Leveraging students strengths with mathematical modeling in cultural/community contexts grades 3-5

Mary Q. Foote
Queens College, CUNY

Julia M. Aguirre
University of Washington, Tacoma

Erin E. Turner
University of Arizona

Amy Roth McDuffie
Washington State University

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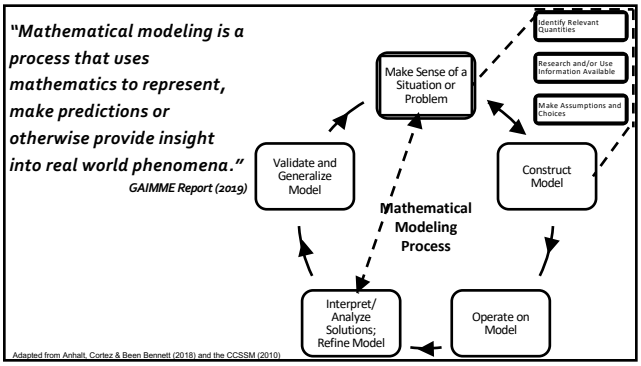
Overview of Session

- Overview of Project
- Introduction to Math Modeling Cycle
- Modeling Routines and Tasks
  - Mathematizing the world-routines
  - Community-based Modeling Task
- Lesson Planning Tools
- Whole Group Discussion

What do you notice?
What do you wonder?

What questions do you have that you could answer using mathematics?

"Mathematical modeling is a process that uses mathematics to represent, make predictions or otherwise provide insight into real world phenomena."
GAIMME Report (2019)



Adapted from Anhalt, Cortez & Been Bennett (2018) and the CCSSM (2010)

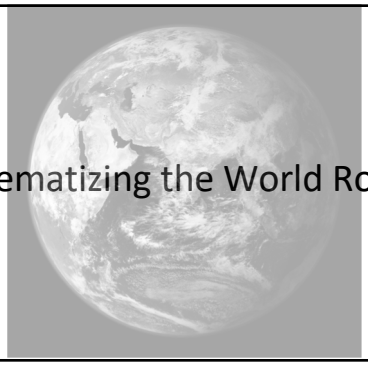
Principles for our Work

- Mathematical modeling *is accessible* to children in upper elementary grades and students from a diverse range of mathematical and cultural backgrounds.
  (Carlson et al, 2018; English et al, 2005; English 2014; Plumb et al, 2017; Suh et al, 2017)
- Contexts matter for supporting student learning of mathematical modeling
  (Anhalt, 2014; Greer, 1997; Verschaffel, De Corte & Borghart, 1997)
- Culturally responsive, community-based approaches to teaching mathematics have added benefits, particularly for students from underrepresented groups in STEM fields
  (Aguirre & Zavala, 2013; Civil, 2007; Gay, 2001 Ladson-Billings, 2009; Lipka et al., 2005; Turner et al., 2008)

Project Sites

- Pacific Northwest, Southwest
- Grades 3-5 Teachers and Math Coaches (15 per site per year, for 2 years)
- Mix of novice and veteran teachers
- Teachers attend professional development (summer and academic year) in school-based teams
- Schools serve multi-racial, multi-lingual, multicultural communities, and working class communities

Mathematizing the World Routines

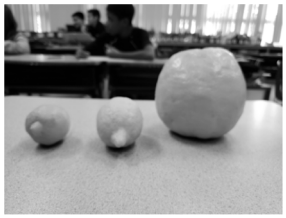


Entry Point to Mathematical Modeling for Elementary Students

- Mathematizing the World - Open Ended
- Pose an image, video, table or graph, a story, or object
  - Ask:
    - What do you notice? What do you wonder?
    - What questions do you have?
    - What do you need to answer those questions?

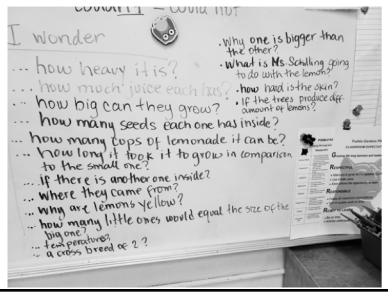
Entry Points to Mathematical Modeling for Elementary Students

- Mathematizing the World – Specific Question
  - Pose a specific, mathematical question related to image, photo or object
  - Question can come from students, or be posed by the teacher
- Discussion focuses on what one would do to answer the question:
  - What do we know? What do we need to know?
  - What can we do to figure this out?
  - What assumptions will we have to make?



It all started when Ms. A brought into the classroom two lemons and showed to the students – first a regular sized lemon that she picked from a tree in the garden, and then a giant lemon called 'ponderosa lemon' which is about the size of a grapefruit

Students' Wonders

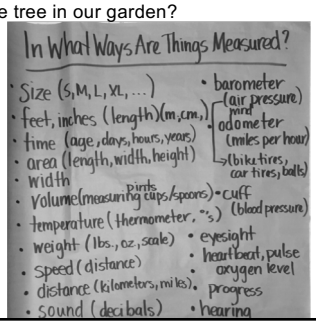


Students shared their notices and wonders based on the two objects in front of them.

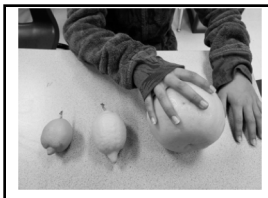
"How many small ones make a big one?"

This led to a math modeling task……

How much bigger is the ponderosa lemon compared to the lemon from the tree in our garden?

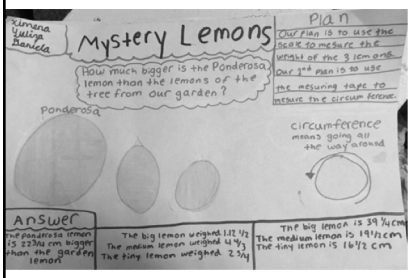


Students generated various ideas about how different things can be measured.

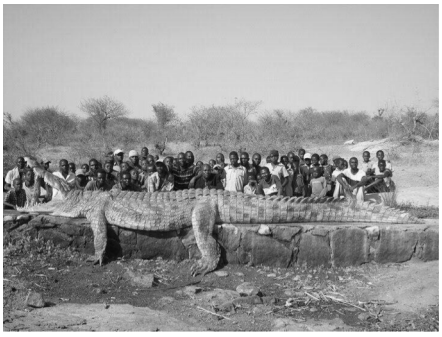


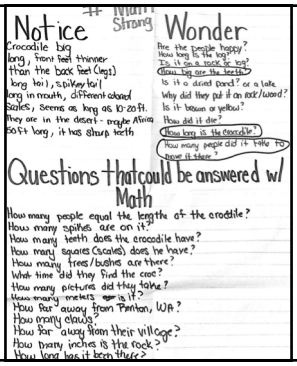
Students came up with different plans to answer the question.

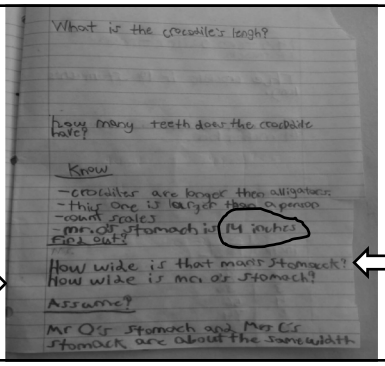
They measured and compared different physical attributes of the two lemons, such as the **height**, **weight**, **circumference**, and **volume,** which one group planned to measure by squeezing the juice out of each lemon!



•This group compared the weights and the circumferences of the two lemons
•They calculated the **difference** in the circumference of the two lemons

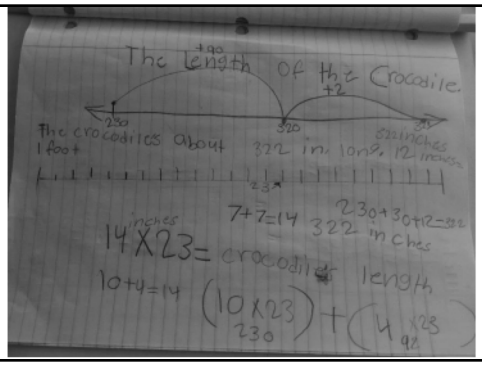






How wide is Mr. O's stomach?

How wide is the man's (in the picture) stomach?



Reflection Questions:

- What are the benefits of using this routine with students?
- What are images in your community you could use?
- What do you do in your classroom that draws on real world contexts that might be interesting to the students?

Modeling Task
Abuelo's Birthday

Abuelo's Birthday

Discuss in Small Groups

- In what situations have you been involved in sharing costs?
  Think about situations with family, friends, siblings, others?
- How do you decide how much each person pays?
- What factors impact your decisions?

Abuelo's 70th Birthday

It is Sr. Aguirre's 70th Birthday.
Four of his grandchildren want to buy him a gift.
They found a Photo Printer on sale for $119.99.
They want to buy him the printer so he can print photos of family members.

- Alex, a 9th grader, earns between $15 and $20 each week from babysitting jobs.
- Sam, a 6th grader, earns $10 each week taking care of his neighbor's pets.
- Elena, a 4th grader, earns $5 each week doing jobs for an aunt.
- Jaden, a 1st grader, has no weekly job but has saved $8 in her piggy bank.

One of the grandchildren says that they should split the cost of the printer among them and each pay the same amount.
Another grandchild says that it is not fair and they should each pay different amounts.

What do you think? What is *fair* in this situation?

TEAM TASK:
Help the children make a plan to share costs in a fair way to buy the gift.

Use mathematics to justify your conclusions.

Your plan should work in other situations where family members want to share costs fairly.

Mathematical Modeling

- What math concepts and practices were needed for this task?
- What funds of knowledge did you bring to this task?

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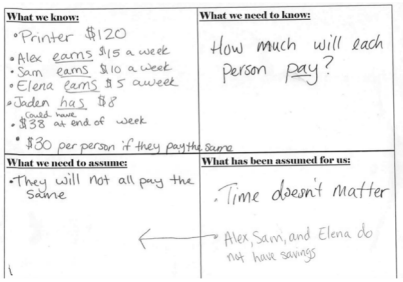
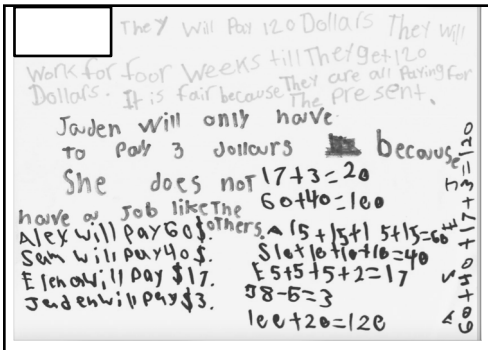
Sample student work from modeling tasks

Making Sense of the Task:
Group Brainstorm

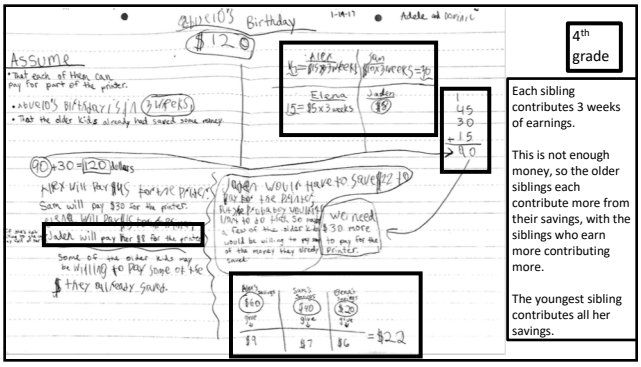




3rd grade

Each sibling contributes 4 weeks of earnings, so siblings' contributions are proportional to their weekly earnings.

The youngest sibling contributes $3 because she does not have a job.

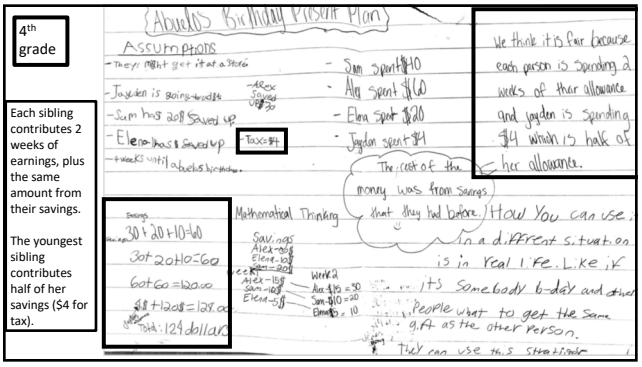


4th grade

Each sibling contributes 3 weeks of earnings.

This is not enough money, so the older siblings each contribute more from their savings, with the siblings who earn more contributing more.

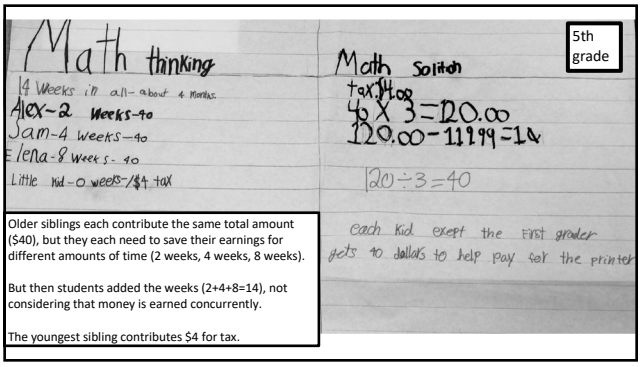
The youngest sibling contributes all her savings.



4th grade

Each sibling contributes 2 weeks of earnings, plus the same amount from their savings.

The youngest sibling contributes half of her savings ($4 for tax).

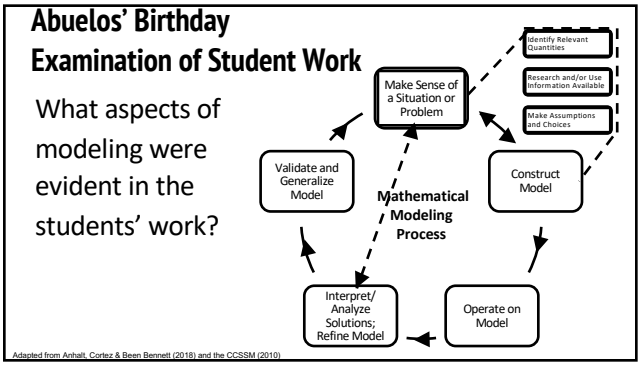


5th grade

Older siblings each contribute the same total amount ($40), but they each need to save their earnings for different amounts of time (2 weeks, 4 weeks, 8 weeks).

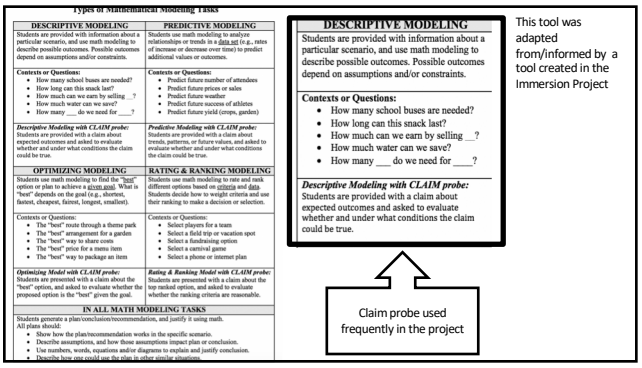
But then students added the weeks (2+4+8=14), not considering that money is earned concurrently.

The youngest sibling contributes $4 for tax.



M2C3
Task Design Tools & Resources

https://sites.google.com/qc.cuny.edu/m2c3/



This tool was adapted from/informed by a tool created in the Immersion Project

Traditional Word Problems v. Mathematical Modeling Tasks

Traditional Word Problems	Modeling Problems
Tend to be closed problems	Tend to be open-ended problems
Context is often contrived	Real-life context less contrived
Solutions have defined algorithms	No particular algorithm is defined
All parameters given	Some parameters given, some are assumed
Structure is given	Less structure is given
Assumptions are usually not necessary to solve the problem	Assumptions are part of the process for solving the problem
Usually there is an exact (single) solution	Approximate (and multiple) solutions are acceptable

(Anhalt, G. 2014). Scaffolding in mathematical modeling for ELLs. In *The Common Core State Standards in Mathematics for English Language Learners: Grades K-8*, edited by Maria Civil and Erin Turner, pp. 111-126. Alexandria, VA: Teachers of English to Speakers of Other Languages

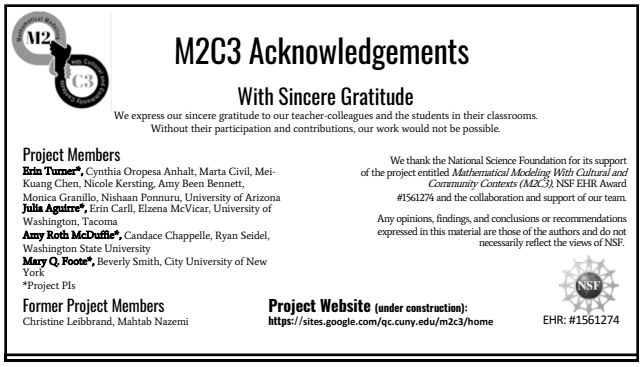
How do you think these types of modeling tasks might benefit students?

Teacher Reported Benefits of MM

- **High Engagement**
  - Especially for students who normally do not participate in math book problems
- **Built math stamina and perseverance**
- **State testing benefits**
  - Tasks were similar to performance based items
  - Removed students' fear from engaging in performance based items

What we've noticed in other situations that our kids don't have a lot of background knowledge about, they don't have a wide range of background knowledge that connects to a lot of the math that we've seen in other curriculums. So it felt really impactful. It was just an eye-opening to see that they really do have a lot of experience and background knowledge, but we just need to create tasks that elicit that. And then their engagement was way higher and they were very knowledgeable. But maybe not about going skiing on a ski slope, or something. They haven't done that before, but they've played soccer and they have a grandmother, an abuela, whose birthday they celebrated… You just have to, I guess, pay attention to what kids know and what their experiences are.

End of year interview 4th grade teacher



M2C3 Acknowledgements

With Sincere Gratitude

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Project Members

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Julia Aguirre*, Erin Carll, Elzena McVicar, University of Washington, Tacoma
Amy Roth McDuffie*, Candace Chappelle, Ryan Seidel, Washington State University
Mary Q. Foote*, Beverly Smith, City University of New York
*Project PIs

Former Project Members

Christine Leibbrand, Mahtab Nazemi

Project Website (under construction):
https://sites.google.com/qc.cuny.edu/m2c3/home

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