by using the argumentation task?

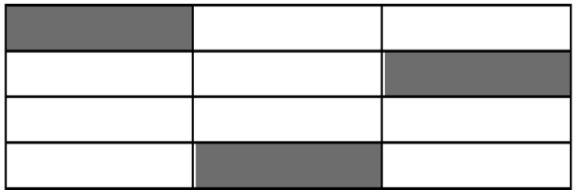
Task 2:

Alexa is training to bike 70 miles. During her first week of training she bikes 12 miles. During her second week she bikes 24 miles, and by her third week she bikes 36 miles. If Alexa continues with the same biking pattern each week, when will she be able to bike 70 miles? Write a mathematical argument to support your answer.

Lens 3: Informing Instruction

Lens 3: What will I **learn about students** by using the argumentation task?

Task 3:
Laura says that ¼ of the rectangle is shaded. Do you think she is correct? Explain why or why not.



Lens 3: Informing Instruction

Lens 3: What will I **learn about students** by using the argumentation task?

Task 4:

DO NOT solve.

Discuss solutions to each equation. Support your ideas with a mathematical argument.

a) $3x + 5 = 2x - 6$

b) $4x + 3 = 4x - 5$

c) $2x - 10 = 2x - 10$

Lenses for thinking about tasks

Lens 1: Engagement

Does the task engage students in mathematical argumentation?

Lens 2: Student Learning

What do you want the students to learn from the mathematical argumentation task?

Lens 3: Teacher Purpose

What will you learn about students by using the mathematical argumentation task?

Tasks create possibilities; But tasks alone are not enough

Tasks create possibilities; But tasks alone are not enough

- The ways teachers *use* a task in the unique setting of their classroom at a particular time determines whether or not that task promotes argumentation.
- A task can have more than one focus. A teacher may use the same task for different purposes.
- Asking students to generate a written argument for an assessment task is *not* equivalent to prompting students to engage in the *practice of argumentation* for the purpose of learning. These are related but distinct activities.
- Argumentation tasks generally allow students to draw on a any tools they have available to them; at the same time, the particular prompt may hone in on a misconception or specific concept.
- Producing an argument is challenging! ”Secure” content may be intentionally selected to support focus on argumentation.

Task Alone Are Not Enough

Developing a Culture of Thinking in Mathematics…

"Children must be taught HOW to think not WHAT to think."

Bridging to Practice

Bridging to Practice

Task Analysis:
Viewing through the three lenses, analyze your own task.

Lens 1: Engagement
Does the task engage students in mathematical argumentation? How can it be modified?

Lens 2: Student Purpose/Goals
What do you want the students to learn from the mathematical argumentation task?

Lens 3: Teacher Purpose- Informing Instruction
What do you want to learn about students by using the mathematical argumentation task?

Bridging to Practice

Protocol Guided Discussion of your Task

1. Examine your task using the lenses (10 mins)
   - use handout to guide your work
   - goal: develop a question you would like others to help you think about with respect to this task and argumentation
2. Record your question on the Protocol sheet. Have a copy (or two) of the task available to share with your group.
3. In groups of 3, participant take turns as the “Presenter” for the 18-minute protocol guided discussion of his or her task

Closure

Acknowledgements

- Bridging Math Practices Project was supported by a Math-Science Partnership Continuation Grant from the Connecticut State Department of Education, 2015-2016

UConn: Megan Staples (PI), Jillian Cavanna (Project Manager), Fabiana Cardetti (Co-PI)
Lead Teachers: Catherine Mazzotta (Manchester), Michelle McKnight (Manchester), Belinda Pérez (Hartford) Teresa Rodriguez (Manchester)

- The initial 2014-2015 Bridges project was a collaborative project among UConn, Manchester Public Schools, Mansfield Public Schools, and Hartford Public Schools

We would like to thank the CT State Department of Education for supporting this work and would like to thank all our participants, across cohorts, whose contributions to these materials are many.