College and Career Readiness

Protocol #4 for Secondary Mathematics Teachers:

Mathematical Modeling

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It's not just a new list of stuff to cover

These Standards are not intended to be new names for old ways of doing business. They are a call to take the next step. It is time for states to work together to build on lessons learned from two decades of standards based reforms. It is time to recognize that standards are not just promises to our children, but promises we intend to keep.

— CCSSM (2010, p.5)

Instructional Shifts Compelled by the CCSS

1. Focus
2. Coherence
3. Rigor

Instructional Shifts Compelled by the CCSS

1. Focus

- Fewer topics
  - ***"Teach Less, Learn More"***
- Critical Areas of Focus
- Developing expertise over time

Instructional Shifts Compelled by the CCSS

2. Coherence

- Learning progressions across grades
- Connections between topics within a grade

Instructional Shifts Compelled by the CCSS

3. Rigor

- Conceptual understanding
- Procedural skill and fluency
- Application

All Means All

- The CCSS articulate rigorous expectations to prepare all students to be college and career ready, including English language learners and Special Education students.
- Classroom culture, relationships, learning activities, along with our instructional and assessment practices must reflect a commitment to these expectations for all, while recognizing that some students will require additional instructional support.

The Standards for Mathematical Practice

"Encouraging these practices in students of all ages *should be as much a goal of the mathematics curriculum as the learning of specific content*" (CCSS, 2010).

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The Common Core State Standards for Mathematics

Modeling:

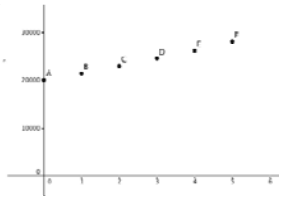
You don't have to be

5'10'' and 105 lbs. to do it!

We use models all the time in mathematics

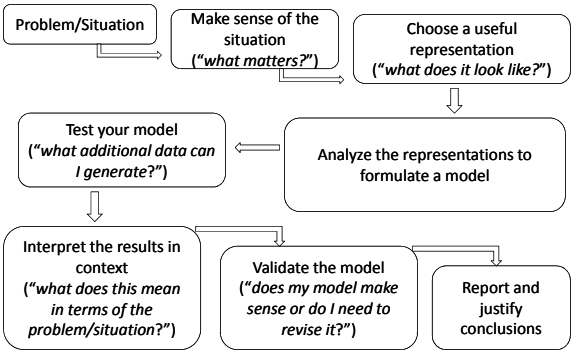
A local university just announced that they plan to raise tuition by 7% each year for the next 5 years.

Time (years)	Cost of tuition
0	20000
1	21400
2	22898
3	24501
4	26216
5	28051



$$C = 20000*(1.07)^t$$

Modeling is a Process



Modeling is a Process

A local university just announced that they plan to raise tuition by 7% each year for the next 5 years.

Make sense of the situation ("*what matters?*")

Growth rate: 7% per year

Time frame: next 5 years

Current tuition: $20,000

Modeling is a Process

A local university just announced that they plan to raise tuition by 7% each year for the next 5 years.

Choose a useful representation (*"what does it look like?"*)

Time (years)	Cost of tuition
0	20000
1	20000 * 1.07 = 21400
2	(20000 * 1.07) * 1.07 = 22898
3	(20000 * 1.07 * 1.07) * 1.07 = 24501
4	(20000 * 1.07 * 1.07 * 1.07) * 1.07 = 26216
5	(20000 * 1.07 * 1.07 * 1.07 * 1.07) * 1.07 = 28051

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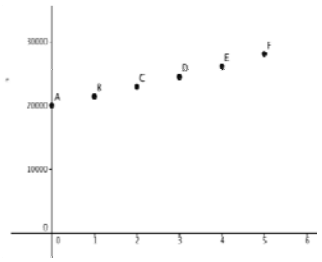

Modeling is a Process

A local university just announced that they plan to raise tuition by 7% each year for the next 5 years.

Analyze the representations to formulate a model (*"what changes and what stays the same?"*)

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What changes?

- Time
- Cost
- The number of times you multiply by 1.07

What stays the same?

- 20000
- 1.07

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$C = 20000 * (1.07)^t$

Modeling is a Process

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Test your model (*"what additional data can I generate?"*)

Interpret the results in context (*"what does this mean in terms of the problem/situation?"*)

Time (years)	Cost of tuition
0	20000
1	21400
2	22898
3	24501
4	26216
5	28051
6	?
8	?
?	40000

Modeling is a Process

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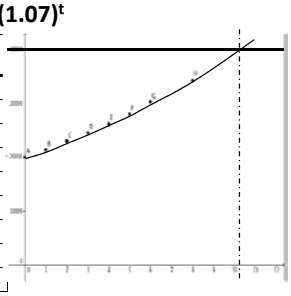
$C = 20000*(1.07)^t$

Validate the model (*"does my model make sense or do I need to revise it?"*)

Report and justify conclusions

Time (years)	Cost of tuition
0	20000
1	21400
2	22898
3	24501
4	26216
5	28051
6	30012
8	34364
?	40000



Mathematical Modeling in the CCSS

- 6.EE.7: Solve real-world and mathematical problems by writing and solving equations …
- 6.EE.9: Use variables to represent two quantities in a real-world problems that change in relationship to one another.
- 6.G.4: Represent three-dimensional figures using nets … and apply these techniques in the context of solving real-world and mathematical problems.

Mathematical Modeling in the CCSS

- 7.RP.2: Recognize and represent proportional relationships between quantities.
- 7.EE.4: Use variables to represent quantities in a real-world or mathematical problem …
- 8.F.4: Construct a function to model a linear relationship between two quantities
- 8.SP.1: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

Mathematical Modeling in the CCSS

- A.SSE.1: Interpret expressions that represent a quantity in terms of its context.*****
- F.IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and … *****
- G.MG.3: Apply geometric methods to solve design problems. *****
- S.ID.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. *****

A pretty cool (and FREE) resource

www.nctm.org

- Click on the "Core Math Tools"
- Click on the "General Purpose Tools"
- In the Algebra & Functions section, click on "Spreadsheet"
- Open and run the file
- A spreadsheet tool will appear … click on the Data menu
  - Explore the drop down menus to find data sets

Next steps

Participate in our online professional learning community

- www.edmodo.com
- Sign-up for a free account (click on "I'm a teacher")
- After you login, on the left side of the screen, look for "Groups" and click on the "Join" link.
- Type one of the following codes into the box that appears:
  - For the grades **6-8 group**, enter the code **z7cwcc**
  - For the grades **9-12 group**, enter the code **mcbkv6**

Next steps

Please feel free to use Edmodo as a venue to:

- Share resources (tasks, lessons, assessments) and ask for feedback on the resources you share.
- Share successes and/or challenges that you may have encountered with activities involving mathematical modeling.
- Ask questions and respond to other questions posted by your colleagues.

Right now

- Do the "Truss Patterns" activity. Do the task as if you are a student.
- Then in your grade level team, discuss how you might be able to utilize (or transform) the task into a classroom activity to engage your students in the modeling process.

Keep the Momentum Going

- In your grade level team, identify a topic that you all will be teaching in the next 2 months that would be a good opportunity to engage students with mathematical modeling.
  - Commit to finding or developing a modeling activity that you will agree to implement.
- During a department meeting in the next few months, plan a time on the agenda to share successes and challenges regarding your efforts to incorporate learning activities that engage students in the modeling process.