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 be able to

- **Select and modify tasks** to prompt argumentation for a variety of instructional purposes by using three conceptual lenses.

- **Evaluate and analyze tasks** to determine how they support argumentation in the math classroom

In order to:

implement tasks that prompt argumentation to support a culture of thinking.

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

-Margaret Mead

Bridging Math Practices Project

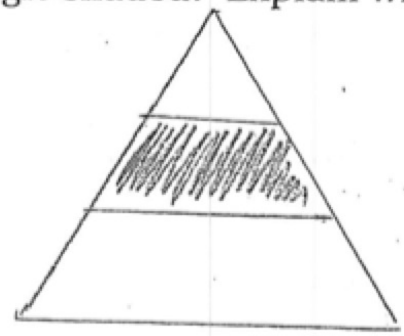
Community Agreements

DO NOW

Triangle Fraction Problem

<u>DO NOT SOLVE</u>. ***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?

Lenses for Analyzing Argumentation Tasks

Lens 1: Does the task *engage* 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?

Lens 2: What do you want the *students to learn* 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 analyze concepts through collaborative work?
d. Does the task help students interpret solutions to problems?
e. Does the task help students understand multiple representations of mathematics?

Lens 3: What do you plan to *learn about your students* by using the mathematical argumentation task?

a. Does the task help the teacher assess students' prior knowledge about a topic?
b. Does the task help the teacher assess students' ability to apply or connect their knowledge of one or more topics from a unit or lesson?
c. Does the task help the teacher assess whether or not students have mastered the skills or concepts?
d. Does the task help the teacher assess students' ability to communicate effectively their reasoning and to make clear connections between their claims, warrants and evidence?

Remember: 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.

Analyze Tasks Using Lens 1:

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.

a. Does the task promote a mathematical discourse? A conversation?
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?

Task 1

Solve each of the following (on a worksheet)

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

Task 2

Alexa is training to bike 50 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 50 miles?

Analyze Tasks Using Lens 1:

Does the task engage students in mathematical argumentation?

Task 3

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

Analyze Tasks Using Lens 1:

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.

a. Does the task promote a mathematical discourse? A conversation?
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 of reasoning to show the result is true?

Task 1:

Solve each of the following (on a worksheet)

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

(Followed by class discussion)

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.

Analyze Tasks Using Lens 1:

Does the task engage students in mathematical argumentation?

Task 3:

The coordinates of the four 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.

Further Details About Lens 2: Some Purposes for Using Argumentation Tasks to Support Student Learning

Here are some goals you might have for using a task to prompt argumentation in your mathematics classroom. There are additional reasons to use argumentation tasks, but these are some common learning goals that are well supported by engaging students in argumentation tasks.

1. **Goal: Students produce better arguments**
    - Support students to communicate their reasoning
    - Work towards clarity of explanations
    - Attention to quality of warrants and evidence

2. **Goal: Students develop conceptual understanding**
    - Dig deeply into mathematical concept
    - Target misconceptions and common errors

3. **Goal: Students consider the qualities of arguments or analyze concepts deeply by engaging in collaborative work**
    - Support students to learn from the reasoning of others
    - Get many different ideas and approaches out on the table
    - Critique the reasoning of others
    - Revise one's approach

4. **Goal: Students mathematize problem situations and interpret contextualize meanings of solutions**
    - 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) mathematical model, (b) correctness of the solution, and (c) respond to the contextualized situation.

5. **Goal: Student understand how representations communicate mathematical ideas and develop proficiency working across multiple representations**
    - Support students to develop fluency with representations
    - Make sense of representations (e.g., symbolic notation, graphs, verbal)
    - Draw connections between representations

Analyze Tasks Using Lens 2:

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

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

1. Does the task help students produce better arguments?
2. Does the task help students develop conceptual understanding?
3. Does the task help students analyze concepts through collaborative work?
4. Does the task help students interpret solutions to problems?
5. Does the task help students understand multiple representations of mathematics?

Task 1

DO NOT Solve.
Discuss how you would solve each of the following problems. Support your ideas by explaining your mathematical thinking.
a) 10 + 5 = 2 + 3 + ___ b) 500 ÷ m = 10 c) 25 x 10 x 4 = ____

Analyze Tasks Using Lens 2:

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

Task 2

Alexa is training to bike 50 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, will she be able to bike 50 miles by week 4? Write a mathematical argument to support your reasoning.

Task 3

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.

Analyze Tasks Using Lens 2:
What do you want students to learn from the mathematical argumentation task?

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

1. Does the task help students produce better arguments?
2. Does the task help students develop conceptual understanding?
3. Does the task help students analyze concepts through collaborative work?
4. Does the task help students interpret solutions to problems?
5. Does the task help students understand multiple representations of mathematics?

Task 1

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.

Analyze Tasks Using Lens 2:

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

Task 2

DO NOT Solve.
Discuss solutions to each equation. Support your thoughts with a mathematical argument.

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

Task 3

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. If she continues to advance in this same pattern, on what week will she be able to bike 100 miles? Write a mathematical argument to support your answer.

Analyze Tasks Using Lens 3:

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

Use the guiding questions to identify what you want to learn about your students from each task.

1. Does the task help the teacher assess students' prior knowledge about a topic?
2. Does the task help the teacher assess students' ability to apply or connect their knowledge of one or more topics from a unit or lesson?
3. Does the task help the teacher assess whether or not students have mastered the skills or concepts?
4. Does the task help the teacher assess students' ability to communicate effectively their reasoning and to make clear connections between their claims, warrants and evidence?

Task 1

DO NOT Solve.
Discuss how you would solve each of the following problems. Support your ideas by explaining your mathematical thinking.
a) 10 + 5 = 2 + 3 + ___ b) 500 ÷ m = 10 c) 25 x 10 x 4 = ____

Analyze Tasks Using Lens 3:

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

Task 2

Alexa is training to bike 50 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, will she be able to bike 50 miles by week 4? Write a mathematical argument to support your reasoning.

Task 3

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.

Analyze Tasks Using Lens 3:

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

Use the guiding questions to identify what you want to learn about your students from each task.

1. Does the task help the teacher assess students' prior knowledge about a topic?
2. Does the task help the teacher assess students' ability to apply or connect their knowledge of one or more topics from a unit or lesson?
3. Does the task help the teacher assess whether or not students have mastered the skills or concepts?
4. Does the task help the teacher assess students' ability to communicate effectively their reasoning and to make clear connections between their claims, warrants and evidence?

Task 1

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.

Analyze Tasks Using Lens 3:

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

Task 2

DO NOT Solve.

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

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

Task 3

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. If she continues to advance in this same pattern, on what week will she be able to bike 100 miles? Write a mathematical argument to support your answer.

Task Analysis: Viewing Through All Lenses

Lens 1: How does the task engage students in mathematical argumentation?
Lens 2: What goal have I set for student learning?
Lens 3: What will I learn about the students from the task?

A Second Look – Viewing Through All Lenses

Change your focus for either Lens 2 or Lens 3. How will this affect the other lenses?

Lens 1: How does the task engage students in mathematical argumentation?
Lens 2: What goal have I set for student learning?
Lens 3: What will I learn about the students from the task?

PROTOCOL:
Guided Discussion Of Math Task (For Argumentation)

Roles:

- **Presenter**—prepares materials in advance (task, focus question). 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 of the particular phases, and uses discretion to adjust timing.
- **Timekeeper**—rings a chime or other sound maker to indicate end of a phase. In the event a team only has three members for one meeting, this role may be combined with that of facilitator.

Phases (with time limits – total time 20 minutes):

1. **Present Task**. (5 minutes) Presenter introduces the task and helps others see link between the task and how the task will a) support students' participation in argumentation, b) support the purpose for student learning, and/or c) support the purpose for teacher learning.

   Presenter also shares, if any, 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 answer or 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 (this section may be bypassed if colleagues feel it is not needed for task). 1
5. **Discussion addressing presenter's question.** (8 minutes)

   (5 min) Participants discuss the 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 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.