Preparing for NGSS: Developing and Using Models

Presented by: Christina Schwarz and Cynthia Passmore

September 25, 2012
6:30 p.m. – 8:00 p.m. Eastern time
Introducing today’s presenters…

Ted Willard
National Science Teachers Association

Christina Schwarz
Michigan State University

Cynthia Passmore
University of California, Davis
Developing the Standards
Developing the Standards
Developing the Standards
Developing the Standards

July 2011

2011-2013
Developing the Standards

July 2011

2011-2013
NGSS Lead State Partners

Achieve

[Map of the United States with various states highlighted in blue, representing the lead state partners for NGSS.]
NGSS Development Process

In addition to a number of reviews by state teams and critical stakeholders, the process includes two public reviews.

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IT’S NOT OUT YET!
A Framework for K-12 Science Education

- Released in July 2011
- Developed by the National Research Council at the National Academies of Science
- Prepared by a committee of Scientists (including Nobel Laureates) and Science Educators

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine
A Framework for K-12 Science Education

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A Framework for K-12 Science Education

Three-Dimensions:

- Scientific and Engineering Practices
- Crosscutting Concepts
- Disciplinary Core Ideas
Scientific and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
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Crosscutting Concepts

1. Patterns

2. Cause and effect: Mechanism and explanation

3. Scale, proportion, and quantity

4. Systems and system models

5. Energy and matter: Flows, cycles, and conservation

6. Structure and function

7. Stability and change
## Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>Life Science</th>
<th>Physical Science</th>
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<tr>
<td>LS1: From Molecules to Organisms: Structures and Processes</td>
<td>PS1: Matter and Its Interactions</td>
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<td>LS2: Ecosystems: Interactions, Energy, and Dynamics</td>
<td>PS2: Motion and Stability: Forces and Interactions</td>
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<td>PS4: Waves and Their Applications in Technologies for Information Transfer</td>
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<tr>
<th>Earth &amp; Space Science</th>
<th>Engineering &amp; Technology</th>
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<td>ESS1: Earth’s Place in the Universe</td>
<td>ETS1: Engineering Design</td>
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<tr>
<td>ESS2: Earth’s Systems</td>
<td>ETS2: Links Among Engineering, Technology, Science, and Society</td>
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<tr>
<td>ESS3: Earth and Human Activity</td>
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Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement.
Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits. [Clarification Statement: Examples of atoms combining can include Hydrogen (H₂) and Oxygen (O₂) combining to form hydrogen peroxide (H₂O₂) or water(H₂O). [Assessment Boundary: Restricted to macroscopic interactions.]

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Closer Look at a Performance Expectation

**MS.PS-SPM.a. Structure and Properties of Matter**

Students who demonstrate understanding can:

a. **Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits.** [Clarification Statement: Examples of atoms combining can include Hydrogen (H₂) and Oxygen (O₂) combining to form hydrogen peroxide (H₂O₂) or water(H₂O). [Assessment Boundary: Restricted to macroscopic interactions.]]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

- **Developing and Using Models**
  - Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems.
  - Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs.

- **PS1.A: Structure and Properties of Matter**
  - All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
  - Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

- **Patterns**
  - Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. Graphs and charts can be used to identify patterns in data.

Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement.
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Developing and Using Models from the Science Education Framework

Christina Schwarz  
*Michigan State University*

Primary funding for Schwarz’s research has come from the National Science Foundation under the grants DRL1020316 and ESI-0628199 to the Scientific Practices and MoDeLS projects at Northwestern University.

Cynthia Passmore  
*University of California, Davis*

Primary funding for Passmore’s work has most recently come from National Science Foundation (DRL 0554652).

The opinions expressed herein are those of the authors and not necessarily those of the NSF.
Who are we?

• Christina Schwarz
  – Professor in science education and teacher education at Michigan State University
  – Background in science (planetary science degree with some astronomy research) and graduate work with teachers and students (U. C. Berkeley) exploring scientific modeling with 7th graders in physics (force and motion) using computer microworlds
  – Current work (past 15 years) supporting teachers and students at the elementary and middle school in scientific practices – especially model-based scientific inquiry. Researches student learning from this approach.

• Cynthia Passmore
  – Associate Professor, science education at University of California, Davis
  – Prior work includes high school teaching in math, biology, and physical science.
  – Current work (past 15 years) includes preservice and inservice teacher professional development on using models in the science classroom and student learning research.
Why we love scientific modeling

• We are passionate about modeling
  – Modeling lies at the core of modern science and engineering – plays an important role in these fields and also overlaps with mathematics
  – Modeling involves working with the scientific theories as well as empirical data and models provide a way to ‘mediate’ or negotiate our ideas
  – Modeling can help learners better advance their ideas and understand science and can help teachers teach more effectively

• The teachers with whom we work have said things like:
  – “This is the way students should learn. This is what science is all about!”
  – “This [approach] has helped me think about teaching all of my subjects”
  – “This has helped me be a better teacher”
Caveats to this presentation

• We are not authors of the framework, so we have no special insight into the decisions made by the committee. We can use our expertise having worked with teachers and students to help you think about what modeling is and how you can engage your students in modeling.

• Our primary expertise is in scientific modeling rather than engineering modeling.
Poll: How do you use models?

What is the most common way that you use models and modeling in your classrooms?

A. To show students what some aspect of a physical phenomenon looks like
B. To help students remember or reinforce ideas presented in class
C. To assess students’ ideas
D. To help students develop or reason with ideas
Overview

• What is modeling?
• Why modeling?
• Modeling and the Framework
• How do we do it?
  – Vignettes to illustrate and highlight essential features
• Resources
• Discussion
What is a Scientific Model?

• A Scientific Model
  • An abstract, simplified representation of a system that makes its central features explicit and visible
  • can be used to generate predictions and explanations for natural phenomena
  • Mental (internal) and conceptual (expressed) models
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• Examples of expressed/conceptual models
  • Bohr model of the atom/particle model of matter
  • Light ray model, water cycle model
  • Food web models and interactions between organisms
  • Computations models of the atmosphere
  • Natural selection model
  • Protein synthesis model

Engineering uses models for analyzing, testing, and designing
What is a Scientific Model?

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  • Food web models and interactions between organisms
  • Computational models of the atmosphere
  • Natural selection model; protein synthesis model

• While we work with conceptual or expressed models in the classroom, what we really care about is advancing students’ mental or internal models of how the world works and focusing on how students can productively engage in modeling. At heart, modeling is about using tools to make sense of the world.
What is Scientific Modeling?

Scientific modeling is the practice of testing and revising of scientific models.

- **Modeling Practice Elements**
  - *Developing* a model that embodies aspects of a theory and evidence
  - *Evaluating* that model against empirical evidence and theory
  - *Using* the model to illustrate, predict and explain
  - *Revising* that model

- **Knowledge about Modeling and Norms**
  - Reflective knowledge about the practice (e.g., the purpose and nature of modeling)
  - The group norms involved in testing and revising models (e.g., consistency with evidence; a focus on mechanism)
Why Engage Students in the Practice of Modeling?

• This and other practices help learners “establish, extend, and refine knowledge”

• Modeling is important for students. It can help learners build
  – subject matter understanding; models make invisible processes, mechanisms and components visible and testable.
  – understanding of the way science works and functions; (testing and revising models of systems and processes used in science and engineering)
  – practices and skills (e.g. systems thinking; sharing and evaluating ideas; thinking about evidence and mechanism)

• But, it can sometimes be difficult for students and teachers to understand and enact – We will help today!
The Framework and modeling

The Framework identifies 8 scientific and engineering 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 mathematics and computational thinking
6. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
How modeling fits with the other practices

*Models and theories are the purpose and the outcomes of scientific practices. They are the tools for engineering design and problem solving. As such, modeling guides the other practices.*
Models help identify questions and predict answers

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2. Developing and using models
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Models help point to empirical investigations

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And models are the filter through which data are interpreted

1. Asking questions and defining problems
2. Developing and using models
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Models are revised and applied to “answer” or explain, predict, and solve

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Why Models Can Explain

• Models are built from observations and patterns of the world. In turn, models can explain patterns and observations.

• OPM triangle from Andy Anderson et al. 
  [Link](http://edr1.educ.msu.edu/EnvironmetalLit/index.htm)
We use mathematics to formulate some models and mathematical reasoning to evaluate models

1. Asking questions and defining problems

2. Developing and using models

3. Planning and carrying out investigations

4. Analyzing and interpreting data

5. Using mathematics and computational thinking

6. Developing explanations and designing solutions

7. Engaging in argument from evidence

8. Obtaining, evaluating, and communicating information
Argumentation is involved in both developing and evaluating models

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Models hold and organize relevant information and become the focus of communicating ideas

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WOW! Models do a lot!

1. Asking questions and defining problems
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“Models serve the purpose of being a tool for thinking with, making predictions and making sense of experience.” And further “scientists use models…to represent their current understanding of a system under study, to aid in the development of questions and explanations, and to communicate ideas to others.” (NRC, 2011, pp. 56-7).
Key Elements of Modeling

• Cycles of model development, evaluation, and revision within a social setting
• Models must be consistent with and evaluated against empirical data and established theoretical ideas.
What ISN’T A Scientific Model or Scientific Modeling

• Scientific models AREN’T ART projects!
  – Art projects are great, but they serve a different purpose
  – Constructing conceptual/physical models for the sake of constructing a model (e.g., jello models of the cell) or to reinforce ideas doesn’t allow students to advance their ideas and consider how the model works with respect to evidence and theory.

• The model has to be useful for helping predict or explain a system. If the model is only descriptive and doesn’t help to answer a question about how, or why, then it isn’t a scientific model.
To reiterate

\[ \Delta E_{\text{thermal}} + \Delta E_{\text{bond}} = + Q \]

These are examples of *tools, physical replicas, or inscriptions* that only serve as models when we use them to communicate about and reason with aspects of the underlying system they represent.
Framework Modeling Goals

• “Construct drawings or diagrams as representations and use as the basis for an explanation or prediction
• Use multiple types of models (including simulations)
• Discuss limitations and precision of a model
• Use models to test a design” (p. 58)
Before We Get to Your Questions…

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Time to Chat!

- Your questions for the presenters
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Poll

At what point in your instructional sequence do you typically focus on models?

A. As a review to solidify the main points
B. Throughout the sequence as a way to organize our ongoing work
C. As a way to assess students’ ideas
Model-Based Inquiry Unit and Sequence

Idealized Curriculum sequence

1. Central question from phenomena
2. Develop initial model
3. Empirical investigations and model elaboration/revision
4. Clarify/explore theoretical ideas
5. Model evaluation and consensus model development
6. Model application
Curriculum Sequences and Vignettes of Scientific Modeling

Two examples of sequences:

• 5th grade unit on evaporation/condensation
• High school genetics
5th Grade Evap/Condensation
Example Model-Based Inquiry Unit and Sequence

Eight-week model-based inquiry unit on evaporation and condensation for 5th grade

Curriculum sequence

1. Central question
2. Develop initial model of evaporation
3. Empirical investigations and model revision
4. Computer simulations and theoretical ideas with model revision and evaluation
5. Consensus model construction
6. Model application
7. Repeat the sequence with condensation
(1) Central Question

Anchoring phenomena and central question:
Would you drink the liquid in the bottle cap from a solar still?

A solar still
(2) Initial Model

Develop an initial model of evaporation – what happens to the water? (second half of unit on condensation)
Using humidity detectors to measure water vapor levels from evaporation and condensation.
(4) Evaluate and Revise Model
(5) Introduce scientific ideas and simulations
(6) Evaluate and Revise Models

Evaporation model before simulation

Evaporation model after simulation
(7) Peer comparison and evaluation
(8) Construct a consensus model

Small group evaporation consensus model

Example of whole class condensation consensus model
(9) Use model to predict and explain

Pre-test

Post-test
Reactions

• How is this type of sequence similar or different from your curriculum?
• Less content coverage, more depth; asking students to make sense of data and theory and to put it a model; peer revisions and whole class conversations
Mrs. M’s classroom
Small Group’s Consensus Model of Evaporation (class #11)

Mrs. M: […] we are going to look at all our third models and we are going to evaluate all of those and then we are going to take the best of them and mix them up and put them together and that is what is going to be on our consensus model.

[work in small group]
Melanie: All right. By majority rules, we're going to have color, okay? … Before, during and after.
Andrew: We're definitely going to use different temperatures.
Melanie: Hot and cold. …
Andrew: We should put the humidity to show that hot water is more humid. … To show that hot water evaporates fast and stuff
Melanie: …, I have an idea. We could do the humidity but still do slower or faster, you know?
Andrew: Yeah.
Melanie: … All right, Zaada, will you do the honors of water vapor?… Just draw dots in the air for water vapor in during and after. More in the after.
Before
The water is beginning to evaporate.

During
The water is evaporating faster.

After
Faster

Before
The water is starting to evaporate slowly.

During
The water is still evaporating slowly.

After
Slower
Evaluation of the Small Group’s Consensus Model of Evaporation (class #13)

Student: I like how they show the percentage of humidity.
Mrs. M: Okay. [Student] likes how they show the percentage of humidity, which directly comes from the humidity detector investigations. …
Small group consensus model of condensation (class #21)

Melanie: [to Hyun] I want you to draw water vapor, a lot of water in here. Okay?
Hyun: But, why?
Melanie: Because there's water vapor=
Andrew: 'Cause we NE:ED water vapor=
Melanie: =There's tons of water vapor. … Draw a lot of water vapor inside the container. … You could say now there's a lot of water vapor in the air but there's more condensation on. … Now, just put, you know, little less. And the third one says there's now barely any water vapor in the air=
Andrew: =No, the third one is where the water bottle gets warm again, so the water evaporates off and then there's water vapor again.
Melanie: Oh! so there's now more water vapor and=
Andrew: =To show that it doesn't just keep taking the condensation.
Melanie: Oh, good idea.
Small group consensus model of condensation (class #21)
Mr. H’s classroom

Diagram: CML (initials' Class Consensus Model of Condensation) Diagram

- **Before**: The molecules are attracted to the bottle, the bottle is colder.
- **After**: The molecules collect on the bottle.

- **Left Side**: Warm air (room temp), humidity high, water molecules, cold bottle.
- **Right Side**: Warm air (room temp), humidity low, water molecules, cold bottle.

Image: Mr. H teaching in a classroom.
Class Consensus Condensation Model Construction

- Mr. H: […] **What else do we need to have?** Water molecules are in the air, it's a room, it's a room and sitting on the counter. Ethan?
- Ethan: Water in the bottle. […]
- Mr. H: **What's the point of this?** Do we have to have water in this bottle to make condensation happen? … So what does it matter if I have something in the bottle or not? **Does that matter?**
- Students: Yes./No.
- Mr. H: Raise your hands if you say it does not matter. So majority, so I'm going to leave an empty for right now because you can decide if you want to put something in your own. What matters then, what do I need to have on here? **Think about the criteria we just came up with.** If I want condensation to happen what needs to be there? […]
- Melanie: Sounds like the bottle itself is cold or (?). It doesn't matter if (there's water in the bottle) or not.
- Mr. H: Remember, where is condensation coming from?
- Students: Air
- Mr. H: It's coming from the air. Does it matter what's inside the bottle?
- Students: No.
- Mr. H: No, on the basis of what? **We need to base what we're making on what?**
- Students: **Evidence.**
- Mr. H: On the evidence, so what did we see in our investigations, Anderson?
- Anderson: We saw in our investigations that the condensation came from the outside after it's already evaporated.
What did students learn?

• Students’ knowledge about evaporation and condensation increased after the unit.

• They learned how to explain their ideas, that there is an audience to which one must pay attention, that their models need to be generalized, that the real world needs to be consistent with their model (and evidence matters!) and that they need to explain in their models how and why things happen (e.g., mechanism).

• What are they still learning? (social norms – like how to negotiate differences with one another, details about the evap/cond and particle nature of mater, and how these ideas apply to other situations)
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What makes this modeling?
What parts do you see as modeling?
What does not seem like modeling?

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NSTA staff helping out on the chat:

Christina Schwarz  
Flavio Mendez

Ted Willard  
Brynn Slate

Cindy Passmore  
Jeff Layman
High School Biology Vignette

Classical genetics
Model-Based Inquiry Unit: Classical Genetics

1. Driving phenomena: Family Histories
2. Construct initial model: Examine and make sense of Mendel’s model of simple dominance
3. Empirical investigations and model elaboration/revision: simulations and model revisions for codominance, multiple alleles, and sex linkage
4. Model evaluation and consensus model development: summarize and return to family histories
5. Model application: novel pedigrees to explain
(1) Driving phenomena/question

- Students explore cases written as family histories taken at a genetics counseling clinic. They make pedigrees of each family and note that several patterns of inheritance can been seen across a range of human conditions:
  - sometimes both parents are affected when a child is, sometimes only one and sometimes neither
  - some conditions seem to occur on both sides of the family and others only one
  - some conditions seem to have a gender component

- Driving question: why do different conditions seem to get “passed down” in different ways?
(2) Construct initial model

- Examine Mendel’s data (taken from his original manuscript).
- Find relevant patterns.
- Work with teacher to develop Mendel’s model of simple dominance.
(3, 4) Empirical investigations and model revision

• Students use model to interpret data from fruit fly crosses (simulation).

• They find some data cannot be explained by Mendel’s model and revise the model to account for patterns such as:
  – three or four variations for the trait
  – males affected more frequently than females

• Revised models must fit with other known genetic models/mechanisms (i.e. meiosis)
(5) Consensus model development

• Formalize their model representations, highlighting the key differences between
  – simple dominance
  – codominance
  – multiple alleles
  – sex-linkage

• Apply their new set of models to the initial pedigree data from the family histories.
(6) Apply models to novel phenomenon

Which model is at play here and how do you know?

I: So you are saying K and L tell you something pretty interesting. What is that?

Paul: That being albino is recessive.

I: How do you know that?

Paul: That is the only way. Because these two are unaffected and they have an affected child. The only way that could happen is if they were both 1,2s [heterozygotes]
What students learned

• The particulars of four different classical genetics models
• They reinforced meiosis model
• They coordinated data/evidence with model revisions
• They engaged in argumentation and communication
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Ideas for Your Modeling

Overall: Consider learners as developers and evaluators of knowledge, not just consumers. All disciplines in science have at their core a central activity of making sense of our world and why things work the way they do. School should engage students in doing this sense-making NOT in hearing about how others have done it.

- Include a driving question that addresses a big and important idea and provides coherence in the unit
- Models address the driving question to target how things happen, how they work, and why they work
- Focus on phenomena and data from those phenomena
- Engage students in repeated cycles of model evaluation and revision
- Models are based on empirical data and evidence
- Ask students to use models to explain the world around them
- Engage students in the social nature of modeling – argumentation is involved in evaluation and consensus in building and applying models
Poll: What is your biggest challenge in implementing modeling?

A. Not sure I understand the practice
B. Not enough curricular resources written from a modeling perspective
C. Not sure how to effectively support students developing and critiquing ideas in my classroom
D. Takes too much time to do it and I’m pressured to cover more material
Some ideas

• Focus on the most important and powerful science ideas (need to know rather than nice to know) – use models as a way to follow and help students revise their ideas and maintain conceptual coherence throughout the unit.

• Students tend to think better and there is some evidence that they can learn more deeply this way.

• Students are likely to learn other 21st century skills involved in the nature of the practice (working and negotiating with others to adhere to a set of explicit norms)
Students’ Modeling Practices

When students are evaluating, comparing, and revising models:

<table>
<thead>
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<th>Modeling Level 2</th>
<th>Modeling Level 3</th>
<th>Modeling Level 4</th>
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<tbody>
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<td>Students refer to models in terms of <strong>right and wrong answers</strong>. They focus on whether the model <strong>replicates the phenomenon</strong>.</td>
<td>Students make modifications to <strong>improve detail, clarity or add new information</strong>, without giving careful consideration to how the model fits with empirical evidence and improves mechanism.</td>
<td>Students compare and revise models to determine how different components or relationships <strong>fit evidence more completely and provide a more mechanistic explanation</strong> of the phenomena.</td>
<td>Students <strong>evaluate competing models</strong>, and attend to counter-evidence to consider revising their current model. Model changes are considered to <strong>develop questions that can then be tested against evidence from the phenomena</strong>.</td>
</tr>
</tbody>
</table>

From MoDeLS learning progression on Scientific Modeling (Schwarz, Reiser, Davis et al., 2009)

Where might your students fit with respect to these modeling practices?
Summary of Main Points

1. Modeling involves testing and revising models to make sense of the world.
2. Modeling works with other practices by establishing ideas about how and why the world works that can be tested and revised.
3. That testing process involves working with others to evaluate and persuade one another of the best ideas and evidence in models (engineering by using models to solve problems).
4. Focus on modeling by choosing the most important science ideas and developing a modeling-centered instructional sequence; monitor and respond to students ideas throughout.
5. Learners may develop skills and knowledge focused on how and why phenomena occur, using evidence, thinking about how models can be applied, and consensus and persuasion skills.
Other Modeling Resources

• Book chapters and research articles:

• Helpful websites
Contact Information

Christina Schwarz: cschwarz@msu.edu
Cindy Passmore: cpassmore@ucdavis.edu
Before We Get to Your Questions…

- Turn off notifications of other participants arriving
  - Edit -> Preferences
  - General -> Visual notifications
Time to Chat!

• Your questions for the presenters

• Continue discussion in community forums
  ➢ NSTA Learning Center, http://learningcenter.nsta.org/discuss

• Minimize or detach and expand chat panel
Submit your questions via the chat.

Remember… you can continue the discussion in the Community Forums at http://learningcenter.nsta.org/discuss
NSTA Efforts around NGSS
NSTA Outreach

- Inform science education community about the NGSS draft
- Encourage science educators to have a voice by engaging in the review process
- Help educators study and learn more about the document
NSTA Website (nsta.org/ngss)
# Upcoming Web Seminars on Practices

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<td>9/11 Asking Questions and Defining Problems</td>
<td>Brian Reiser</td>
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<td>2</td>
<td>9/25 Developing and Using Models</td>
<td>Christina Schwarz and Cindy Passmore</td>
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<td>3</td>
<td>10/9 Planning and Carrying Out Investigations</td>
<td>Rick Duschl</td>
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<td>4</td>
<td>10/23 Analyzing and Interpreting Data</td>
<td>Ann Rivet</td>
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<td>8</td>
<td>12/18 Obtaining, Evaluating and Communicating Information</td>
<td>Philip Bell, Leah Bricker, and Katie Van Horne</td>
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All take place on Tuesdays from 6:30-8:00 pm ET
Next Web Seminar
October 9 (two weeks from today)

Planning and Carrying Out Investigations

Teachers will learn more about:

- how scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually;
- how scientific investigations are systematic and require clarifying what counts as data; and identify variables or parameters; and
- how engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Presenter: Rick Duschl
Graduate Credit Available

Shippensburg University will offer one (1) graduate credit to individuals who attend or view all eight webinars.

Participants must either:

- Attend the live presentation, complete the survey at the end of the webinar, and obtain the certificate of participation from NSTA, or
- View the archived recording and complete the reflection question for that particular webinar.

In addition, all participants must complete a 500 word reflection essay.

The total cost is $165.

For information on the course requirements, as well as registration and payment information visit [www.ship.edu/extended/NSTA](http://www.ship.edu/extended/NSTA)
Community Forums

Below are group forums that you may join. Post to existing topics or start your own! All NSTA resources, personally uploaded resources, and collections may be shared and commented upon within these discussions.

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<th>Pedagogy and Research Forums</th>
<th>Last Post</th>
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| **Evaluation and Assessment** | 35 Topics  
A public forum discussing formative, summative, and dynamic assessments and evaluations. | by Susan German  
Wed Sep 12, 2012 10:25 PM  
Science Lessons for Inclusion Students |
| **New Teachers** | 11 Topics  
145 Posts | by Mary Bialow  
Thu Sep 13, 2012 6:20 PM  
New Teacher Question |
| **Next Generation Science Standards** | 5 Topics  
22 Posts | by Wendy Ruchti  
Today, 10:33 AM  
CCSS and NGSS |
| **Professional Development** | 67 Topics  
754 Posts | by Adah Stock  
Wed Sep 12, 2012 4:33 PM  
WestEd New Series “Making Sense of Science” |
These three conferences will include a number of sessions about the K–12 Framework and the highly anticipated Next Generation Science Standards.

Among the sessions will be an NSTA sponsored session focusing on the Scientific and Engineering Practices.
NSTA Print Resources

NSTA Reader’s Guide to the Framework

NSTA Journal Articles about the Framework and the Standards
Thanks to today’s presenters!

Ted Willard
National Science Teachers Association

Christina Schwarz
Michigan State University

Cynthia Passmore
University of California, Davis
Thank you to the sponsor of tonight’s web seminar:

This web seminar contains information about programs, products, and services offered by third parties, as well as links to third-party websites. The presence of a listing or such information does not constitute an endorsement by NSTA of a particular company or organization, or its programs, products, or services.
National Science Teachers Association
Gerry Wheeler, Interim Executive Director
Zipporah Miller, Associate Executive Director, Conferences and Programs
Al Byers, Ph.D., Assistant Executive Director, e-Learning and Government Partnerships
Flavio Mendez, Senior Director, NSTA Learning Center

NSTA Web Seminars
Brynn Slate, Manager
Jeff Layman, Technical Coordinator