

Together is Better! Using The Modeling Cycle to Connect Secondary Math and Science

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Agenda

1. C versus D Lab to collect data
2. Create data on whiteboards
3. Share whiteboards
4. Dialogue about Modeling Instruction pedagogy
5. Identify how to get started in the math class

objectives

- Model with mathematics
- Identify and verbalize the relationships
- “We’re not finding Pi!”

C versus D Lab

- Create whiteboards
- Whiteboard questions
- Artifact creation

Worktime

- Collect data

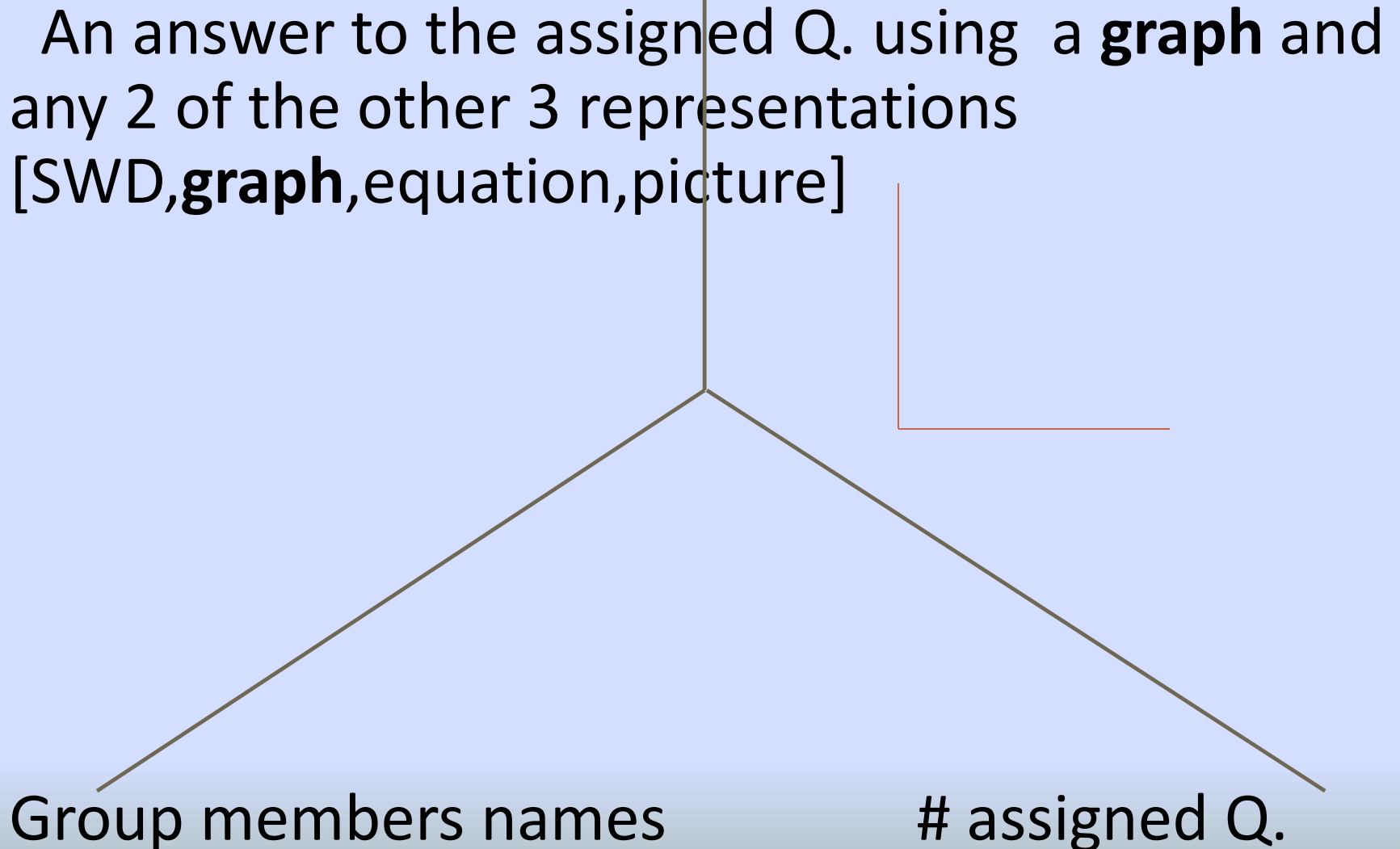
Group #:

Assigned Question(s):

- | | |
|---------|--------|
| • One | A,B |
| • Two | A,C |
| • Three | A,D |
| • Four | A,E(D) |
| • Five | A,F |
| • Six | A,G |
| • Seven | A,G |

Your whiteboard needs:

An answer to the assigned Q. using a **graph** and any 2 of the other 3 representations
[SWD,**graph**,equation,picture]



Group members names

assigned Q.

Question A

X **Y**

Circle number	Diameter (X)	Circumference (Y)	Ordered pair (x, y)	About how many diameters are needed to complete a circumference? (Estimate)	Ratio: <u>Circumference</u> diameter Convert to a decimal
1.					
2.					
3.					
4.					
5.					

B.What is the pattern that you notice in your estimations and your exact answers in Chart A?

X-values represent the input of the diameter of the circles.

Y-values represent the changing circumference .

C. Estimate how many diameters it takes to complete a circumference. Show your work.

D. Complete this chart by estimating:

Diameter	Circumference
1	
	15
	36
4	

E. What did you do to find your answers for the missing spaces?

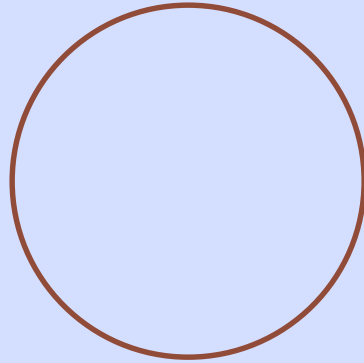
Diameter	Circumference
1	
	15
	36
4	

F. It takes a little more than three diameters to complete a circumference. It takes about 3.14 diameters. Complete the chart again, using this new information

Diameter	Circumference
1	
	15
	36
4	

G. Collect data from more circles and graph the ordered pairs. Find the slope of a line of best fit. How does the slope compare to the ratios? What does the slope of the line tell you about the relationship of the circumference to the diameter?

artifact



A rule for finding the diameter-of any circle- if you know the circumference would be.....

A rule for finding the circumference-of any circle-if you know the diameter would be.....

Standards reflections

- Using the 2 documents on your table, turn and talk to a neighbor:

MP #3: Construct viable arguments
MP #4: Modeling with math

SEP #2: Develop and use models
(inputs and outputs)
SEP # 4: Analyzing and interpreting
data (relationships)

you

and you use?

But I don't teach 7th grade!!!

Statistics:

- variation of measurement
- Mean absolute deviation
- dot plot

Algebra:

- Constant Rate of change
- Slope
- Equal differences over equal intervals for a linear relationship

Proportional relationships

Solving equations

Connections to math classrooms

“This isn’t in my textbook!”

How to “**modelify**” current math lessons:

- Use whiteboards as a surface to construct thinking for open-ended questions
- For any graphing lesson, require four representations: graph, table, equation, description
- Give an answer to a problem (right or wrong) for error analysis discussions
- Students use the surface to draw algebra tiles, number lines, area models to connect to algorithms

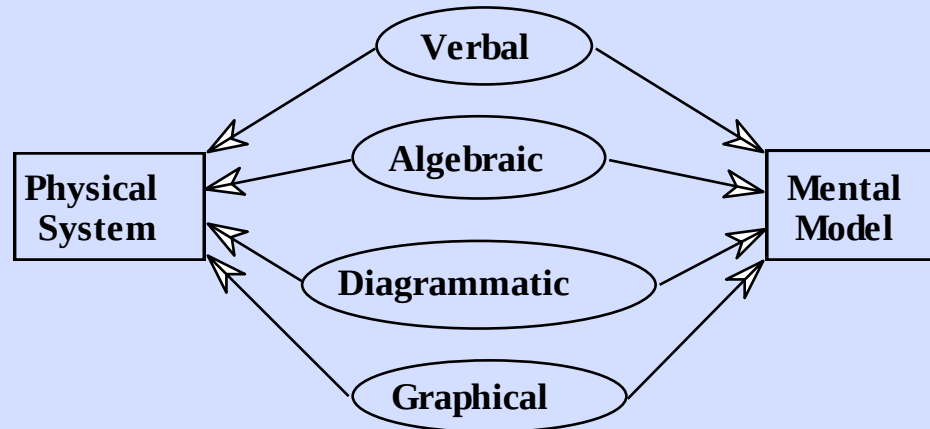
What is Modeling Instruction?

Model Development

- Students in cooperative groups
 - design and perform investigations
 - formulate functional relationships between variables.
 - evaluate “fit” to data.
- Post-lab analysis
 - whiteboard presentation of student findings
 - multiple representations
 - justification of conclusions

What Do We Mean by a Model?

Symbolic Representations



- Essential and non-essential elements of a physical system or process are identified
- Models are used to represent the structure underlying the essential elements

Model Discussion

- In post-lab discussion, the instructor
 - brings closure to the investigation
 - relating common features of various representations of the model
 - helps students to abstract the model from the context in which it was developed

Model Application

- In application activities, students:
 - learn to apply the model to various related situations
 - articulate their understanding in oral presentations.
 - are guided by instructor's questions:
 - » Why did you do that?
 - » How do you know that?

Modeling in a Nutshell

- Collect data from an investigation, or answer open-ended questions about data
- Students construct representations of the data
- Students do the talking
 - Ask, “How do you know that?”
 - Require diagrams and representations
- Facilitate a discussion to highlight students’ findings (Socratic)
- **Direct the discussion toward the underlying mathematical concepts.**

Modeling Instruction origins

- Arizona State
- Dr. David Hestenes

District implementation...

- Wichita – Modeling Instruction
 - Science content and MI cycle for science teachers
 - Whiteboarding and MI cycle for math teachers
 - Math Practice #4 and “Modeling” high school category
 - Common language and Practices for both teachers
 - i.e. “volume”
 - Math Practices and Science/Engineering Practices

Go forth and model!

- Thank you
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- AMTA[American Modeling Teachers Association]

<https://www.eweb life.com/prm/AMTA>

- Arizona State University

<http://modeling.asu.edu/>