



Mystery Models and More: Infusing Computational Thinking Across the Content Areas

**Stephanie Beauregard & Michelle Altamirano
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K-12 ELA, Math, and Science**

**Welcome NM STEM Symposium Attendees!
Please have a seat at a table with a poster.**

Meet the facilitators:

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Today's Goals

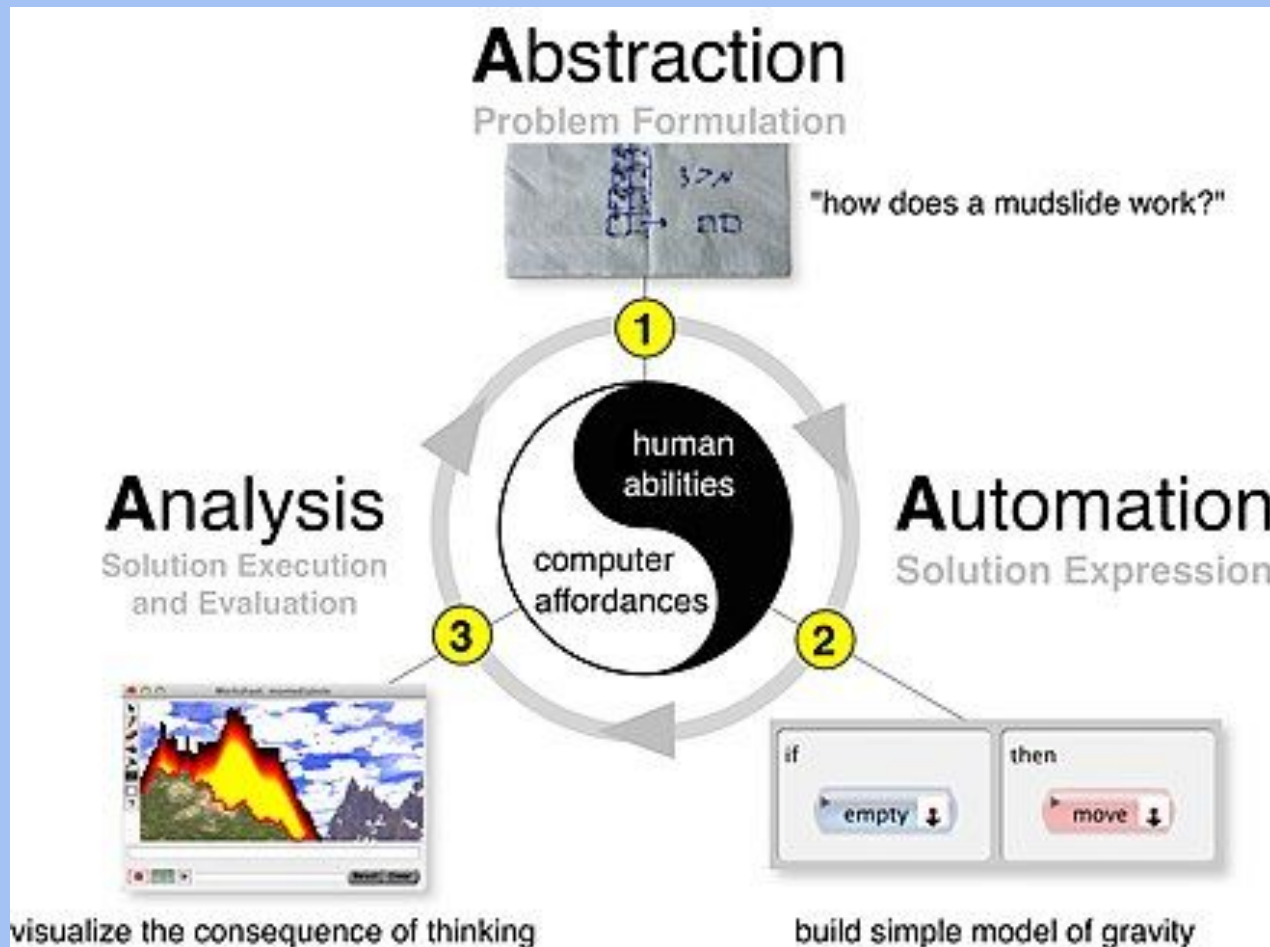
- Run activity based introduction model for Computational Thinking
- How does this apply to ELA, Math, and Science?

Free Resources and Testimonials:

<https://teacherswithguts.org/welcome>



Pillars of Computational Thinking



- **Abstraction** – strip down a problem
 - **Automation** – repetitive tasks
 - **Analysis** – validate abstractions

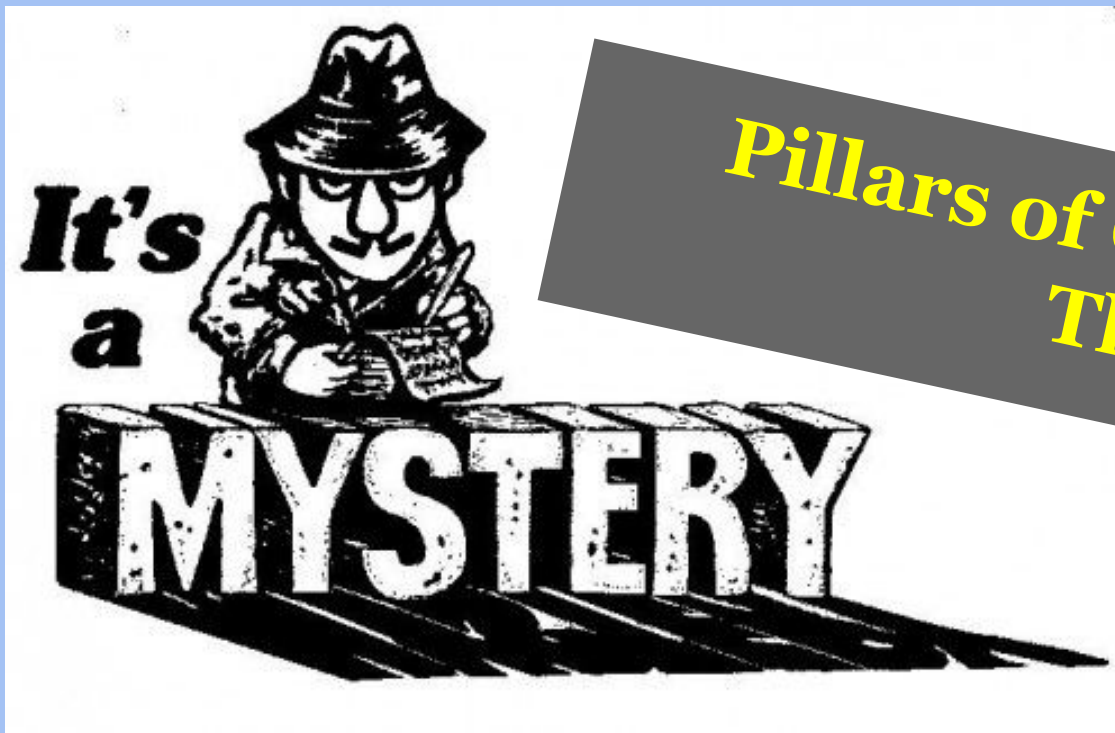
Introduction to Computer Modeling and Simulation

mystery model

- WHAT Inferences can you make about the model?
- Quick tour of interface



Think Pair Share:
What Computational Thinking Skills
Did the Mystery Model Activity
involve?



*Pillars of Computational
Thinking*

Computational Thinking

Skills, habits and approaches that are integral to solving problems using computers, developing models and performing simulations

Three Pillars of Computational Thinking

- **Abstraction** – strip down a problem
- **Automation** – repetitive tasks
- **Analysis** – validate abstractions
- ***Decomposition** – break down into smaller parts

Resources

Computational Thinking for Educators

Computational Thinking
for Educators



g.co/computationalthinking

Application of Models

1. **ELA**
2. **Math**
3. **Science**



What's your idea???

SHARE!

NGSS Framework

8 Scientific practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using math and computational thinking

NGSS Framework

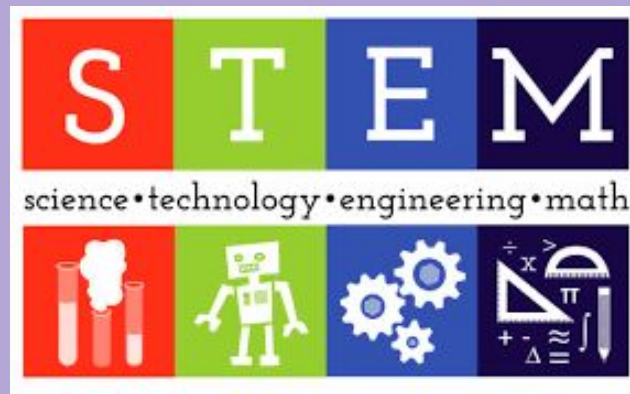
8 Scientific practices

- 6. Constructing explanations / solutions
- 7. Engaging in argument from evidence
- 8. Obtaining, evaluating, and communicating info.



What's new?

- A) Content and practice are intertwined.
(Greater emphasis on “learn and do”, and learn by doing, rather than on rote memorization.)
- B) Practice includes the use, creation and analysis of computer models and simulations in STEM inquiry and engineering design cycle.



What's new?

C) Practice includes computational thinking

D) No prescribed ordering of practices



Computational Thinking



Framework concepts

- Mathematics and computational tools are central to science and engineering.
- Aspects of computational thinking and statistical thinking must be understood and applied in learning about the sciences.
- Students should learn to use mathematics, computational models and computational and statistical thinking for scientific inquiry and data analysis.

Goals relating to developing and using models (NRC Framework, p. 50)

By grade 12, students should be able to:

- Represent and explain phenomena with multiple types of models.
- Discuss the limitations and precision of a model ...
- Refine a model

Goals relating to developing and using models (NRC Framework, p. 50)

By grade 12, (cont) students should be able to:

- Use computer simulations as a tool for understanding aspects of a system....
- Make and use a model to test a design and to compare the effectiveness of different design solutions.

Goals related to using computational and mathematical tools for data analysis (NRC Framework, p. 56)

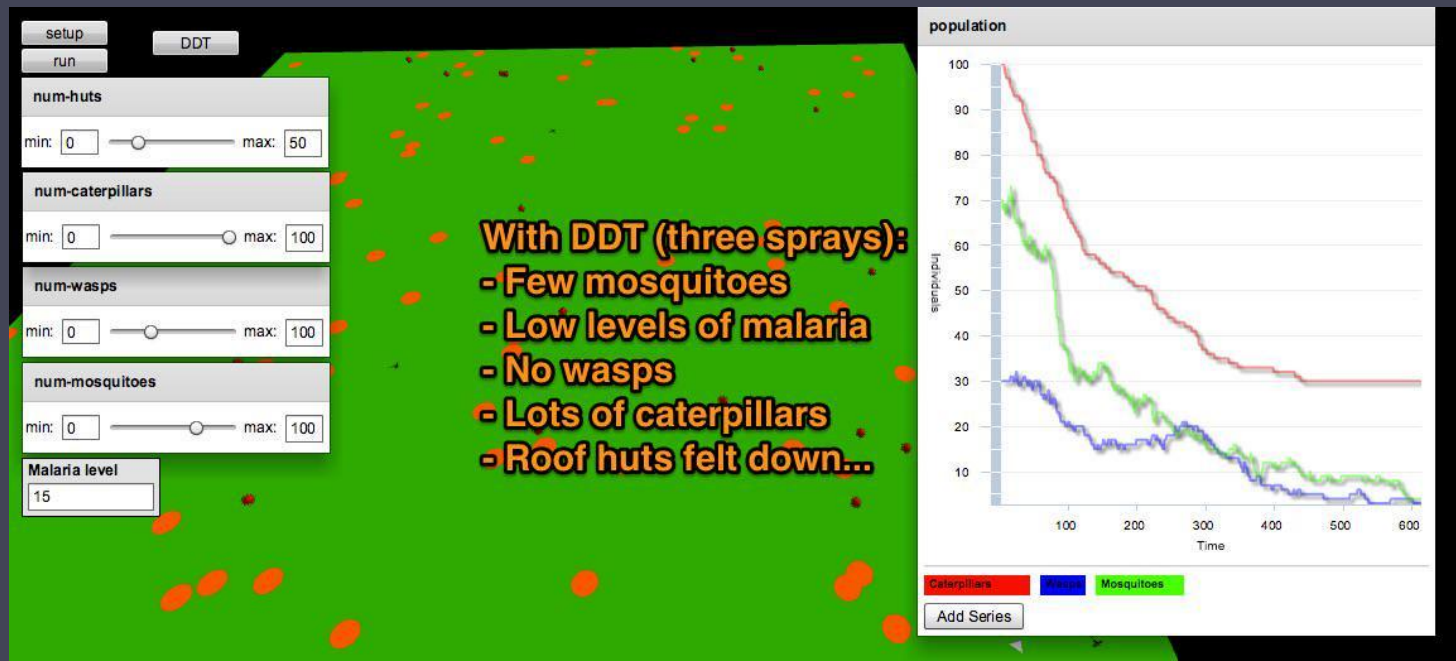
By grade 12, students should be able to:

- Recognize that computer simulations are built on mathematical models that incorporate underlying assumptions about the phenomena or systems being studied.

Goals related to using computational and mathematical tools for data analysis (NRC Framework, p. 56)

By grade 12, (cont) students should be able to:

- Use simple test cases of mathematical expressions, computer programs, or simulations—that is, compare their outcomes with what is known about the real world—to see if they “make sense.”
- Use grade-level appropriate understanding of mathematics and statistics in analyzing data.



Student example

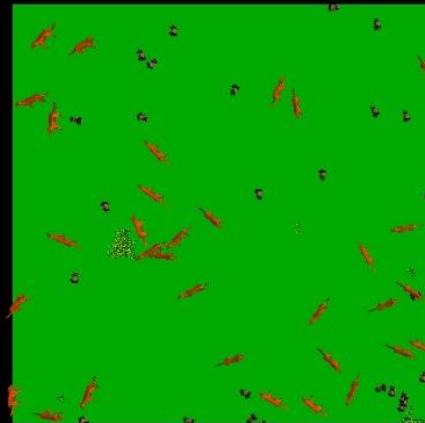
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setup

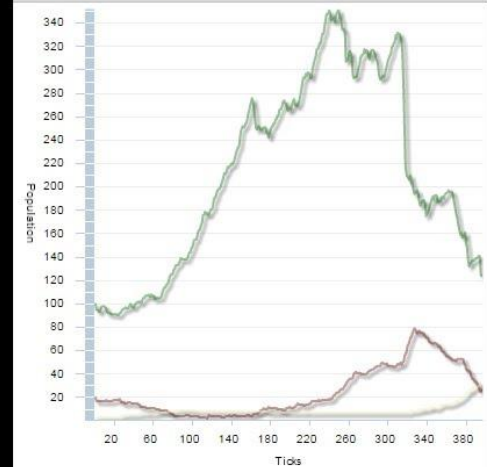
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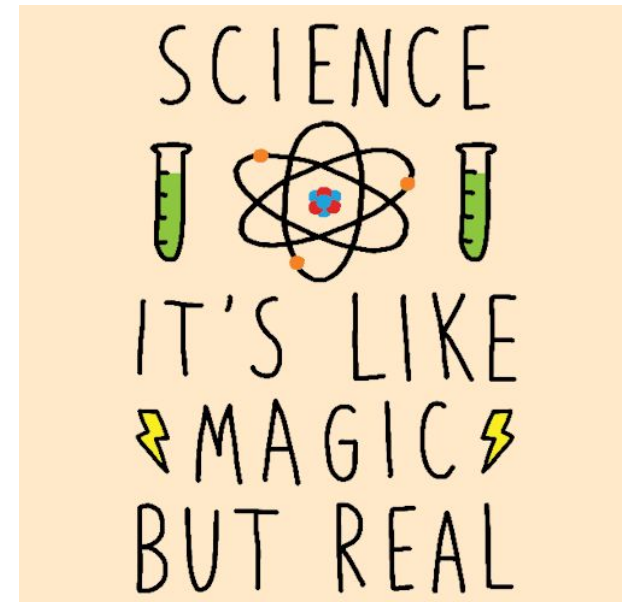


Population size over time

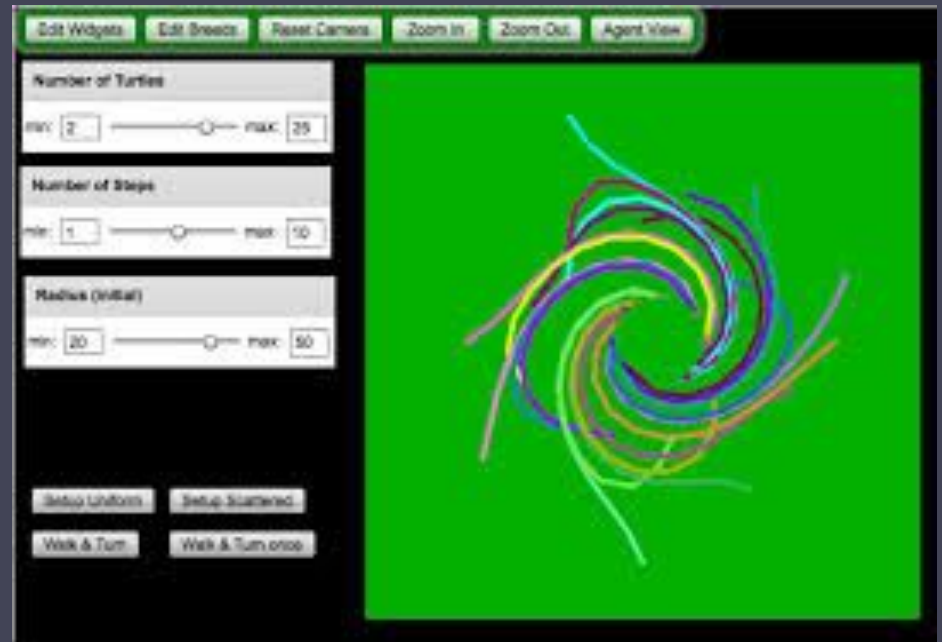


Science and Engineering Practices

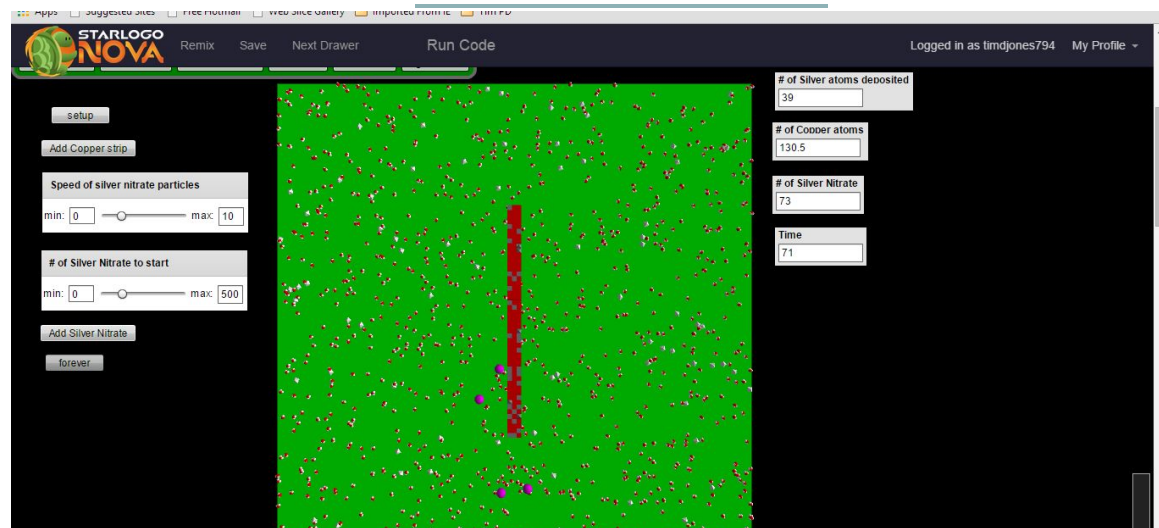
1. Ask questions
2. Develop and use models
3. Plan and carry out investigations
4. Analyze and interpret data
5. Use math and computational thinking
6. Construct explanations



Math



Student example data table and graph



CCSS Math Practices

1.

Make sense of problems & persevere in solving them

2.

Reason abstractly & quantitatively

3.

Construct viable arguments & critique the reasoning of others

4.

Model with mathematics

5.

Use appropriate tools strategically

6.

Attend to precision

7.

Look for & make use of structure

8.

Look for & express regularity in repeated reasoning

Math & Computational Thinking & Modelling

S2: Develop & use models.

S5: Use mathematics & computational thinking

M4: Models with mathematics.

S7: Engage in argument from evidence

E4 & M3: Construct viable arguments and critique reasoning of others.

Computational Thinking & ELA



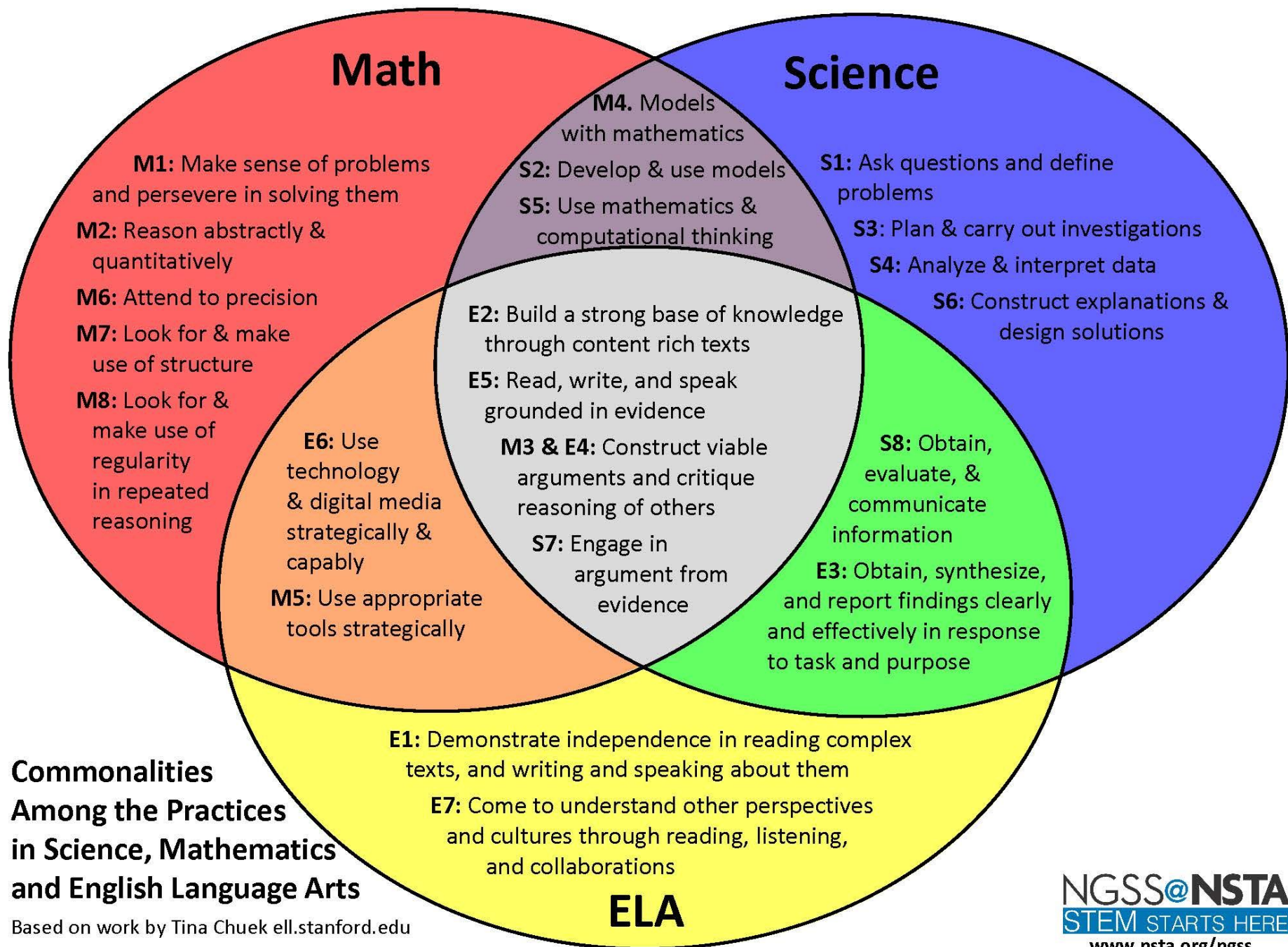
S7: Engage in argument from evidence

S8: Obtain, evaluate, & communicate information.

E3: Obtain, synthesize, and report findings clearly and effectively in response to task and purpose.

Application of Computational Thinking Models to ELA practices

-
- E2: Build a strong base of knowledge through content rich texts
- E5: Read, write, and speak grounded in evidence,
- E4 & M3: Construct viable arguments and critique reasoning of others.



Practices in Mathematics, Science, and English Language Arts*

Math	Science	English Language Arts
M1. Make sense of problems and persevere in solving them. M2. Reason abstractly and quantitatively. M3. Construct viable arguments and critique the reasoning of others. M4. Model with mathematics. M5. Use appropriate tools strategically. M6. Attend to precision. M7. Look for and make use of structure. M8. Look for and express regularity in repeated reasoning.	S1. Asking questions (for science) and defining problems (for engineering). S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S5. Using mathematics, information and computer technology, and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information.	E1. They demonstrate independence. E2. They build strong content knowledge. E3. They respond to the varying demands of audience, task, purpose, and discipline. E4. They comprehend as well as critique. E5. They value evidence. E6. They use technology and digital media strategically and capably. E7. They come to understanding other perspectives and cultures.

* The Common Core English Language Arts uses the term “student capacities” rather than the term “practices” used in Common Core Mathematics and the Next Generation Science Standards.



PROJECT GUTS

Growing Up Thinking Scientifically

Model Observations → Use → Modify → Create

Take it further!

About Project GUTS

NM Adventures in Modeling (2003, NSF-ITEST)

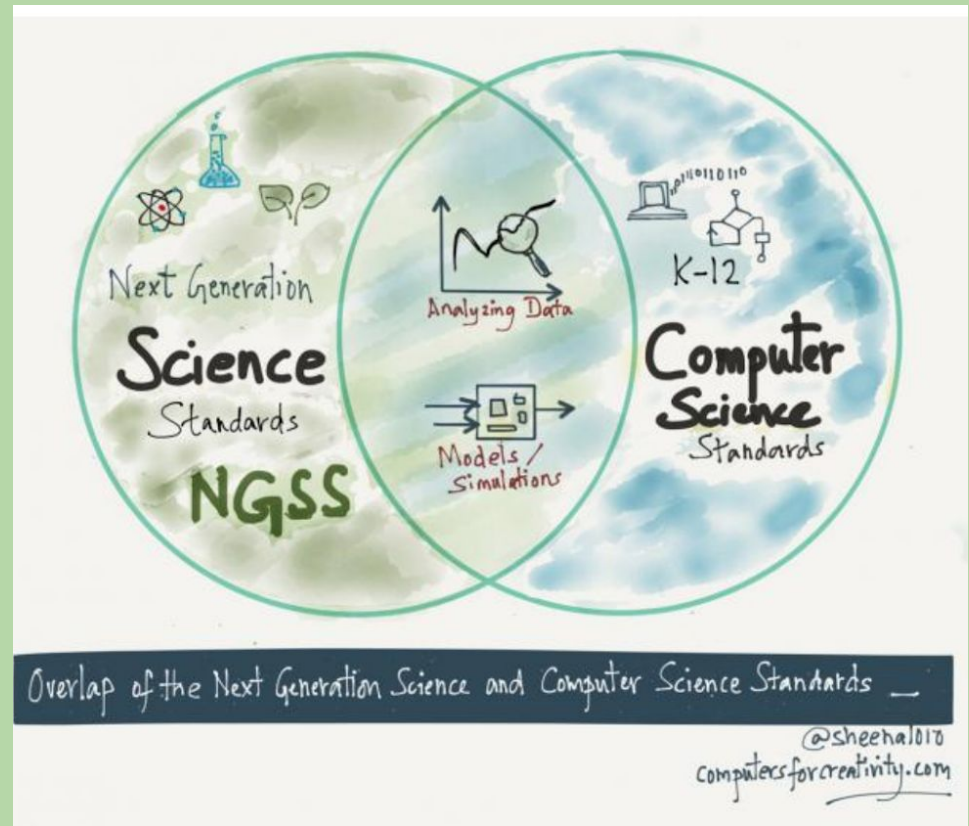
Project GUTS afterschool (2007, NSF-AYS)

2014+ embedding Project GUTS during the school day!



Project GUTS resources

- Join teacherswithguts.org
- Access to free forums, resources, and support



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