Additional Pedagogical Routines to Support Argumentation – Everyday

Pedagogical moves or tools you likely already know

- Turn and talk
- Think-Pair-Share
- Quick Write (pre-write; check for understanding)
- Exit slip
- Journal prompts

General Pedagogical Moves

Talk Moves (Chapin, O'Connor, & Anderson (2003)

- **Revoicing** *"So what you're saying is that it's an odd number?"*
- **Asking students to restate someone else's reasoning** *"Can you repeat what he just said in your own words?"*
- **Asking students to apply their own reasoning to someone else's reasoning** *"Do you agree or disagree and why?"*
- **Prompting students for further participation** *"Would you like to add on?"*
- **Using wait time** *"Take you time….we'll wait…"* ***AND*** *After a student responds, so others can process the idea. "Think about what she said."*

What counts as argumentation?

*** Recall that argumentation can be thought of broadly – more than constructing a full argument autonomously—and also includes a host of other practices such as:

- making conjectures, finding patterns, making inferences (reason inductively)
- analyzing a situation; analyzing relationships
- breaking into cases
- using a counterexample
- testing plausibility of a conjecture or idea (testing with examples)
- distinguishing correct logic from logic or reasoning with flaws
- stating assumptions; stating definitions used; stating relevant previous results (and applying, as appropriate)

What can you talk about?[1]

- Mathematical Concepts, Computational Procedures, Mathematical Reasoning, Mathematical Terminology, Symbols, and Definitions, Forms of Representation

[1] From presentation by Kelly Lenox

A generative list of questions and prompts to elicit arguments (reasons)

Sense making:
Why does it make sense that… ? Why doesn't it make sense that… ?
What makes you think that he's correct?
Are these the same? Are these different?

Analysis:
Can you show me where xx came from?
Can you show me where xx is in your diagram?
Can you see where John used the idea xxxx (e.g., Can you see where John used the idea that it was 3 times as large? Can you see how John represented the slope?)
Are these the same? Are these different?

Direct prompts for an argument:
How did you know …?
Why does that method work?
Please explain your reasoning to us.

Do you agree or disagree, and why?

Decision making:
Why did you decide to/ choose to … ?
Why do you think she…? (ask about the idea of another real or fictitious student)
Could I/you have done xxxx instead? Why/why not?
Am I allowed to xxxx? Why/why not?
Why was that a good move/step?
What did s/he just show?

Defending, convincing, proving:
How do you know your answer is right?
Can you convince me… ? What convinces you that… ?
Can you show me why that *has* to be true?
John, did he convince you yet that… ?
Can you explain why that must be so?
Defend your answer.
Prove it to me.
Sell me on that idea.

Other tips

- Start "easy access" or "low threat:" What do you think might happen? What's your guess? What are you noticing? – or – What do you notice in this picture?
- ** Have something – visuals, diagrams, graphs, tables, equations, tiles, blocks –to talk about! It's easier to start explaining an idea when you have something to point to and can use words like "this" and "that part." ****
- Develop language that can be used to share ideas (model, practice)
- Be specific about what you want students to share, clarify, show or prove. Ask about *their* idea and *their* thinking. Ask something you honestly do not know.

Four Other Routines to Support Argumentation in Math Class [2]

1. Alike and Different

Prompt can be written at the beginning of class, or any time during class. Students make lists, or can use Venn diagrams to show differences and similarities. Follow up questions lead to "how do you know…"

Ex. A. How are these equations alike? How are they different?

$x^2 + 3x + 10 = 0$ $\qquad\qquad$ $-x^2 + 12 = 0$

Student may observe: "one opens up and one opens down." Or "one has no solutions the other has 2 solutions." You can follow up such statements with How do you know?

Ex. B. How are these two shapes alike? How are they different?

2. Noticing & Wondering

Prompt asks students what they notice about a diagram, scenario, equation, etc. and what they are wondering about. The "wonderings" turn into places for reasoning and argumentation. The "noticing" helps students make sense of what they are discussing.

- **Say/write one thing you notice (or understand); one thing you're wondering about (give stems)**

I'm noticing…	I'm wondering …

3. Mystery Number; Giving Clues

Version 1a: You give four clues for a number, equation, object, etc.

1. My number has 2 digits.
2. The sum of the digits is 15.
3. The product of the digits is 56.
4. The number is even.

[2] Several of the above are from McCoy, Barnett, & Combs (2013). *High-Yield Routines.* Reston, VA. NCTM. *Wondering and Noticing* is from Math Forum

Version 1b. *What's my shape?* (an elaborated version!)
Present one item at a time.

What's my shape?

At what point do you definitively KNOW what the shape is?

1. It is a closed figure with four straight sides
2. It has two long sides and two short sides
3. It has a right angle
4. The two long sides are parallel
5. It has two right angles
6. The two long sides are not the same length
7. The two short sides are not the same length
8. The two short sides are not parallel
9. The two long sides make right angles with one of the short sides
10. It has only two right angles

Version 2: Students can create the clues and give to a partner to solve.
Develops vocabulary; strengthens inference skills; allows you to discuss redundant information.

4. How do you know?
Give students a question that may or may not have an obvious answer, but that requires reasoning. You can do private think time, pairs-share, or sharing with the whole class. You can model writing a response; have students write a response. There are lots of ways to do it.

Ex. 1: What shape is this? How do you know?
Or: Is this a rectangle? How do you know?

Ex 2: How many solutions does this system have? How do you know?

$2x - 5y = 3$
$4x - 10y = 1$

Ex 3: How do you know that $2(x - 3) = 2x - 6$?

Ex 4: Which expression represents a larger value? How do you know?

$(x^2 + 3)$ - or - $x^2 + 6x + 3$