



Math Materials

Summer Learning Exchange
July 21-26, 2019

MATHEMATICS, RIGHTLY
VIEWED, POSSESSES NOT
ONLY TRUTH, BUT
SUPREME BEAUTY.

- BERTRAND RUSSELL



“The only way to learn mathematics is to do mathematics.”

-Paul Richard Halmos

Name(s): _____

Are these vending machines functions?

Instructions: Open the vending machine applet at <https://www.geogebra.org/m/uR9uFreX>. As you explore the machines make sure you test each button multiple times, click “Take Can” to remove the soda can from the machine after each trial.

Machines	Function or Not a Function?	How do you know?
A	YES	
B	NO	

C	YES	
D	NO	

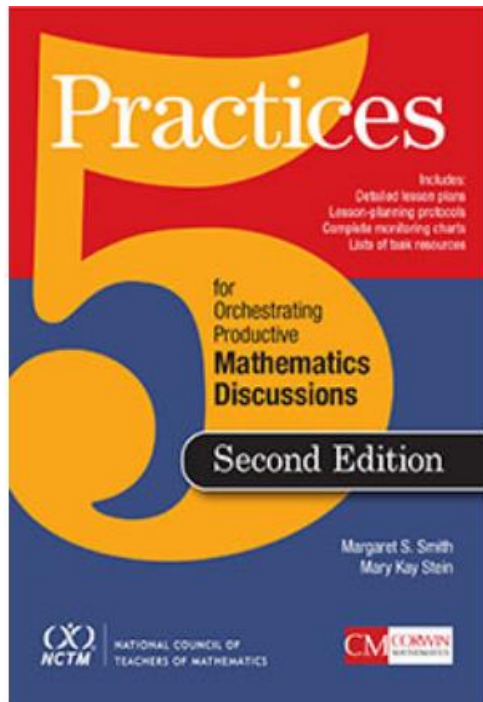
Describe how you used the applet to justify why each vending machine was, or was not, a function?	
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Machines		Function or Not a Function?	How do you know?
Page 3	E		
	F		
Page 4	G		
	H		
Describe how you used the applet to determine if each vending machine was, or was not, a function?			
Page 5	I		
	J		
Page 6	K		
	L		
Describe how you used the applet to determine if each vending machine was, or was not, a function?			

Using the terms “input” and “output” write a definition for function based on your exploration of the machines.

Machines	Function or Not a Function?	How do you know?
M		
N		

5 Practices for Orchestrating Productive Mathematics Discussions



Anticipating student responses prior to the lesson

Monitoring students' work on and engagement with the task

Selecting particular students to present their mathematical work

Sequencing students' responses in a specific order for discourse

Connecting different students' responses, and connecting the responses to the key mathematical ideas

Anticipating & Monitoring Chart (Adapted from Smith & Stein, 2018)

	ANTICIPATE	MONITOR			SELECT & SEQUENCE
Task	Student Strategy	Assessing Questions	Advancing Questions	Who & What	
Other					



Anticipating & Monitoring Chart (Adapted from Smith & Stein, 2018) – *Focus on Anticipating*

	ANTICIPATE
Task	Student Strategy
Other	

Anticipating & Monitoring Chart (Adapted from Smith & Stein, 2018) – *Focus on Monitoring*

	MONITOR	
Task	Assessing Questions	Advancing Questions
Other		

Responding to Students

Assessing Questions

Intended to make a student's current thinking visible, ensuring the teacher understands what the student did and why

- Are based closely on the work students have produced
- Clarify what the student has done and what the student understands about what he or she has done
- Give the teacher information about what the student understands

*Teacher **STAYS** to hear the answer to the question.*

Advancing Questions

Intended to move students beyond where they currently are, toward the goals of the lesson

- Use what students have produced as a basis for making progress toward the target goal of the lesson
- Move students beyond their current thinking by pressing students to extend what they know to a new situation
- Press students to think about something they are not currently thinking about

*Teacher **WALKS AWAY**, leaving students to figure out how to proceed*

Favorite Wrong Answer Activity

After completing the Function Vending Machine Sketch, students were asked the following:

Using the terms “input” and “output” write a definition for function based on your exploration of the machines.

Five student answers are shown below. Consider these answers as the student solutions that have been **selected** to share for a whole class discussion. In your groups:

- Determine which is your “favorite wrong” definition(s) to start the class discussion with. Provide a justification of your choice.
- Describe the order of how you would **sequence** these student responses as part of a whole class discussion about the definition of function.
- What questions and discourse moves would be useful to help **connect** these student definitions to come to a class definition for function? Indicate what vending machines you will draw upon as examples during the discussion.

Student Response 1:

An input that always has the same output

Student Response 2:

A function is when you have a number, or the input, and you apply a rule. ($y = x4$) when you apply the rule you get the same output every time.

Student Response 3:

The input is what you select and
the output is what you get out.
The input is always consistent
with the output in a function.

Student Response 4:

the output follows a pattern
no matter what the input is.

Student Response 5:

A specific input has a specific output. The rule
doesn't vary. If it's a function the data will
follow the rule.

Video Reflection Questions

As you watch the video clip, utilize the “I heard, I saw, I wonder” protocol to answer the following questions.

1. What assessing questions did the teacher ask?
2. What advancing questions did the teacher ask?
3. What questions did the teacher ask other than advancing/assessing questions?
4. What discourse moves did the teacher employ during the video (i.e., revoicing, ask student to restate someone else’s reasoning, apply their reasoning to someone else’s, prompt for further participation, wait time)?
5. How did the use of questioning and discourse moves influence the classroom discourse?



Notes

SAMPLE LESSON PLAN FORMAT

Topic:	Period:	Course:	
Content Standards:			
Practice Standards: <i>Which 1 or 2 Practice Standards will this lesson address?</i>			
Mathematical Teaching Practice: <i>Which 1 or 2 Teaching Practices will this lesson address?</i>			
Mathematical goals: <i>State the specific mathematical goals for procedural fluency, conceptual understanding, and reasoning/problem solving.</i>			
Materials needed: <i>List all tools and/or materials that will be needed to implement the task(s).</i>			
Assessment: <i>How will you know students have achieved the goals?</i>			
	Activities of the Lesson	Furthering and Assessing Student Thinking	Things to Consider as You Plan
Launch/ Before	<i>What will the class be doing to get this lesson started?</i>	<i>What discussion starters will you use to help students connect this starting activity to their prior learning?</i> <i>What questions will you ask to focus student thinking?</i> <i>What questions will you ask to assess students' understanding of key mathematical ideas, problem-solving strategies, or the representations needed for today's lesson?</i> <i>How will you help students connect this starter to the upcoming lesson?</i> <i>How will this activity need to be adapted to address the learning needs of individual students in your class?</i>	<i>What definitions, concepts, or ideas do students need to know to engage in today's lesson? How does your starting activity help students revisit these?</i> <i>In what ways does this lesson build on students' previous knowledge?</i> <i>What understandings and misunderstandings will you be looking for during this portion of the lesson?</i>

<p>Explore/ During (This is where you will put the task that you selected.)</p>	<p><i>What are the activities in which students will engage during this lesson? How will the students explore mathematical concepts during this lesson?</i></p> <p><i>How will you assess the mathematical ideas brought out in the lesson?</i></p>	<p><i>What difficulties might students have as they engage in this activity?</i></p> <p><i>What scaffolding moves will you use during this activity if students are struggling?</i></p> <p><i>What misconceptions might students have?</i></p> <p><i>What questions will you ask to help students confront and correct misconceptions?</i></p> <p><i>What questions will you ask to advance students' understanding of the mathematical ideas?</i></p> <p><i>How will this activity need to be adapted to address the learning needs of individual students in your class?</i></p>	<p><i>What are all the ways the task can be solved?</i></p> <p><i>How will this activity help students develop procedural fluency?</i></p> <p><i>How will this activity help students develop conceptual understanding?</i></p> <p><i>How will this activity help students develop mathematical reasoning/ problem-solving skills?</i></p>
<p>Summarize/ After</p>	<p><i>What activity will you do to help summarize today's lesson?</i></p> <p><i>How will students share their work/thinking?</i></p>	<p><i>What questions will you ask to encourage students to share their thinking with others and to assess their understanding of their peer's ideas?</i></p> <p><i>What talk/discourse moves will you use to facilitate a good class discussion of the mathematics?</i></p> <p><i>What questions will you ask to advance students' understanding of the mathematical ideas?</i></p> <p><i>How will this activity need to be adapted to address the learning needs of individual students in your class?</i></p>	<p><i>What mathematics content and processes need to be emphasized?</i></p> <p><i>How can I orchestrate the discussion, so students summarize their thinking?</i></p>