Module 2:
Prompting Argumentation:
Focus on Tasks

Module Goals:

- Participants will develop a deeper understanding of argumentation and its potential in the math case.

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

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

-Margaret Mead

Module 2: Opening Activities

Please use this space to personalize the opening activities for your group.

In the Monthly PLC Format, we recommend that the opening activities for Module 2 should provide opportunities for participants to share and reflect on the Bridging to Practice work they did since the group last met.

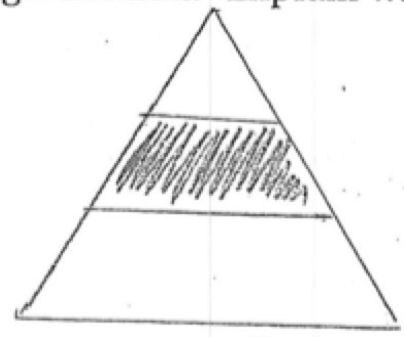
In the Workshop Format, we recommend that participants be given opportunities to continue to develop as a learning community, including community building activities or engaging in doing and discussing mathematics. Below is a task that we used in some of our enactments of these materials.

In our enactments, we emphasized that participants should focus on discussing how they could solve the problem, instead of individually working to write down a solution. By shifting the focus to an interaction, we hoped to support participants to engage in verbal argumentation.

Math Task: Triangle Fraction Problem

DO NOT SOLVE. ***Discuss*** how to solve the following problem.

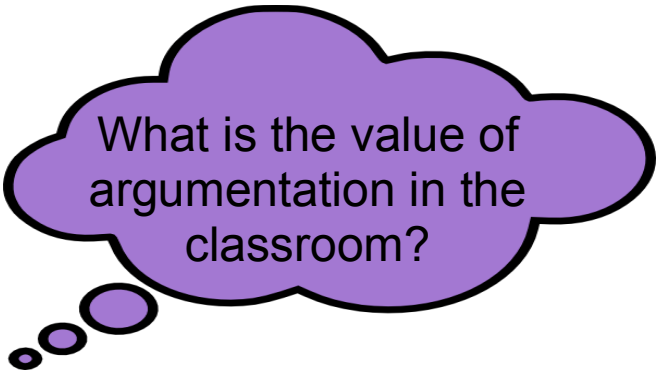
Is 1/3 of the triangle shaded? Explain why or why not.



Value of Argumentation in the Classroom

Brainstorm Page

What's the value of argumentation? What does it do for you as a teacher? What does it do for your students?



Three Lenses for Analyzing Argumentation Tasks

As you select and modify tasks with an eye to mathematical argumentation, it can be helpful to consider the following three guiding questions (bolded). We offer these as "lenses" to use to support your analysis of the tasks, and subsequent revisions, as you deem appropriate.

1. **Does the task <u>engage</u> students in mathematical argumentation?**
   a. Does the task promote a mathematical discourse?
   b. Does the task prompt students to articulate a chain of reasoning?
   c. Does the task require students to write or otherwise record their chain or reasoning to show the result is true?

2. **What do you want the <u>students to learn</u> from the mathematical argumentation task?**
   a. Does the task help students produce better arguments?
   b. Does the task help students develop conceptual understanding?
   c. Does the task help students interpret solutions to problems?
   d. Does the task help students understand multiple representations of mathematics?

3. **What do you plan to <u>learn about your students</u> by using the mathematical argumentation task?**
   a. Does the task help you learn about students' prior knowledge about a topic?
   b. 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?
   c. Does the task help you learn about students' degree of mastery of the skills or concepts?
   d. 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?

<u>Note</u>: Asking students to generate a written argument for an assessment task is *not* the same as to prompting students to engage in the *practice of argumentation* for the purpose of learning. These are related, but distinct activities.

Lens 1: Elementary

Does the task engage students in mathematical argumentation?

Please review each task and use the following guiding questions to modify the task to engage students in mathematical argumentation.

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

Task 1

Fill in the missing value that makes the statement true.

a) $10 + 5 = 2 + 3 +$ _____ b) $500 \div$ ___ $= 10$ c) $25 \times 10 \times 4 =$ _____

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. On what week does she bike close to 70 miles?

Lens 1: Elementary

Does the task engage students in mathematical argumentation?

Task 3

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

Is figure ABCD a rectangle?

Lens 1: SECONDARY

Does the task engage students in mathematical argumentation?

Please review each task and use the following guiding questions to modify the task to engage students in mathematical argumentation.

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

Task 1:

Solve each of the following:

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

Task 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.

Lens 1: SECONDARY

Does the task engage students in mathematical argumentation?

Task 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.

Lens 2: Purposes for Using Argumentation Tasks to Support Student Learning

Here are some purposes or goals you might have as you use a task that prompts argumentation in your mathematics classroom. Alternatively, as you analyze tasks, you may notice different tasks are particularly well suited for different types of goals related to argumentation. There are additional goals you might pursue as well when using argumentation tasks, but these are some of the more common ones.

A. Goal: Students produce better arguments

- Support students to communicate their reasoning
- Critique the reasoning of others
- Revise one's approach
- Work towards clarity of explanations
- Attend to quality of warrants and evidence

B. Goal: Students develop conceptual understanding

- Dig deeply into mathematical concept
- Target misconceptions and common errors
- Analyze why a result holds, which reveals the underlying mathematics

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

- Work towards appropriately applying concepts and prior knowledge in new ways to problem contexts
- Support students to articulate the chain of logic that demonstrates their solution is correct and/or reasonable
- Consider justifications for: (a) the mathematical model used, (b) the correctness of the solution, and (c) how the solution responds to the contextualized situation

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

- Support students to develop fluency with representations
- Make sense of representations (e.g., symbolic notation, graphs, verbal)
- Get many different ideas and approaches out on the table
- Draw connections between representations
- Support students to learn from the reasoning of others

Lens 2: Purposes of Argumentation Tasks

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

Review each task and use the following guiding questions to identify what you want 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?

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.

Task 2

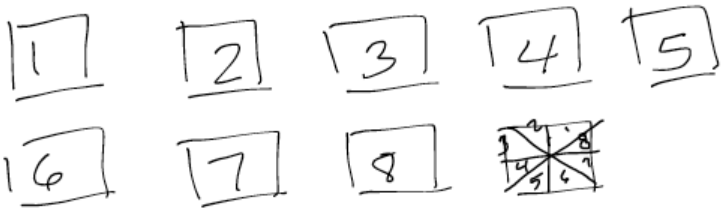
Alexa is training to bike 70 miles. During her first week of training she bikes 12 miles. During her second week she bikes 24 miles, and by her third week she bikes 36 miles. If Alexa continues with the same biking pattern each week, when will she be able to bike 70 miles? Write a mathematical argument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

Lens 2: Purposes of Argumentation Tasks

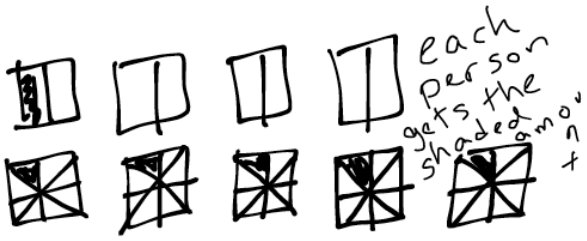
What do you want students to learn from the mathematical argumentation task?

Task 3

Jenna shows 9 people sharing 8 brownies this way:



Giselle shows 9 people sharing 8 brownies this way:



Who is right?

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.

Lens 3: Informing Instruction

What do you plan to learn about students by using the argumentation task?

Use the guiding questions to identify what you want students to learn from each 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?

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.

Task 2

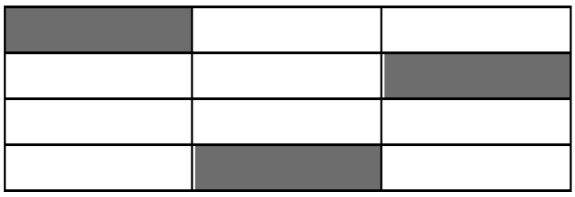
Alexa is training to bike 70 miles. During her first week of training she bikes 12 miles. During her second week she bikes 24 miles, and by her third week she bikes 36 miles. If Alexa continues with the same biking pattern each week, when will she be able to bike 70 miles? Write a mathematical argument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

Lens 3: Informing Instruction

What do you plan to 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.



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

Bridging to Practice:
Task Analysis: Viewing Through the Lenses

In preparation for a guided discussion of your task, please reflect on the following questions and jot some notes, as useful. Your goal is to reflect on this task, any modifications you have made for different purposes.

Lens 1: How does the task engage students in mathematical argumentation?

Modifications: (proposed or already made; can be none)

Lens 2: What goal have I set for student learning?

Modifications: (proposed or already made; can be none)

Lens 3: What will I learn about the students from the task?

Modifications: (proposed or already made; can be none)

Bridging to Practice: Guided Discussion of Tasks for Argumentation

Roles:

- **Presenter**—prepares task and focus question in advance. Responsible for bringing copy of resource.
- **Facilitator**—reads the phases of the protocol as each new phase begins; answers questions about the protocol, helps group members stay true to the intent of each phase, uses discretion to adjust timing.
- **Timekeeper**—rings a chime or provides other cue to indicate end of a phase.

Phases (with time limits – total time 18 minutes):

1. **Present Task**. (3 minutes) Presenter introduces the task and helps others see link between the task and how it will support a) students' participation in argumentation, b) the purpose for student learning, and/or c) the purpose for teacher learning about students.

   Presenter also shares, as appropriate, changes made to the task and the impact he/she hopes changes will have on student learning. Presenter shares the physical artifact.

2. **Question/dilemma/concern.** (1 minute) Presenter articulates one key question or concerns he/she would like colleagues to address:

3. **Silent reading.** (2 minutes) Colleagues review the material provided. Colleagues take notes quietly, attending to presenter's question(s) as well as their own insights and questions.

4. **Clarifying questions.** (2 minutes) Colleagues ask factual questions to gain additional information necessary for them to understand the resource and its use and make helpful suggestions.

Bridging to Practice:
Guided Discussion of Tasks for Argumentation

5. **Discussion addressing presenter's question.** (8 minutes)

(5 min) Participants discuss the key question or concern, generate alternatives or new considerations. Presenter listens, and is silent, taking notes during this time. *Facilitator is responsible for enforcing Presenter's listening role, balancing voices among Participants, and ensuring that the Presenter's question is addressed.*

(3 min) Presenter joins the conversation. The group continues to work on the dilemma (often leading to refinement of what the dilemma is) and ways to address the question.

6. **Presenter's debrief.** (1 minute) Presenter summarizes what she/he heard and plans to do.

7. **Group check.** (1 minute) Group reflects on and summarizes how well the group used the protocol format; group may consider modification of time limits or other additions that retain the spirit of the protocol.