Modeling Scientific Practice in High School Biology

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University of California, Davis
PI Meeting, August 5, 2014
The end goal: A yearlong NGSS-aligned curricular resource package for high school biology

<table>
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<tr>
<th>Program Year</th>
<th>Year One</th>
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<tr>
<td>Phase</td>
<td>Design</td>
<td>Pilot &amp; Refine</td>
<td>Implement &amp; finalize</td>
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Model-Based Educational Resource
Effective NGSS Curriculum

• Focused on student sense making
• Coherent, rigorous, focused on big ideas
• Leverages diversity of students’ experiences
• Educative for teachers and students

Carlson, Davis, Buxton, 2014
MBER Contribution to Theory and Practice

Theory: How can a focus on model-based reasoning support design of effective NGSS curricula?

Practice: What does this look like? In classrooms? For teachers? For students?
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Carlson, Davis, Buxton, 2014
What is a scientific model?

“Few terms are used in popular and scientific discourse more promiscuously as model.”

– NGSS Framework
What is a scientific model?

*Models* are **reasoning tools** that are developed and used by *cognitive agents* for the purpose of generating and refining *explanations* that address *questions* about *phenomena* in the world.

Models “of” vs. models “for”
Models “of” vs. models “for”

tools for

reasoning about
What is a scientific model?

Models are reasoning tools that are developed and used by cognitive agents for the purpose of generating and refining explanations that address questions about phenomena in the world.

Model Triads

**Phenomenon**
- What are the puzzling patterns in the world about which we want students to reason?
- How to engage students with that phenomenon?

**Question**
- How to focus and bound the classroom inquiry?
- What is the explanation we want students to be able to generate?

**Model**
- How to make the relevant ideas clear and public for students?
- How to represent those ideas?
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Carlson, Davis, Buxton, 2014
Why do organisms eat?

Food provides energy

How does food provide energy?

Matter and Energy Budget Model

Chemical Energy Model

Organisms do different things

How do organisms allocate that energy?

Matter and Energy Budgets (tradeoffs)
Model-based NGSS Curriculum

• **Coherent, rigorous, focused on big ideas**
  – looping structure as models are developed and refined
  – loops reflect chains of questioning through model hierarchy

• **Focused on student sense making**
  – model triads keep models for making sense of phenomena

• Leverages diversity of students’ experiences

• Educatively for teachers and students
MBER Team

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• Arthur Beauchamp
• Rich Hedman
• Candice Guy
• Chris Griesemer
• Libbie Coleman
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