“Models turn facts into stories, and information into insight. They can take the individual links of isolated facts and turn them into a strong chain of knowledge,” (Ian Leslie)
Do You See What I See?
Making Student Thinking Visible
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@sci_innovations
In the mean time the rest of the class looks like:
Everybody is a genius.

But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid.

Albert Einstein.
Open Minds
Making Student Thinking Visible

**Norms:** I will be looking for:

- Leaning in - Working in the center of the table.
- Equal air time
- Sticking together – no side conversations
- Listening to each other.
- LOTS of questions.
- Rephrase and practice: “So what we did was…”
  “That helps because…” (Use of Academic Conversation Placemat.)
- **MAKE SURE EVERYONE UNDERSTANDS!!!**

This gives us an opportunity to **catch kids being smart**
Many kids have become proficient at “playing school” so we must design high cognitive demand tasks that require students to demonstrate their thinking in ways that they are not experienced in.

When designing activities we must view the activity through the lenses of equity and access and build in accountability throughout.
Student thinking made visible

States of Matter

Solid
- freezing point
- Phase Change
- melting point

Liquid
- dew point
- Phase Change
- boiling point

Gas

Remove Energy
- Particles move slower and closer together.

Add Energy
- Particles move faster and further apart.
Heat Source

Liquid (water molecules)

Gas (water molecules)
Scientific Models/Scientific Modeling
Less of . . . More of . . .

• Scientific models AREN’T ART projects!

• Student models need to:
  • Help predict or explain a system.
  • Help to answer a question about how or why.
Open Minds
Making Student Thinking Visible

Whiteboard Modeling: Genetics and Connections to Evolution
Allow students to grapple with the information provided by the feedback.
Open Minds
Making Student Thinking Visible

Grab Bag Modeling
The paperclip represents the Joules, and how much trophic level has
Other Ideas

Not necessarily modeling but they make student thinking visible and require students to communicate their understandings.
RESPONSE TO STIMULUS

USE AND OBTAIN ENERGY

HOMEOSTASIS

BIOLOGICAL ORGANIZATION
In addition to modeling we have worked on:

- NGSS and Standards Based Grading
- Planning and carrying out investigations
- Intro to NGSS
- Classroom discourse and NGSS

If you think folks at your school or district would be interested in learning more about these topics feel free to contact us.

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Modeling and the NGSS.

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The Science and Engineering Practices call on students to use models to make their thinking visible and revise their thinking as new knowledge is uncovered.

From the NGSS: SEP 2 Developing and Using Models

Modeling can begin in the earliest grades, with students’ models progressing from concrete “pictures” and/or physical scale models (e.g., a toy car) to more abstract representations of relevant relationships in later grades, such as a diagram representing forces on a particular object in a system. (NRC Framework, 2012, p. 58)

Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations. Although models do not correspond exactly to the real world, they bring certain features into focus while obscuring others. All models contain approximations and assumptions that limit the range of validity and predictive power, so it is important for students to recognize their limitations.

In science, models are used to represent a system (or parts of a system) under study, to aid in the development of questions and explanations, to generate data that can be used to make predictions, and to communicate ideas to others. Students can be expected to evaluate and refine models through an iterative cycle of comparing their predictions with the real world and then adjusting them to gain insights into the phenomenon being modeled. As such, models are based upon evidence. When new evidence is uncovered that the models can’t explain, models are modified.

In engineering, models may be used to analyze a system to see where or under what conditions flaws might develop, or to test possible solutions to a problem. Models can also be used to visualize and refine a design, to communicate a design’s features to others, and as prototypes for testing design performance.

Modeling

- Modeling is a description of some thing or process that we wish to understand.
- It is a representation but not a replacement of the real thing or phenomenon.
- It is an abstraction of the real world based on our current level of understanding.
  - This is what makes using models so powerful. The NGSS asks kids to revise their thinking based on new evidence. As they engage in that productive cognitive struggle their understanding will change and so will their model.

Purposes of Scientific Models

- Understanding: To provide a more complete understanding of the system being studied.
- Prediction: To enable prediction of a future event in a system being studied.
- Organization: To serve as a conceptual framework for organizing or coordinating information.
Proficiency in science is more than knowing facts. It is not a simple accumulation of information.

Factual knowledge must be placed in a conceptual framework to be well understood. Students must be able to demonstrate how concepts are related to each other.

What does modeling look like?

- What it used to look like: Teachers using models to explain phenomena to kids.
  - Atomic models etc
- What it looks like with NGSS: Kids using models to clarify their own thinking and explain phenomena to teachers and classmates.
- Model vs Modeling.
  - Model – a description or conceptualization of a system.
  - Modeling – using a model to simulate system processes.

White Board Modeling

Grab Bag Modeling!!

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