NGSS Webinar:

Designing instructional units using the NGSS Storyline Approach to support student sensemaking

September 13, 2018
1:00 PM Pacific | 2:00 PM Mountain | 3:00 PM Central | 4:00 PM Eastern

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NAGT
National Association of Geoscience Teachers

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION

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Organizers:
Aida Awad, NAGT Past President / Secretary/Treasurer
Ed Robeck, American Geosciences Institute
Carla McAuliffe, NESTA Executive Director
Jessica Bean, UCMP Berkeley
John McDaris, SERC/NAGT
Andrew Haveles, SERC/NAGT

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Webinar overview:

➢ Welcome and introductions
➢ Presenter:

  Abe Lo, Ph.D., Science Educator, BSCS
  Science Learning

➢ Discussion, Q&A & Online Discussion Forum

Upcoming Events & Resources:

➢ Future Events:
  ○ October webinar: 10/11/2018 - Using the Five Tools and Processes for Translating the NGSS into Instruction and Classroom Assessment presented by: David Randle, American Museum of Natural History
  ○ November webinar: 11/8/2018 - Quickly Increasing Anthropogenic Global Warming Acceptance: Five Experimentally-Vetted Methods and HowGlobalWarmingWorks.org presented by: Michael Ranney, UC Berkeley

Please feel free to type your questions into the chat box during the webinar.

Today's presentation:
Designing instructional units using the NGSS Storyline Approach to support student sensemaking

Abe Lo, Ph.D., Science Educator, BSCS Science Learning

Transforming Science Education Through Research-Driven Innovation

Designing instructional units using the NGSS Storyline Approach to support student sensemaking

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Shifts involved in implementing the NGSS

- Shift 1: Learning *scientific facts* to constructing *explanatory knowledge*
    - **Explanatory models** - components, relationships, and processes that can explain a set of related phenomena

- Shift 2: Engages **all students** in scientific thinking and moves from *learning about science* to *figuring things out* through phenomena-driven instruction.

- Shift 3: *Rote* to *meaningful* use of scientific practices and crosscutting concepts
    - Focus less on the *steps of a process* to attending to whether *students understand what they are doing* and how and why their decisions will help them achieve their scientific goals (Berland et al., 2016)

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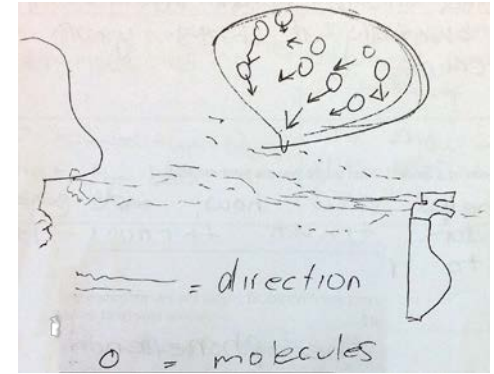
Problems of Practice

- Many students and teachers have little experience using scientific practices in authentic or meaningful ways (Banilower et al., 2013; Driver, Newton, & Osborne, 2000).

- Students often experience science class as a series of disconnected activities that lack coherence or connection both between and within lessons.

Use of NGSS Storyline Approach to Support Coherent Student Learning (e.g., Reiser, 2014; Lo et al., 2014)

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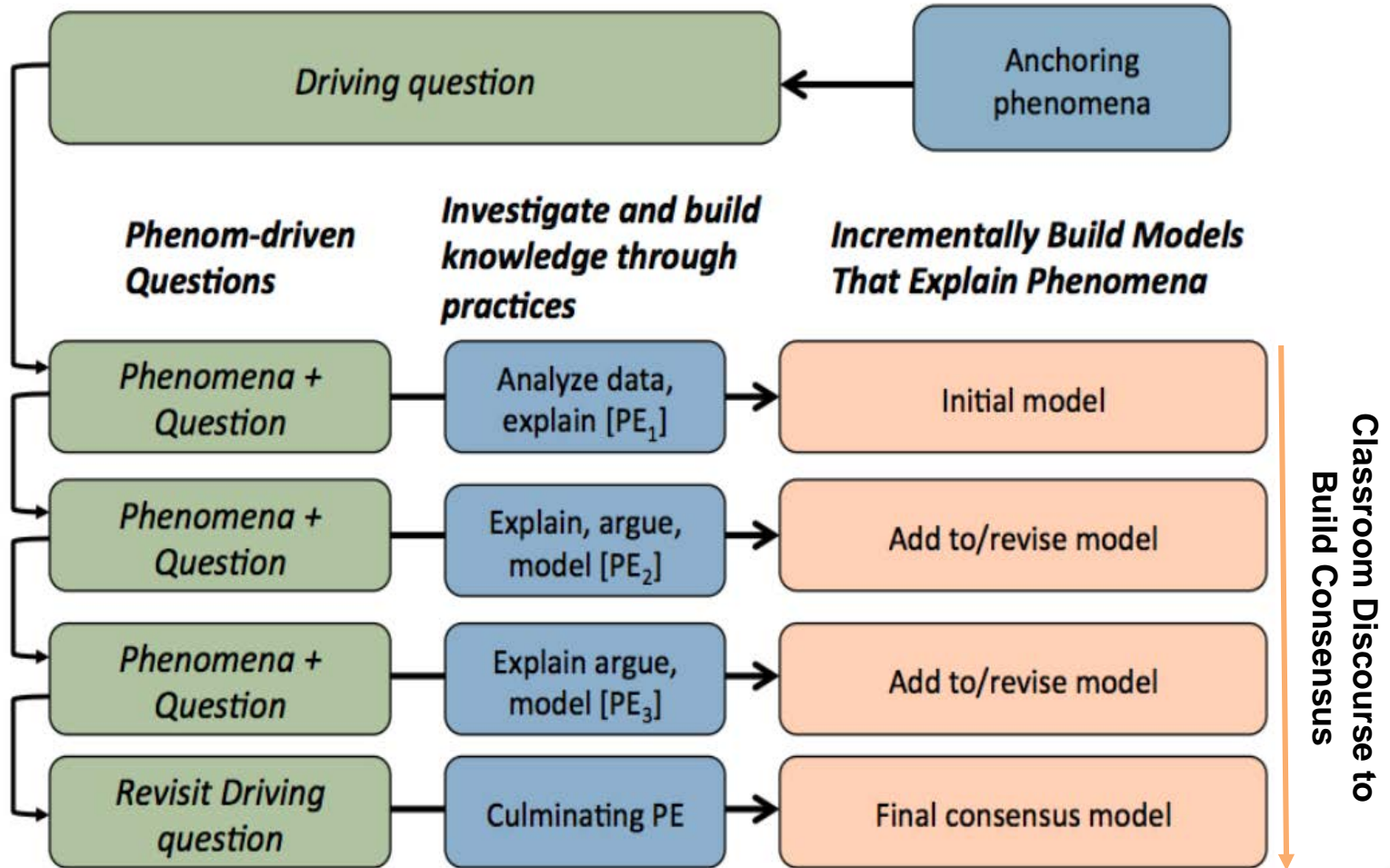
Webinar Goals

- Share principles and tools that can be used to design NGSS-aligned curriculum materials using the NGSS Storyline Approach

- Share instructional routines that could be used to support coherent classroom teaching and learning

Planning NGSS Storyline Units

1. **What is the goal of students' learning?**
2. What anchor phenomenon/problem context can drive students' learning about the target ideas?
3. What initial ideas and questions are students likely to pose?
4. How can I sequence the investigation of students' questions?
5. What opportunities do students have to monitor and revise their understanding over time?

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Choose Target Performance Expectation(s)

- Each performance expectation reflects what we expect students to be **able to do** – not just know.

- **HS-ESS2-2** **Analyze geoscience data to make the claim** **that** **one change** **to Earth's surface can** **create feedbacks that cause changes** **to other** **Earth systems**.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	**ESS2.A: Earth Materials and Systems** • Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **ESS2.D: Weather and Climate** • The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system. - - - - - - - - - - - - - - - *Connections to Engineering, Technology, and Applications of Science* **Influence of Engineering, Technology, and Science on Society and the Natural World** • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Planning NGSS Storyline Units

1. What is the goal of students' learning?

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Choosing productive anchor phenomena & problems

- Require **students** to develop and use understanding of targeted disciplinary core ideas and crosscutting concepts
- Can motivate and sustain students' interest → **Why should my students care?**
  - Students will likely have some ideas and questions about the phenomenon.
    - Complex, not straightforward
  - Students able to investigate their ideas and question.
- Phenomena can be in a variety of forms (e.g., observations, pictures, videos, datasets)

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What might be a good phenomenon context for demonstrating this PE?

- **HS-ESS2-2** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. *[Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice.]*

Sea Levels are Changing Around the World

http://www.miamitodaynews.com/2016/09/13/miami-getting-serious-sea-level-rise

Relative Sea Level Trends
mm/yr (feet/century)

| Above 9 (Above 3) | 6 to 9 (2 to 3) | 3 to 6 (1 to 2) | >0 to 3 (0 to 1) | -3 to 0 (-1 to 0) | -6 to -3 (-2 to -1) | -9 to -6 (-3 to -2) | Below -9 (Below -3) |

https://tidesandcurrents.noaa.gov/sltren
ds/sltrends.html
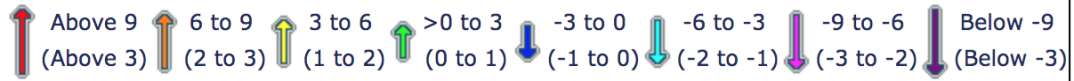
Assessing appropriateness of phenomenon/problem context

Explanation

- Increases in greenhouse gases causes a rise in global temperatures that melts glacial ice.

- Increased glacial ice melt moves to oceans and contributes to increased sea levels.

Performance Expectation

- **HS-ESS2-2** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

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Planning NGSS Storyline Units

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Anticipating students' initial ideas and questions

- Why important for students?
  - Promote shift in the students' knowledge-building role
- Using your **student hat**, what ideas are students likely to raise to *explain* the phenomenon?
  - What **existing knowledge** are students likely to draw from?
  - What **connections** are students likely to make to other related situations?
- What questions are students likely to raise about the phenomenon?

What questions do you think students might have for how and why sea levels are changing?

Example: Process for Revising UGC Sea Level Rise Unit using NGSS Storyline Approach

Planning NGSS Storyline Units

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Suggested Process: Use Sticky Notes

1. **Write** questions on individual sticky notes.

2. **Group** similar questions

3. **Sequence** questions so that the answer to those questions will contribute to understanding of anchor phenomenon.

4. What additional questions might students need to think about?

Storyline Planning Guide

Lesson Question	Activity or Phenomenon	What did we figure out?	From a student's perspective, how did we get here?

Revised Model

- Assess how students' learning iteratively builds over time in service of investigating anchor phenomenon

- Assess degree of fit between questions and activities

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Storyline Planning Guide

Lesson Question	Activity or Phenomenon	What did we figure out?	From a student's perspective, how did we get here?

- **Navigation**: How does what students are learning make sense in context of what they previously learned and our overarching goal?

- Identify additional questions or activities to supplement the storyline

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UGC Sea Level Rise Unit Storyline

Lesson Question	Activity or Phenomenon	What did we figure out?
How and why are sea levels changing?	Students pose their initial ideas and questions.	Sea levels are changing around the world, but seem to be rising more near coastal areas.
What is/are the source(s) of water that are contributing to changes in sea level?	Use map to identify potential sources of water. *Water, water everywhere (NOAA)* Analyze water reservoir data	Largest source of water outside oceans is found in ice.
What's happening with the ice?	Analyze and interpret data sets showing land and sea ice melt.	Sea ice and land ice are melting at a faster than historical rate.
How does the water from ice melting get to the ocean?	*What-a-cycle (NOAA): Move like a water molecule*	Water often does not stay in one place -- it moves from one place to another.

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UGC Sea Level Rise Unit Storyline

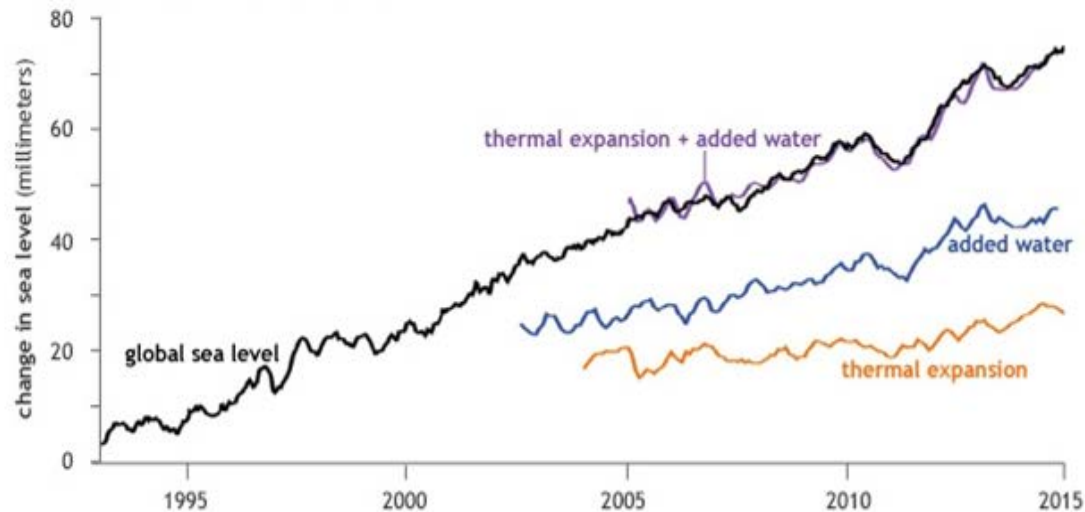| Lesson Question	Activity or Phenomenon	What did we figure out?
Are there differences in how sea and land ice melt contribute to sea level rise?	*Global Climate Change and Sea Level Rise (California Academy of Sciences)*	Land ice melt contributes to increased sea levels.
How do glaciers form and melt?	Data analysis from glacier monitoring projects	Water can stay in glaciers for a long time (long residence times). Glaciers are not accumulating as much ice as is melting.
Revise model: How and why are sea levels changing?	Add model ideas related to question: "What is/are the source(s) of water that are contributing to changes in sea level?"	

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UGC Sea Level Rise Unit Storyline

Lesson Question	Activity or Phenomenon	What did we figure out?
What might be causing the ice to melt at a faster than historical (normal) rate?	Students interpret graphs to assess whether earth is indeed warming and identify potential causes.	Increased greenhouse gas emissions cause for observed warming rates.
How does increases in greenhouse gas emissions lead to increased global temperatures?	*How Global Warming Works Video (UC Berkeley)*	Mechanism for greenhouse effect
What are the primary sources for increased greenhouse gas emissions related to ice melting?	Students analyze and interpret data to compare natural vs. human contributions *It's Us Video*	It's us!
Revise model: How and why are sea levels changing?	Add model ideas related to question: "What might be causing the ice to melt at a faster than historical (normal) rate?"	

Problematizing

- What happens if there's an idea or question that students are not likely to think about on their own?
- Create experiences where students realize that their model cannot fully explain the phenomenon
  - "Created a need" for model revision (Edelson, 2001)

Global mean sea level budget since 1993

change in sea level (millimeters)

thermal expansion + added water

added water

global sea level

thermal expansion

1995   2000   2005   2010   2015

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Students pose their initial ideas for explaining phenomenon

- Why important for students?
  - Makes visible students' ideas
  - Opportunity for students to use their existing knowledge to construct a coherent explanation.
  - Creates a product that students can share with others and mediate consensus-building
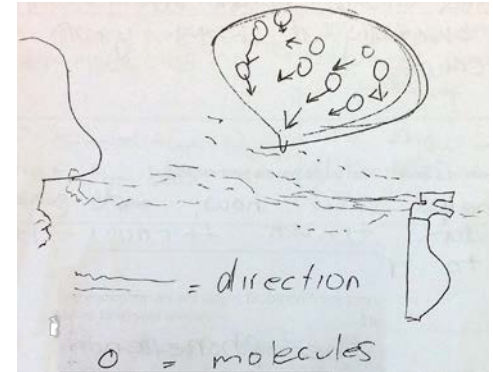
Construct Driving Question Board (DQB)

- Students post questions on individual sticky notes.
- Students order questions and develop ideas for investigating questions.
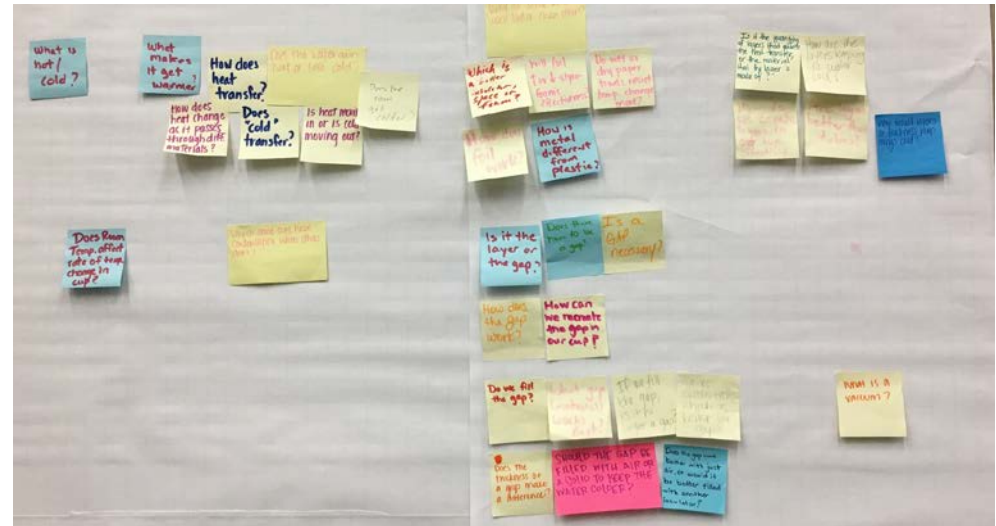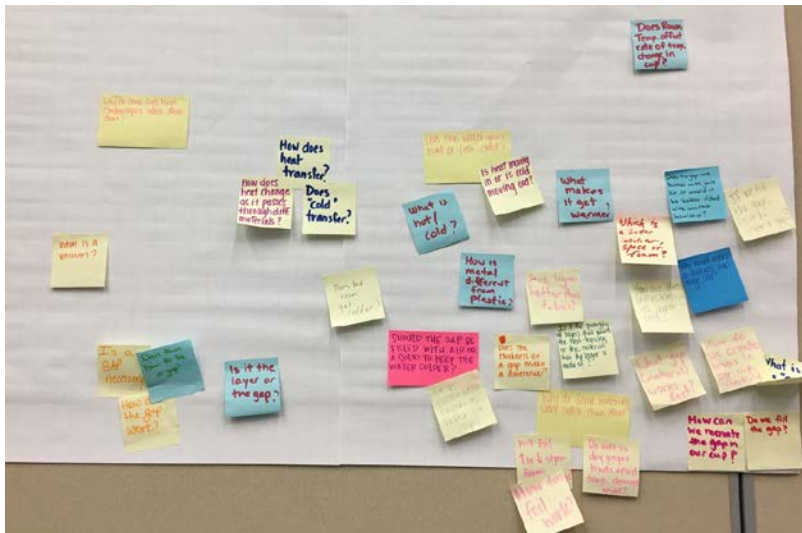
Incremental Model Tracker

Lesson Question	Evidence	What did we figure out?	How do we represent this?

Revised Model

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Putting the Pieces Together: Revising Our Model

Gotta Have It Checklist

❑ Glaciers and ice caps large source of water

❑ Land ice melt responsible for increased ocean levels

❑ Water from ice melt moves to oceans through water cycle

❑ Increased greenhouse gases increases earth's average temperature

❑ Increased temperature leads to higher rates of ice melt

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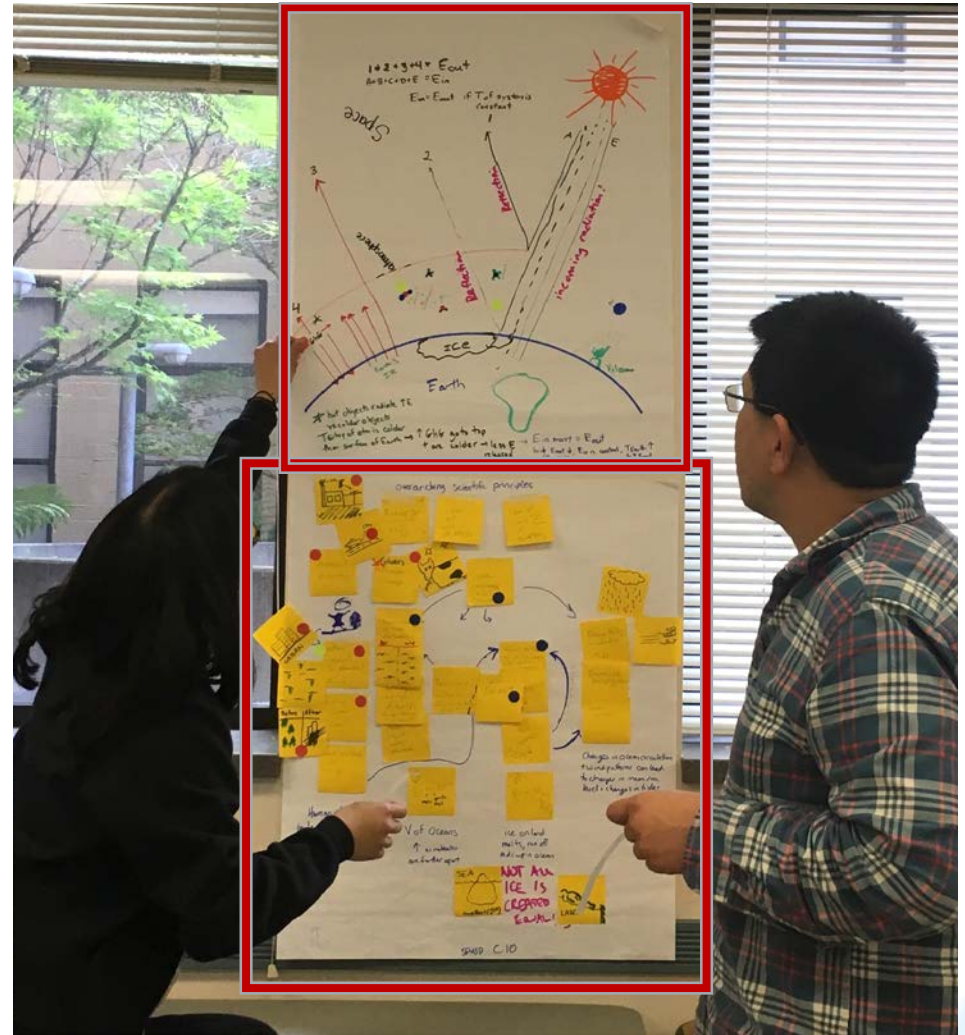
Why is revising students' models helpful?

1. Offer opportunity for students to make connections between ideas

2. Formative and summative assessment opportunity
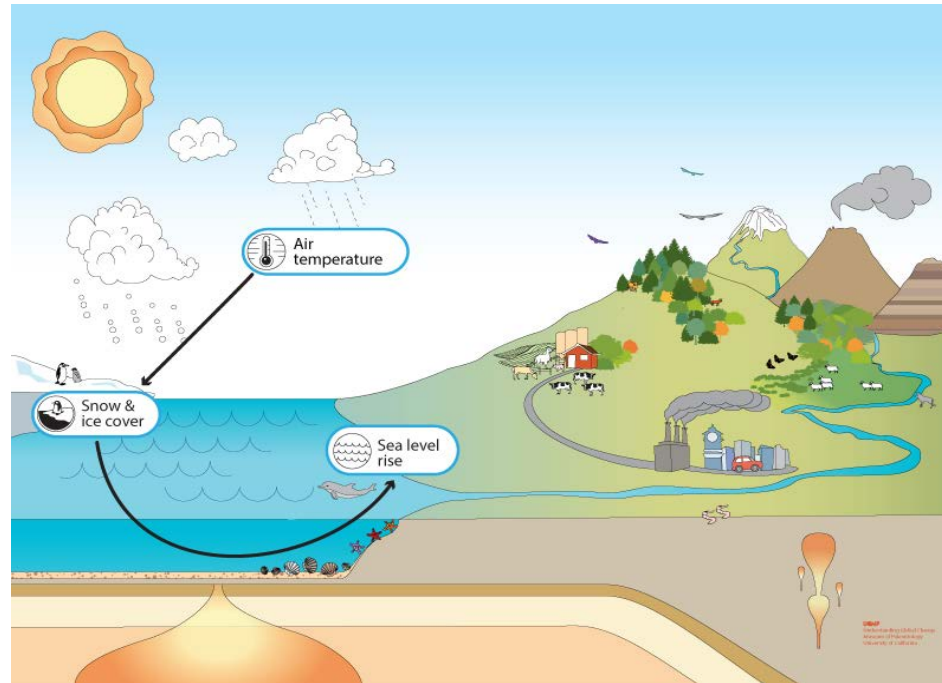
Putting the Pieces Together: Revisit DQB

- Students assess progress towards answering driving question
    - What questions have we answered?
    - What additional questions do we have?

Planning NGSS Storyline Units

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Resources

-

- nextgenstorylines.org

- Email for access to Understanding Global Change resources

- **NABT Workshop**: *Using the NGSS Storyline Approach to Help Students Understand the Processes of Science and Global Change,* Thursday, November 8, 12:30-3:30 PM

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Join us for discussion following today's webinar!

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➢ http://bit.ly/92018webinar
➢ You must have & be signed into a SERC account to join in the discussion!

Sign-up for SERC account

Sign-up for new post notifications

Join us for discussion following today's webinar!

➢ Discussion forum access:
➢ http://bit.ly/92018webinar
➢ What do you think? What are your experiences?

➢ Please join in the discussion:
  ○ How have you or will you use storylines in your work implementing NGSS?

Upcoming Events & Resources:

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Thank you for participating!

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