Getting Students to Write Mathematical Arguments:

How might we get them there?

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“Writing” = paper + pencil

Writing Takes on New Meaning!

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1.23

Writing Takes on New Meaning!

$$x \cdot y$$

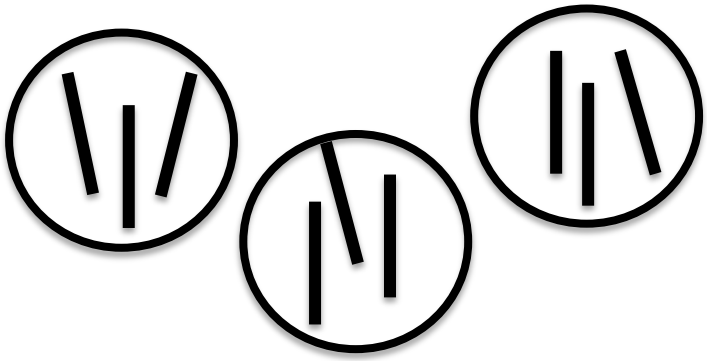
Writing Takes on New Meaning!

I like math.

Some Types of Mathematical Evidence

- Symbols
- Graphs
- Tables
- Pictures
- Words

$ ¼ ≥ ÷ ≠



vertex

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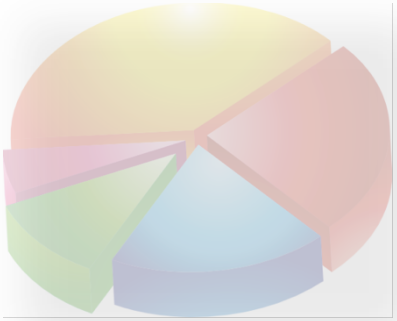
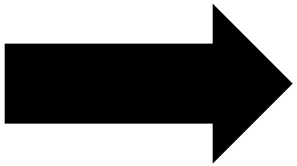
- **Words**



vertex

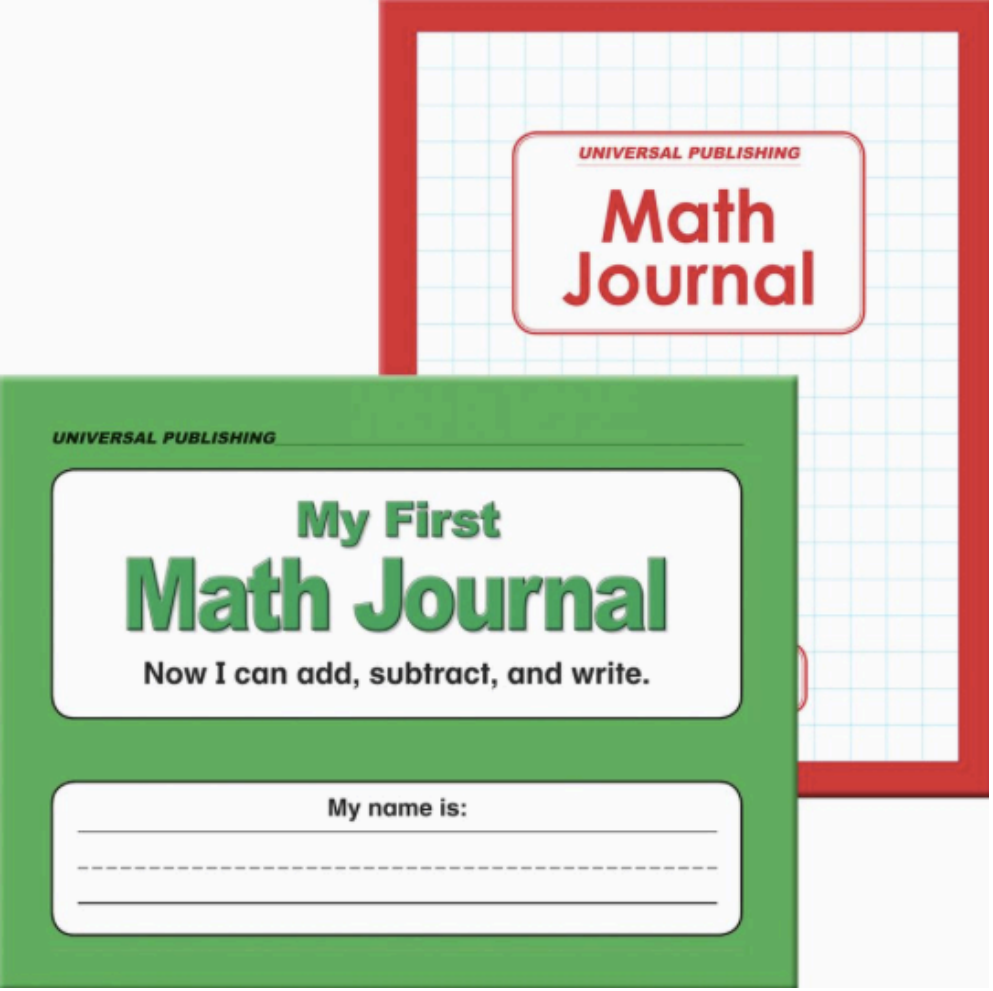


Project M^3

- 5-yr. Javits grant
- Grades 3-5, gifted
- Process Standards

Project M^2

- 5-yr. NSF grant
- Grades K-2, all
- Process Standards

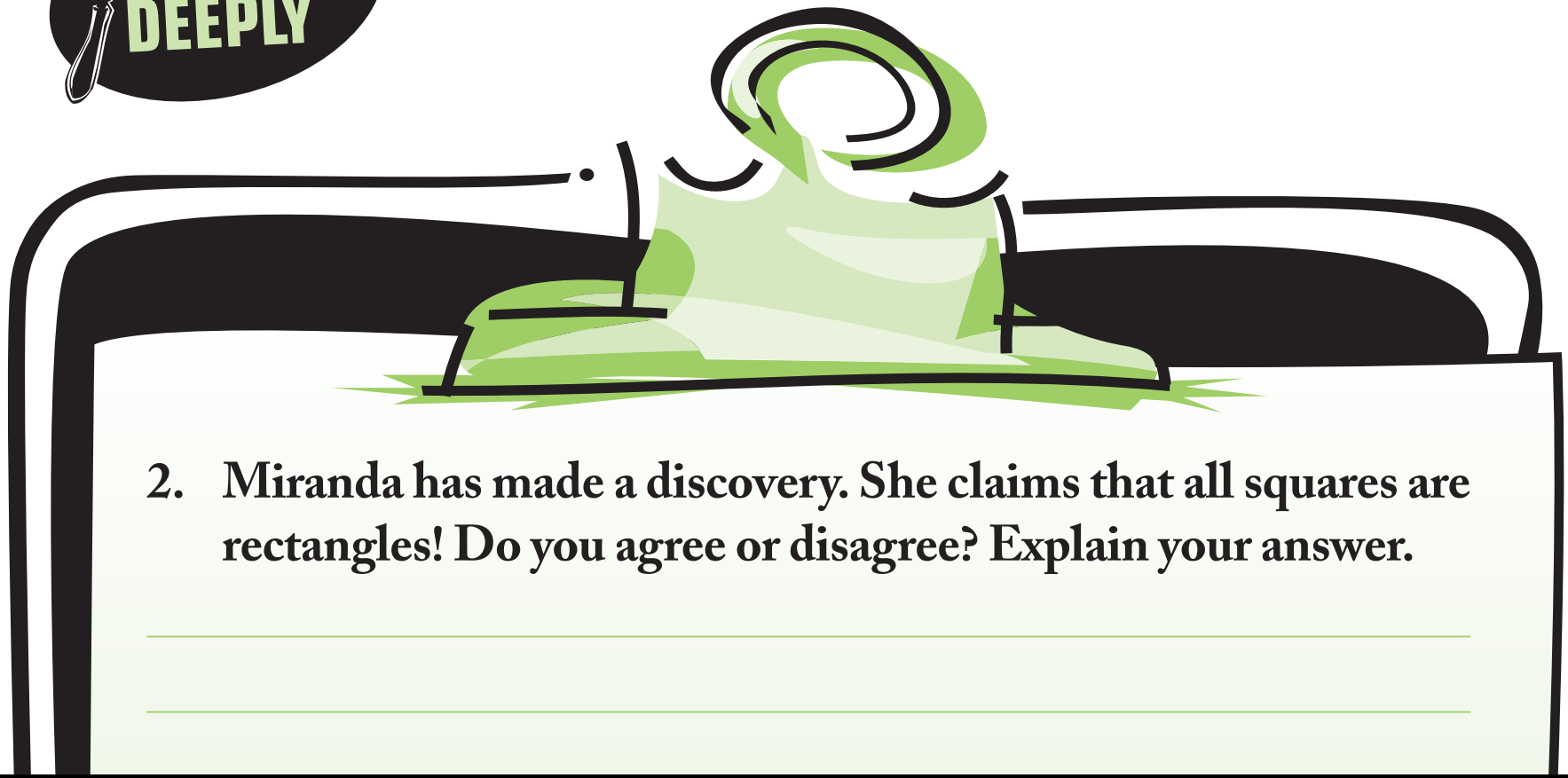


It's about the <u>purpose</u>, not the <u>medium</u>

THINK DEEPLY

Student Mathematician: Date:

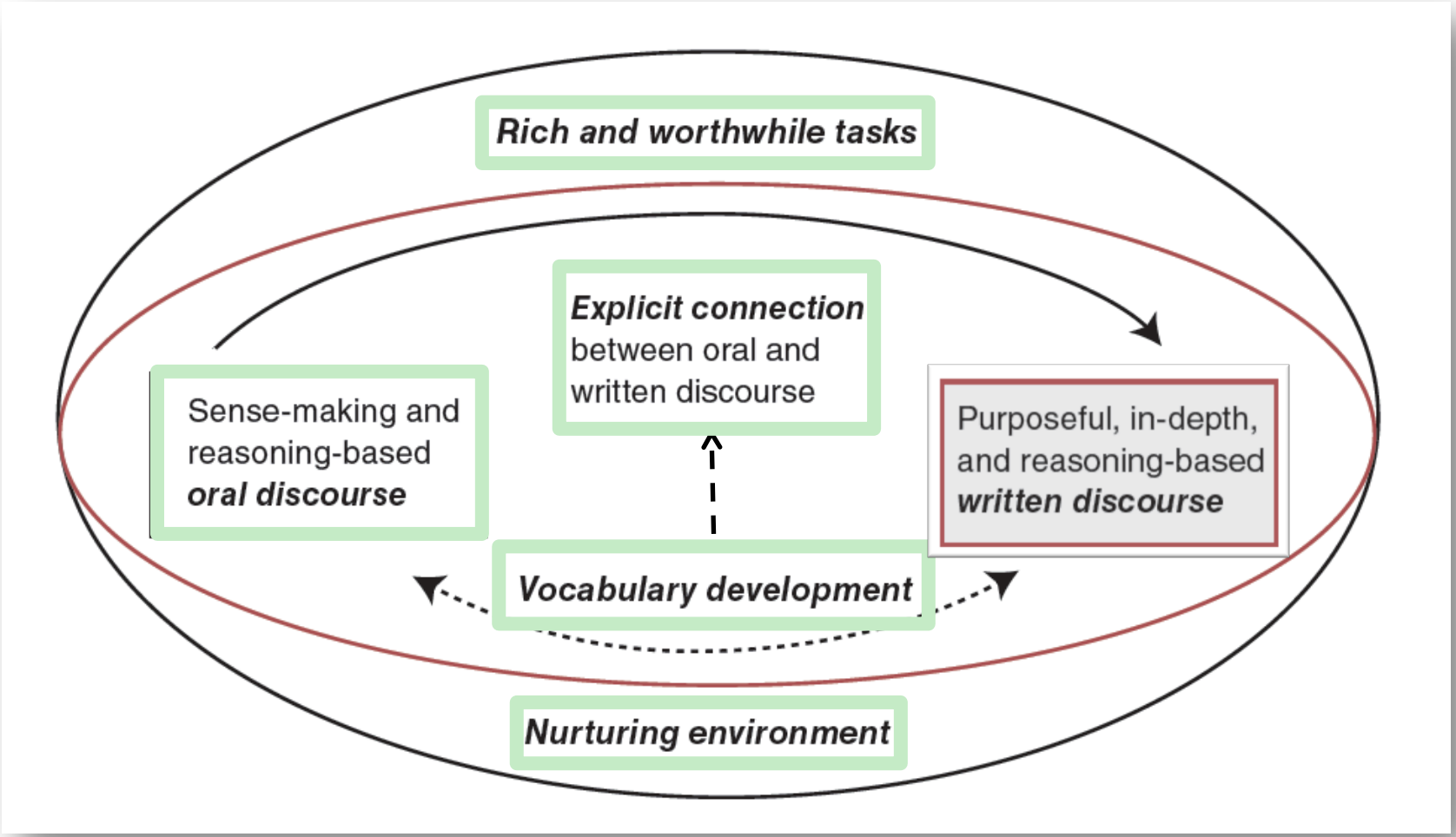
Mathematician's Journal



2. Miranda has made a discovery. She claims that all squares are rectangles! Do you agree or disagree? Explain your answer.

I agree to Miranda's theory. I agree because a square has all the atributes of a rectangle. Those atributes are: 4 sides, 4 90° angles, and 2 sets of opposite parellel and congruent lines. A square fits all those atributes but it also has 1 extra atribute. That all its sides are congruent. A square also has many other names. Those are, rectangle, parallelogram, rhombus, and quadrilateral. But its clearest name is square

Student Mathematician Discourse Framework



(Casa, 2014)

Things to Consider

1. Strategies to share conventions of written mathematical arguments
2. Strategies for encouraging appropriate use of representations
3. Strategies for providing constructive feedback
4. Strategies for encouraging mathematical vocabulary

- General prompt types that may press students to write a mathematical argument

Strategies to share conventions of written mathematical arguments

- Writer's roles (think about q, write the answer, explain why using words and possibly other representations)
- Use the talk frame (e.g., "This is how mathematicians would write what you said.")
- Share models of writing, and critique
- Share samples of writing, and critique
- Provide feedback in writing and orally

Strategies to share conventions of written mathematical arguments

- Talk Frame
- Be specific about your expectations, math vocabulary you want them to use
- What does a mathematical argument look like. "These are the aspects of what this style of writing should look like."
- Support with graphic organizer
- What does "explain" and "explain your thinking" look like?

Strategies for encouraging appropriate use of representations

- Use the talk frame (e.g., “This is how mathematicians would show what you mean.”)
- Have students critique one another’s use of representations
- Compare different forms of representations

Appropriate Reps

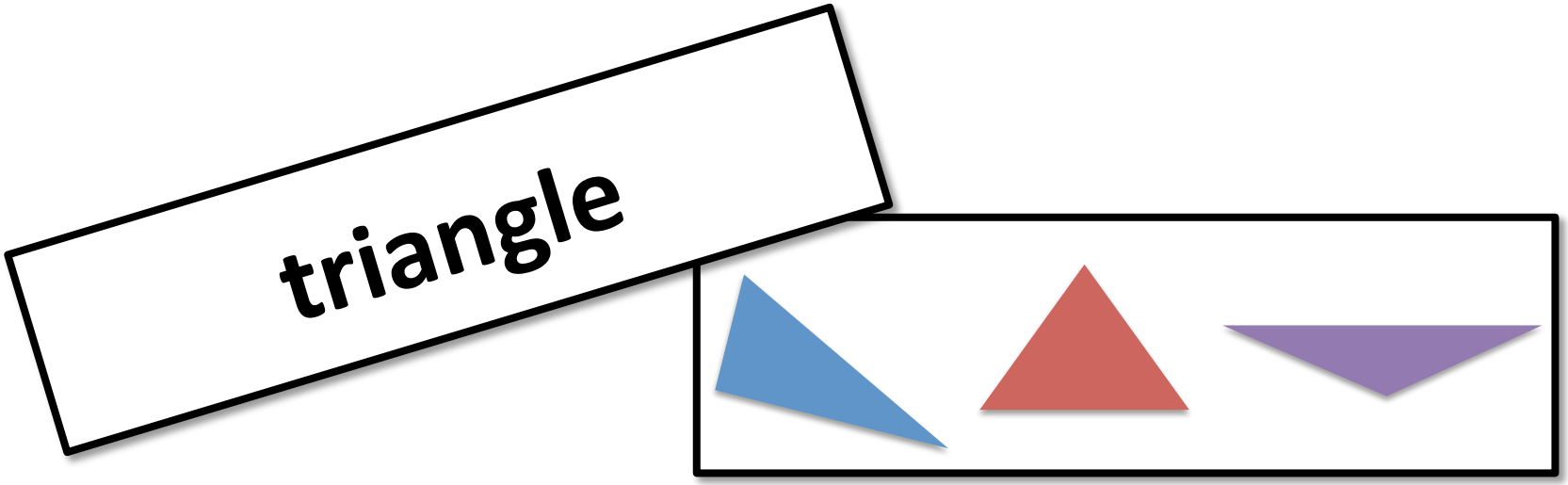
- Teacher modeling
- Critique other students' work
- Providing a rubric or check list
- Having multiple representations of the same thing – compare/contrast
- Give a problem frame
- Creating a poster/display and cumulatively add different representations
- Have students "work backwards" – give a rep and ask what problems they connect with
- Why is this a good/not good representation for this problem?
- Opportunities to practice and revise

Strategies for providing constructive feedback

- Model first as a teacher
- Highlight the strengths
- Point out what to improve
- Focus on one component at a time
- Focus on the *mathematical* conventions
- Have students eventually participate

Strategies for encouraging mathematical vocabulary

- Model their appropriate use
- Use an interactive word wall
- Introduce terms when “needed”
- Encourage student use



Encouraging Appropriate Vocab

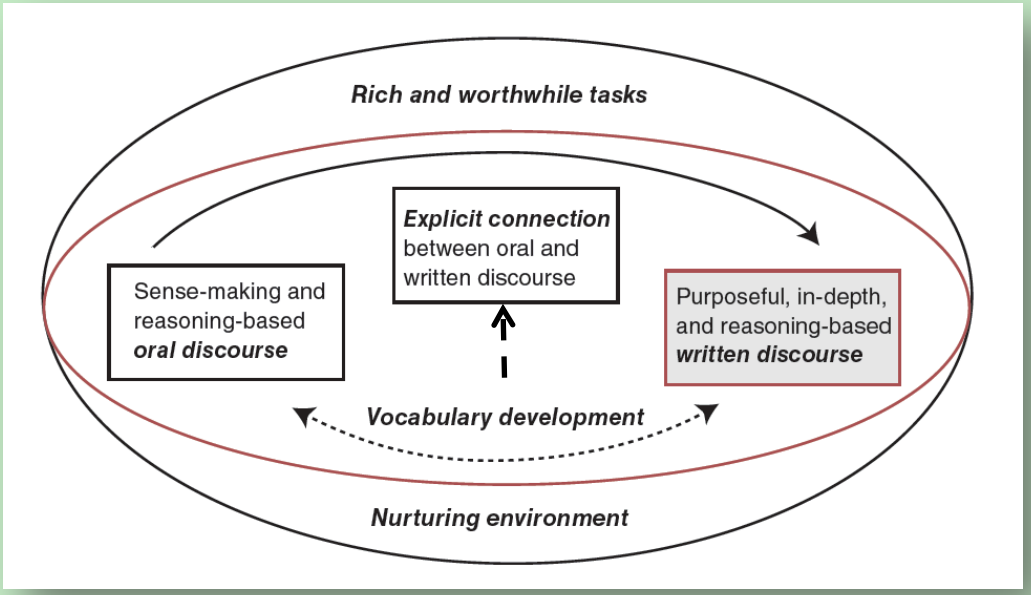
- Vocabulary centers
- Word bank for the day
- Vocabulary confession videos
- Vocabulary wanted posters
- Vocab riddles
- Class vocab journal
- Teacher modeling, prompting, and expecting frequent and appropriate vocab use
- Giving students credit/holding them accountable for using math vocab
- Having students write/say definitions in their own words

Encouraging Appropriate Vocab

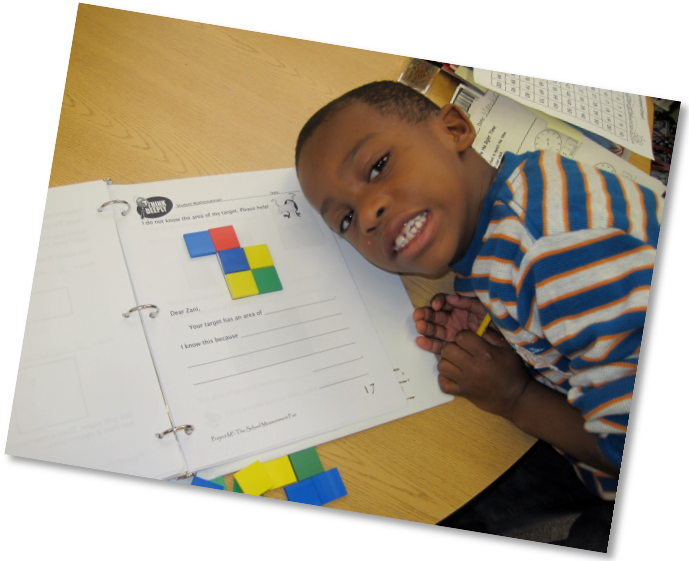
- Post definitions
- Categorize words
  - Create connections between words
  - Web the words
  - Level of knowledge about words
- Student notes
  - Keep glossaries
  - Add pictures, symbolic representations
  - Digital glossaries (so you can alphabetize)
- Color code vocab (dedicate one color to a key term (e.g., slope), use that color any time you use the term or an alternate representation of it (e.g., *m*, rise/run)

Prompt types that may press students to write a mathematical argument

- Multiples solutions, common misconceptions
- Student A thinks X. Do you agree or disagree? Why?
- From Bostiga, Cantin, Fontana, & Casa, in press:
  - Student A thinks X. Student B thinks Y. Who do you agree with, and why?
  - Sometimes A right, sometimes B right, sometimes both right, sometimes neither


Rich and worthwhile tasks
Explicit connection between oral and written discourse
Sense-making and reasoning-based oral discourse
Purposeful, in-depth, and reasoning-based written discourse
Vocabulary development
Nurturing environment

TIPS



Thank you!