“Modeling allows students to see new science ideas, to reason about how they are related, to argue from evidence and to monitor their own thinking along the way.”

Give us a shout if...
- You teach or work with elementary students
- You teach or work with middle school students
- You teach or work with high school students
- You work with adults

Scientific Modeling and the NGSS
- Modeling begins in the earliest grades.
- 24% of the middle school PE’s have modeling as the key practice.
- 21% of the high school PE’s have modeling as the key practice.

Performance Expectations Associated with SEP3: Developing and Using Models

<table>
<thead>
<tr>
<th>K-2</th>
<th>3-5</th>
<th>6-8</th>
<th>9-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.ESS3-1</td>
<td>3.LS1-1</td>
<td>MS-PS1-1</td>
<td>HS-PS1-1</td>
</tr>
<tr>
<td>2.ESS3-2</td>
<td>4.PS1-1</td>
<td>MS-PS1-4</td>
<td>HS-PS1-4</td>
</tr>
<tr>
<td>3.ESS3-2</td>
<td>4.PS2-1</td>
<td>MS-PS1-4</td>
<td>HS-PS1-4</td>
</tr>
<tr>
<td>K-8.ESS1-2</td>
<td>5.PS2-1</td>
<td>MS-PS1-2</td>
<td>HS-PS1-2</td>
</tr>
<tr>
<td>5.LS2-1</td>
<td>MS-PS1-2</td>
<td>HS-PS1-2</td>
<td></td>
</tr>
<tr>
<td>5.ESS2-1</td>
<td>MS-LS1-1</td>
<td>HS-LS1-1</td>
<td></td>
</tr>
</tbody>
</table>

Source: ngss.sdcoe.net

The Purpose of Modeling
“The unobservable always explains the observable in science”

To provide a “sense making” process for students.

For the student to have a visual record of how their understanding changes during the learning process.
Advantages of Modeling ...
and discourse

- Introduce yourself to the person next to you...
- How much time do we spend on teacher input vs student output in a typical week?

Models...

- Are a simplified representation of a system or phenomena that makes its central features explicit and visible. It often includes labels and arrows.
- Can be used to generate predictions and explanations for natural phenomena.
- They should be made public.

Models should reveal three things:
From the NGSS evidence statements:
1. Components of the model
2. Relationships
3. Connections

Components of a model
a. Students define and clearly label all of the essential variables or factors (components) within the system being modeled.
b. When appropriate, students describe the boundaries and limitations of the model.

Relationships in a model
Students show and describe the relationships among the components of the model.

Connections in a model
Students connect the model to phenomena, and then use their model to describe or predict something new.
Types of Models

- Paper / Jam Board etc
- Manipulatives (grab bag)
- Simulations

Think of the most recent model your students made or engaged with...

- What were they explaining?
- Did they make the model or did you give them the model?

So, let's jump in...

Paper Model

HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

MS-ESS2-1: Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process.

Thinking about How Land Can Move

1. Watch the animations. Focus on Africa and South America.

Source: Tanya Atwater

180 million years ago

Source: Tanya Atwater
Thinking about How Land Can Move

Think for a minute about how and why change might happen.

In your scientific notebook (8 1/2 x 11 piece of paper) develop an initial model that makes your thinking visible. Your model should focus on WHY and HOW such movement might occur.

Why Individual Products First?

- One thing that keeps people from creativity is comparison with others. (Brené Brown)
- Individual products prevent or delay comparison and allow people to get their own ideas on paper before being asked to collaborate.

Next Steps

1. Phenomena: Tanya Attwater animations
2. Essential Question: How are large masses of land able to move?
3. Initial model: how can you currently describe the movement of plates?
4. Lab or activity: The Sweet Taste of Tectonics
5. Additional information from class discussion, text, direct instruction and animations

Revise your initial model

- Use a different color than your original model, in order to make the changes in your thinking visible.
Next Steps

1. **Phenomena:** Tanya Attwater animations
2. **Essential Question:** How are large masses of land able to move?
3. **Initial model:** How can you currently describe the movement of plates?
4. **Lab or activity:** The Sweet Taste of Tectonics ✔
5. **Additional information** from class discussion, text, direct instruction and animations ✔
6. Revise model ✔
7. Gallery walk and revision
8. Additional instruction and explanation

Let’s try a different type of model

Grab Bag Modeling

“**The paperclip represents the Joules,** and how much each trophic level has.”

Now you try...

**Ecological Relationships**

- This time we are only going to use the grab bags, rather than the initial drawings
- Turn your paper over so you have a clean surface.
- You will grab bag model the affects of top down and bottom up influences on ecosystems.
Top Down…

Source: HHMI

Bottom up…

Source: HHMI

Now you try…
Ecological Relationships

* You will grab bag model the affects of top down and bottom up influences on ecosystems.

Next Steps

http://gph.is/2bj9gf3

Thank you!

Our Contact Information
Jim Clark and Samantha Johnson:

@Sci_innovations  
@JimClarkNGSI

ngsiteam1@gmail.com

www.nextgenscienceinnovations.com