A Routine for Reasoning to Ensure ALL Students are Modeling with Mathematics

Agenda

- Framing and Agenda
- What does it mean to Model with Mathematics?
- Overview of Analyzing Contexts and Models Routine
- Unpack Analyzing Contexts and Models Routine
- Q & A

Standards for Mathematical Practice

- MP1 Make Sense of Problems and Persevere in Solving Them
- MP2 Reason Abstractly and Quantitatively
- MP3 Construct Viable Arguments and Critique the Reasoning of Others
- MP4 Model with Mathematics
- MP5 Use Appropriate of Tools Strategically
- MP6 Precision in Mathematics
- MP7 Look for and Make Use of Structure
- MP8 Look for and Express Regularity in Repeated Reasoning

MP4 Model with Mathematics

www.fosteringmathpractices.com
What does it mean to Model WITH Mathematics?

Model with Mathematics

Model with Mathematics

Model with Mathematics

How do we develop mathematical modelers?

www.fosteringmathpractices.com
Instructional Routines: Repeatable & Predictable

"Designs for interaction that organize classroom activities"
– Magdalene Lampert, NCSM 2015

Model with Mathematics

- Analyze a situation or problem
- Develop & formulate a model
- Compute solution of the model
- Interpret the solution & draw conclusions
- Validate conclusions
- Compare conclusions with the situation, and adapt or improve the model as needed

Identify variables and constraints in the situation and select those that represent essential features.

Analyzing Contexts and Models

**WHAT:** Consider the mathematics of a real world situation, and analyze a model that represents the situation.

**WHY:** To interpret and engage in the real world with a mathematician's eye. To develop a bank of questions to ask yourself that are critical in the mathematical modeling process.
**Make Sense of the Situation**

Ask Yourself:

- What's the question I'm exploring?

- What about the context do I need to consider?

**How many square inches of pizza will everyone in this class eat in their lifetime?**

**Analyze the Situation**

Pair                        Tour                        Pair

**Share Interpretations & Analyze the Context**

Standing with your partner, share your interpretations of the context and together create a list:

- Important quantities are…

- It will be helpful to know…

**How many square inches of pizza will everyone in this class eat in their lifetime?**
Consider Classmates’ Interpretations

Remove your chart, reflect and refine

- Place a + next to key ideas
- Place a - next to ideas less relevant
- Describe quantities as ‘The number/amount of…’
- Articulate questions as quantities ‘How much/many…?’

How many square inches of pizza will everyone in this class eat in their lifetime?

Consider Classmates’ Interpretations

Tour the room and read others’ lists. Consider what you’d add to your own. Ask yourself:

- Have they considered something we should also consider?
- Have they (or we) made assumptions?

How many square inches of pizza will everyone in this class eat in their lifetime?
Interpret a Model

Ask yourself:

▪ Where/how does the model represent quantities?

Share the quantities with your partner, together identify questions you have and assumptions the model makes.

They considered the number/amount of...

They found the number/amount of... by...

A question I have about the model is...

An assumption the model makes is....

Interpret a Model

Share the quantities with your partner, together identify questions you have and assumptions the model makes.

They considered the number/amount of...

They found the number/amount of... by...

A question I have about the model is...

An assumption the model makes is....

Analyze and Adapt the Model

▪ We think the model predicts ... because...

▪ We aren’t sure the model is precise because...

▪ The estimation impacts the outcome because...
Reflect on learning

- Next time I consider a situation and try to mathematize it I will ask myself….
- When thinking about constraints, it’s important to….
- When analyzing models, I learned to pay attention to….
- A critical feature of modeling is….

Reflect on learning

A. When making sense of a situation with my mathematician’s eye, I learned to pay attention to all the variables that can change the situation.

B. Next time I consider a situation and try to mathematize it I will ask myself: What is important in the problem and where I have to pay attention to.

C. When analyzing models, I learned to pay attention to details that could make a big impact on the solution, or the starting base numbers.

Reflect

I notice…

I wonder…

Designs for Interaction

Routine Designs
- Think-Pair-Share
- Ask Yourself Questions
- Sentence Starters and Frames
- Turn and Talks
- Four Rs
5 Essential Instructional Strategies that keep the focus on mathematical thinking while providing access for ALL learners... routinely

- Ask-yourself questions
- Annotation
- Sentence frames and starters
- The Four Rs – repeat, rephrase, reword, record
- Turn-and-Talk

Ask-Yourself Questions...

- Combat learned helplessness
- Promote student agency

Annotation Connects the Verbal to the Visual

Sentence Frames and Starters

- Important quantities are...
- It will be helpful to know...
- An assumption the model makes is...
- When analyzing models, I learned to pay attention to...
The Four Rs

Repeat Rephrase Reword Record

Math Ideas & Language

Process

Articulate

Develop

Refine

Turn and Talks

- Engage ALL students
- Work out ideas and language with a partner

Designing remote interactions

Ask yourself…?

- How can I ensure students have the space they need to think and talk mathematically? (e.g. pregnant pause, press pause, turn and talk, stop and jot, etc.)
- Based on my goal, where should I provide the most processing time/space? (e.g. analyze situation, interpret model, analyze and adapting the model, etc.)
- How are students working with rough draft talk and rough draft thinking to refine both? (Individual: Think it through, Jot it down, Talk it out; Partner: talk together, write together)
- How can I see/hear student thinking?
Q & A

Modeling Resources

Anhalt and Cortez, NCTM Mathematics Teacher Vol. 108, No. 6 • February 2015

Blum and Ferrie, Mathematical Modeling: Can it be taught and Learnt?, 2009

www.corestandards.org

Tasks: 3 Act Tasks, Fermi Problems, Achieve the Core
www.fosteringmathpractices.com