


COMAP's @COMAPMATH 
EXPLORING MATH MODELING IN AND OUTSIDE OF THE
CLASSROOM WEBINAR SERIES

WEBINAR #1

**INTRODUCTION TO MATH MODELING IN MIDDLE AND
HIGH SCHOOL: THE MIDGE PROBLEM**

OCTOBER 28, 2020 4 PM EST

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GOALS FOR THE SESSION

- Introduce the Modeling Process
- Share the Midge Problem
- Create Models
- Analyze and Assess YOUR models
- Discuss Teacher Role
- Share Assessment Ideas
- Share Resources for Future Modeling Work



WHAT IS MATH MODELING?

Mathematical modeling is a process that uses mathematics to represent, analyze, make predictions or otherwise provide insight into real-world phenomena.

Most short definitions we find emphasize this most important aspect, namely the relation between modeling and the world around us.

- Using the language of mathematics to quantify real-world phenomena and analyze behaviors.
- Using math to explore and develop our understanding of real world problems.
- An iterative problem solving process in which mathematics is used to investigate and develop deeper understanding.

From GAIMME Report



MATHEMATICAL MODELING

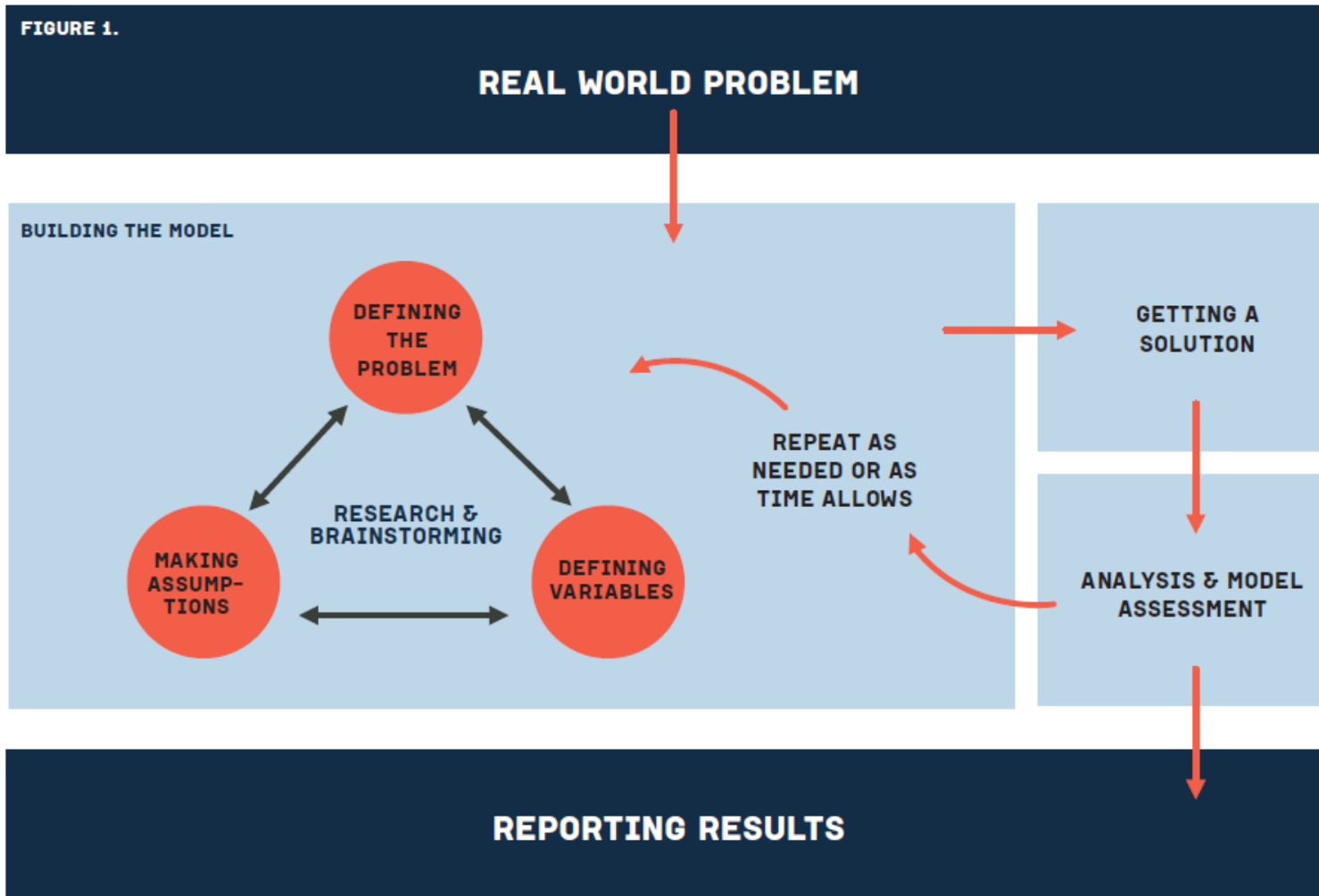
“Mathematicians are in the habit of dividing the world into two parts: mathematics and everything else, sometimes called the ‘real world’. People often tend to see these two as independent of one another – nothing could be further from the truth. When you use mathematics to understand a situation in the real world, and then perhaps use it to take action or even to predict the future, both the real world situation and the ensuing mathematics are taken seriously.”

Henry Pollak



MODELING CYCLE

From *SIAM Modeling Guidebook: Getting Started, Getting Solutions* Fowler, Bliss, Galluzzo



COMPONENTS OF MODELING CYCLE

- Defining the Problem
- Making Assumptions
- Defining Variables
- Getting a Solution
- Analysis and Model Assessment
- Reporting Results



PROBLEM STATEMENT

In 1981, two new varieties of a tiny biting insect called a midge were discovered by biologists W. L. Grogan and W. W. Wirth in the jungles of Brazil. They dubbed one kind of midge an Apf midge and the other an Af midge. The biologists found out that the Apf midge is a carrier of a debilitating disease that causes swelling of the brain when a human is bitten by an infected midge. Although the disease is rarely fatal, the disability caused by the swelling may be permanent. The other form of the midge, the Af, is quite harmless. In an effort to distinguish the two varieties, the biologist took measurements on the midges they caught. The two measurements most easily obtainable were of wing length and antennae length, both measured in centimeters.



AF MIDGES

WING LENGTH (CM)	1.72	1.64	1.74	1.70	1.82	1.82	1.90	1.82	2.08
ANTENNA LENGTH (CM)	1.24	1.38	1.36	1.40	1.38	1.48	1.38	1.54	1.56

APF MIDGES

WING LENGTH (CM)	1.78	1.86	1.96	2.00	2.00	1.96
ANTENNA LENGTH (CM)	1.14	1.20	1.30	1.26	1.28	1.18



Is it possible to distinguish an Af midge from an Apf midge on the basis of wing and antenna length? If so, use your method to classify three new midges with Wing and Antenna lengths of (1.80, 1.24), (1.84, 1.28), and (2.04, 1.40).



What do you notice?
What do you wonder?

Collect Ideas on Padlet

<https://padlet.com/mariahdz2718/f54krn8fvjd2014g>



COMPONENTS OF MODELING CYCLE

- Defining the Problem
- Making Assumptions
- Defining Variables
- Getting a Solution
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- Reporting Results



MATH MODELING REFERENCE CARDS

DEFINING THE PROBLEM STATEMENT

WHAT IS MY GOAL?

Real-world problems can be broad and complex. It's important to refine the conceptual idea into a concise problem statement which will indicate exactly what the output of your model will be.

TIPS FOR MOVING FORWARD...

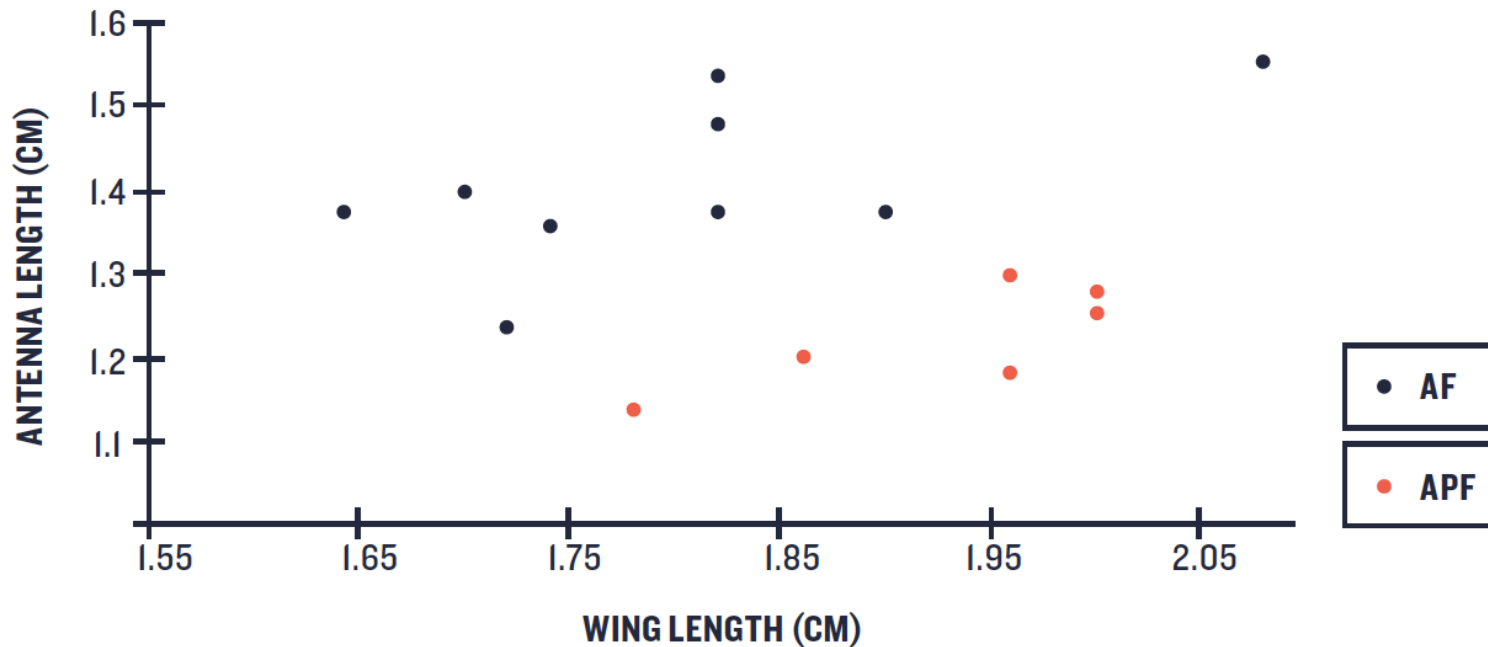
- ① Defining the problem statement requires some research and brainstorming. The goal is to have a concise statement that explains what the model will predict.
- ② When brainstorming, let the ideas flow freely. Stay positive and be open-minded. This part of the modeling process is about creativity, so it is important that there is no criticism about anyone's ideas or suggestions. What seems like a ridiculous approach may later seem innovative after given some more thought, so make note of everything!
- ③ Since modeling problems are often open-ended, there is an opportunity for creative problem solving and interpretation. In some cases, it is up to the modeler to define the outputs of the model and what key concepts will be quantified.



SCATTER PLOT OF THE DATA

Link to Desmos in Chat

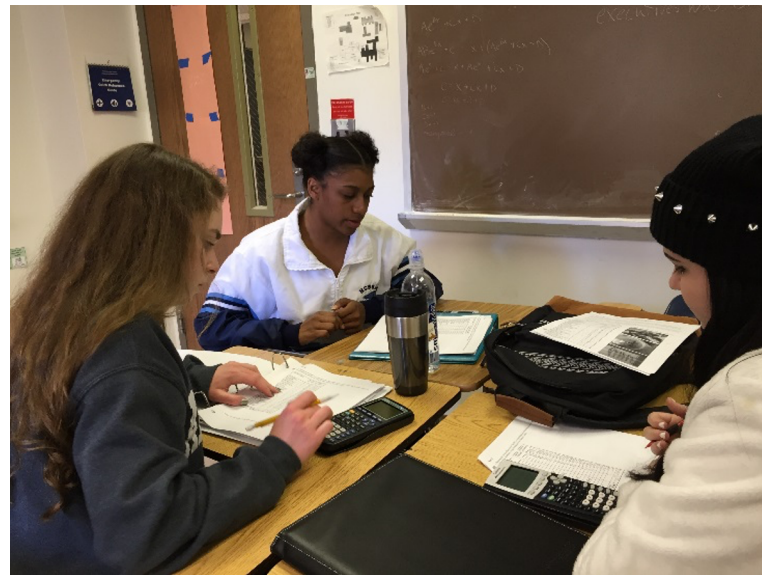
<https://www.desmos.com/calculator/3794xvh8cu>



CREATING MODELS

Let's do it together...

Take some time to write down some ideas and/or share your ideas in the chat.



SHARE IDEAS

Room for your thoughts...



EVALUATE THE MODELS – THINGS TO CONSIDER:

- Simplifying assumptions
- Limitations of your model
- Can we use the model to understand something about the physical problem?
- Are we taking **BOTH** the math and the real world seriously?



FRAMEWORK FOR TEACHERS' ROLES

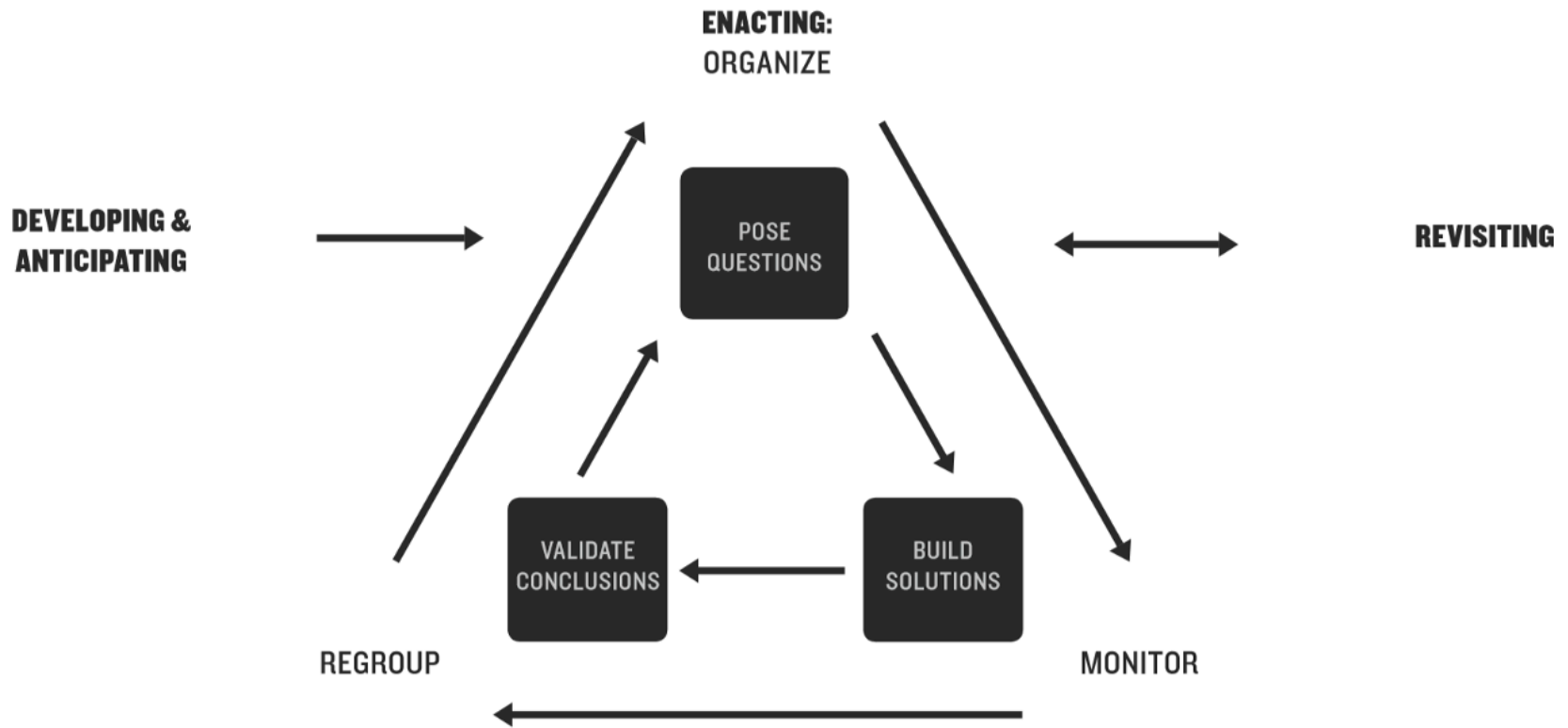


FIGURE 2.3: FRAMEWORK FOR TEACHERS' ROLES IN FACILITATING MODELING, INCLUDED WITH PERMISSION FROM CARLSON ET AL. (2016).



TEACHER ROLE

- Developing and Anticipating
- Enacting
- Monitoring
- Regrouping
- Revisiting –

Have students name the math topics, connect their work to the modeling process, or extend or modify the problem to see those effects on the models.



WHEN ARE WE DONE?

Modeling is an iterative process.



ASSESSMENT

The assessment should focus on the content but can also incorporate components of the modeling process and how students progress as modelers.

Communication of assumptions, mathematical reasoning and evaluation of the model are also important.

The understanding of the mathematical concepts can be made more evident through the application of those concepts to real-world problems.



ASSESSMENT

Hints from GAIMME Report: **For a Modeling Course**
Focus on the process, not the product. Assessment should be in the service of helping student improve their ability to model, which will, in time, translate to a better product.

Some goals could include:

- Mastery of applying components of the modeling process (individual and entire)
- Ability to effectively and appropriately communicate findings
- Ability to work as a member of a team
- Development of persistence.



ENCOURAGE YOUR STUDENTS TO BE SPECIFIC IN SHARING THEIR WORK GAIMME REPORT

- Explain the process your team used to develop a solution.
- Explain the mathematics used to develop your team's solution.
- Who is the audience for your report?
- What are three (to five) things you want some one reading your report to understand about your model?



PARTIAL RUBRIC FOR PRESENTATION

MATH MODELING PRESENTATION SCORE SHEET

Presentation made by team:

Please select a value (1-5) reflecting the extent to which you agree with the given statement.

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
I understood the presenting team's interpretation of the question.	1	2	3	4	5
All stated assumptions were adequately justified.	1	2	3	4	5
The model's strengths and weaknesses were addressed.	1	2	3	4	5
Appropriate mathematics was used to create the model.	1	2	3	4	5
A final solution was clearly presented.	1	2	3	4	5
The mathematical model produced a plausible result.	1	2	3	4	5
Visual aids were easy to read and understand.	1	2	3	4	5
The team addressed authentic alternative scenarios and/or the need for future work.	1	2	3	4	5



BENEFITS OF ENGAGING IN MODELING EXPERIENCES

When students create a model of their own, they feel excited and a feeling of accomplishment. It can change a student's view of themselves as a mathematics student.

Student Reflection

"It [modeling] helps me remember the math, because then I have some kind of example that can help me think through a problem logically and relate it to something that I know about outside of the classroom. I feel like I can apply this method to a lot of things outside of math, like sciences and literature and history."




MORE REFLECTION

“Before this problem, I had never felt this specific type of frustration. There has always been a book, peer or teacher to turn to. However, the pestering exasperation of not being able to get this problem, was what made it literally impossible to get out of my mind. For the first time, I found myself thinking about math outside of the classroom completely voluntarily. I genuinely wanted to figure this out, for me...”



HOW CAN MODELING ADDRESS TEACHERS' CONCERNS

- Invites students into the mathematical conversation: Addressing the need of students with varied levels of math preparation and different learning styles.
 - Addresses the changing curriculum standards.
 - Addresses some assessment challenges – “One size fits all”
 - Can slow down the “Race to Calculus”
 - Opens up access and can contribute to equity!
- 

Pursuing Gender Equity in Mathematics
Competitions A Case of Mathematical Freedom. Jo
Boaler, Montse Cordero and Jack Dieckmann

http://digital.ipcprintservices.com/publication/?i=566588&article_id=3302571&view=articleBrowser&ver=html5

Mathfest 2018 – Facebook Live Session

https://www.facebook.com/watch/live/?v=2625892280968550&ref=watch_permalink



MODELING RESOURCES

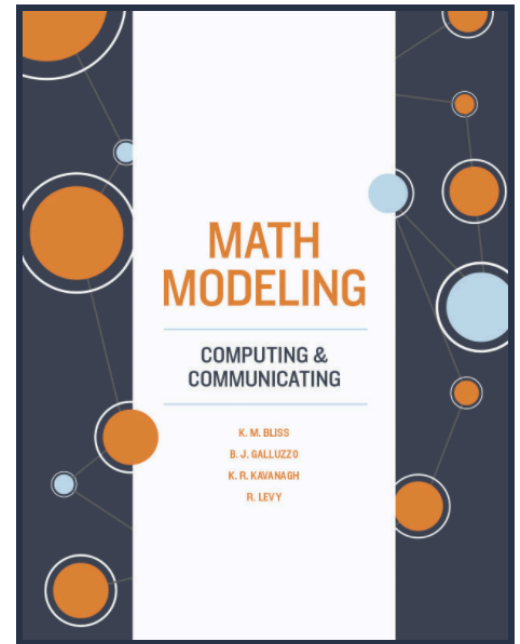
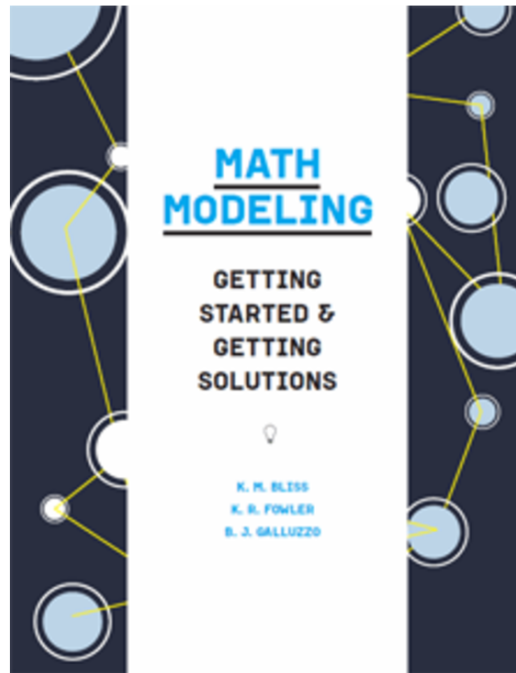
Math Modeling Videos – SIAM Applied Math Ed Conference

<https://m3challenge.siam.org/resources/teaching-modeling-videos>

1. Teaching Math Modeling: An Introduction
2. Teaching Math Modeling: The Process
3. Teaching Math Modeling: An Introductory Exercise



MORE RESOURCES – SIAM HANDBOOKS AND GAIMME ARE FREE



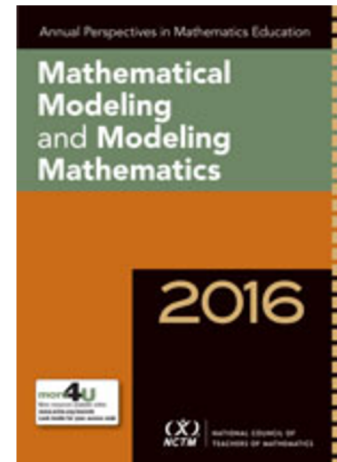
Modeling Reference Cards from Handbook

<https://m3challenge.siam.org/sites/default/files/uploads/siam-cards-final-press.pdf>

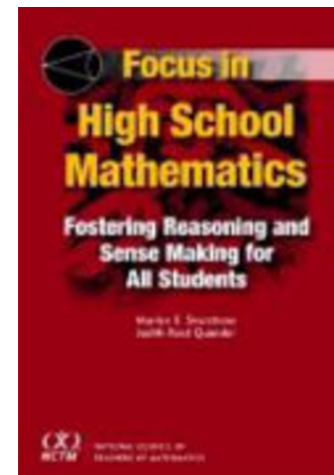


NCTM PUBLICATIONS

- “Annual Perspectives in Mathematics Education 2016: Mathematical Modeling”



- “Focus in High School Mathematics: Fostering Reasoning and Sense Making for All Students”



MODELING ACTIVITIES RESOURCES

- NCSSM Algebra 2 and Advanced Functions

<https://ncssm.instructure.com/courses/1065>

<https://ncssm.instructure.com/courses/1067>

- NCSSM Post AP Projects

<http://www.ncssm.edu/courses/math/apcalcprojects/>

- Math Modeling Hub

<https://qubeshub.org/community/groups/mmhub>

- COMAP Curriculum & Modeling Contests nfo, etc

<https://www.comap.com/>



2020
23rd Annual
High School Mathematical Contest in Modeling (HiMCM)[®]
Will Be Held on November 4-17, 2020

HiMCM offers students the opportunity to compete in a team setting using mathematics to present solutions to real-world modeling problems.



To print a copy of the 2020 HiMCM brochure in pdf format [click here](#).

Additional support provided by the
National Council of Teachers of Mathematics (NCTM),
the Mathematical Association of America (MAA),
and the Institute for Operations Research and
Management Sciences (INFORMS).



STAY TUNED FOR MORE
COMAP
EXPLORING MATH MODELING WEBINARS

Wednesday, November 18, 2020
4 PM EST

Greta Mills @mathteacher671
Oxbridge Academy



QUESTIONS, COMMENTS, DISCUSSION

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