Welcome to NSTA Web Seminars!

How the OpenSciEd Instructional Model Supports a Coherent Sequence that Addresses Student Questions and Achieves Specified Outcomes

Presented by: Brian J. Resier, Michael Novak, and Sarah Delaney

May 20, 2020
12:00 pm ET / 11:00 am CT / 10:00 am MT / 9:00 am PT

Today's Presenters

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Director
OpenSciEd
@SarahOpenSciEd

Agenda

- Introducing OpenSciEd
- Coherence from the students' perspective
- The Instructional Model
  - Anchoring Phenomena
  - Navigation & Investigation
  - Putting Pieces Together & Problematizing
- Q&A

Type your questions into the chat window for discussion in the Q&A blocks

Introducing OpenSciEd

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OpenSciEd is an innovative nonprofit organization that brings together

- world-class curriculum developers,
- state science administrators,
- teachers, and
- philanthropic organizations

to develop free, high-quality science instructional materials.

OpenSciEd

OpenSciEd Staff			Advisory Board	State Steering Committee
			The OpenSciEd Advisory Board provides oversight and vision. The Board is made of members from the education, curriculum development, science and policy sectors.	As part of their participation in the OpenSciEd project, the ten partner states have a representative that sits on the State Steering Committee to provide guidance on how the materials can best meet the needs of their students and teachers.
James Ryan Executive Director	Matt Krehbiel Director of Outreach	Sarah Delaney Director of Science		

The Developer's Consortium of World-Class Experts in Science Education

BSCS Science Learning is the lead institution in the OpenSciEd Developers Consortium and is jointly leading the development of the OpenSciEd instructional materials.

The Next Generation Science Storylines Project at Northwestern University is jointly leading the development of the OpenSciEd instructional materials with BSCS.

Boston College is leading the development of professional learning materials and the implementation of field test professional learning.

The Dana Center is leading the field test implementation efforts and is jointly leading the field test data collection and analysis effort with Digital Promise.

Digital Promise is jointly leading the field test data collection and analysis efforts with the Dana Center at the University of Texas.

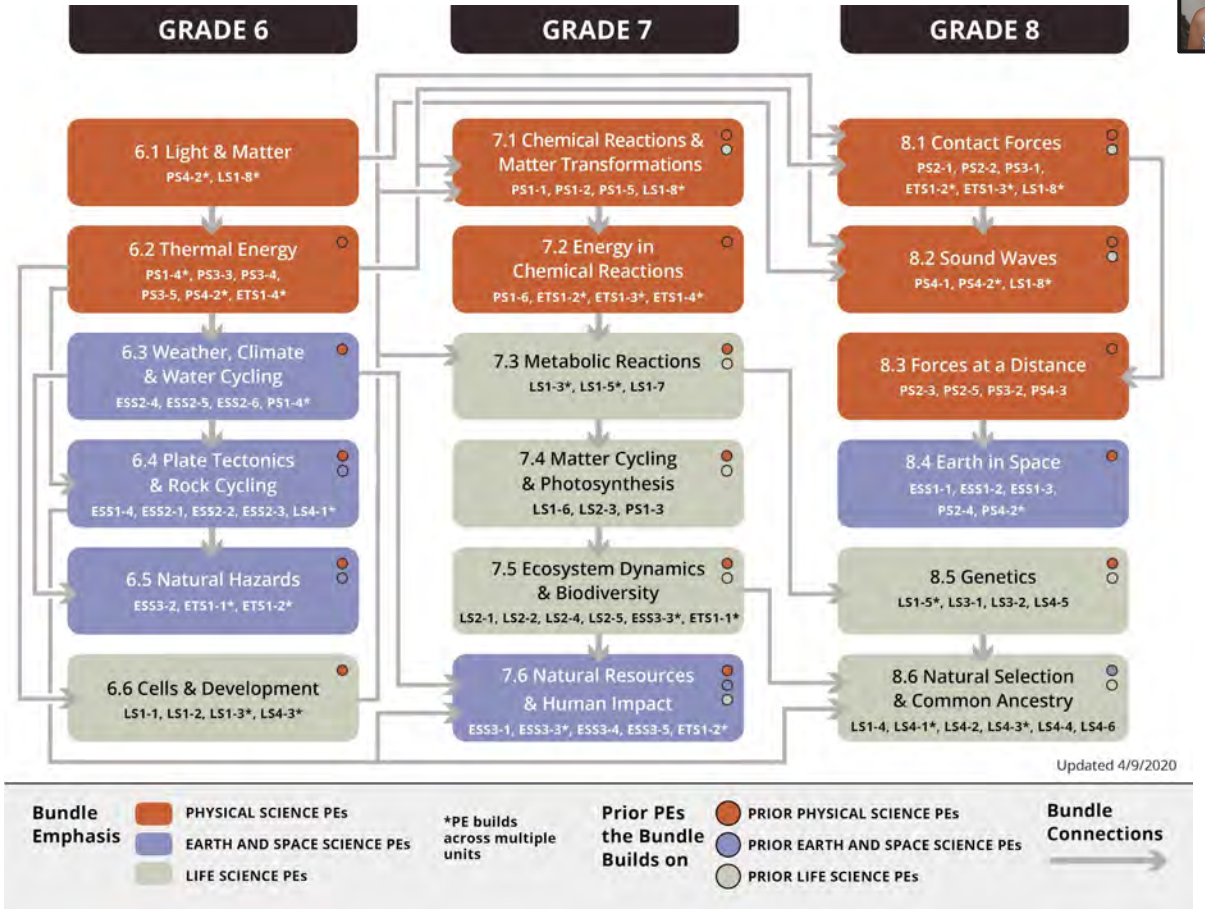
OpenSciEd Teachers & Students

228 field test teachers
and
5800 participating students
in
115 school districts
in
10 states

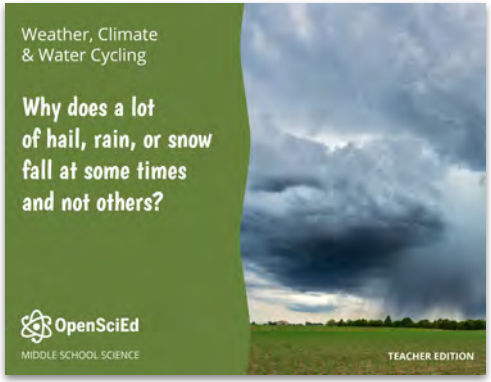
teach the OpenSciEd units and provide feedback.

OpenSciEd is Generously Supported by Four Philanthropic Organizations

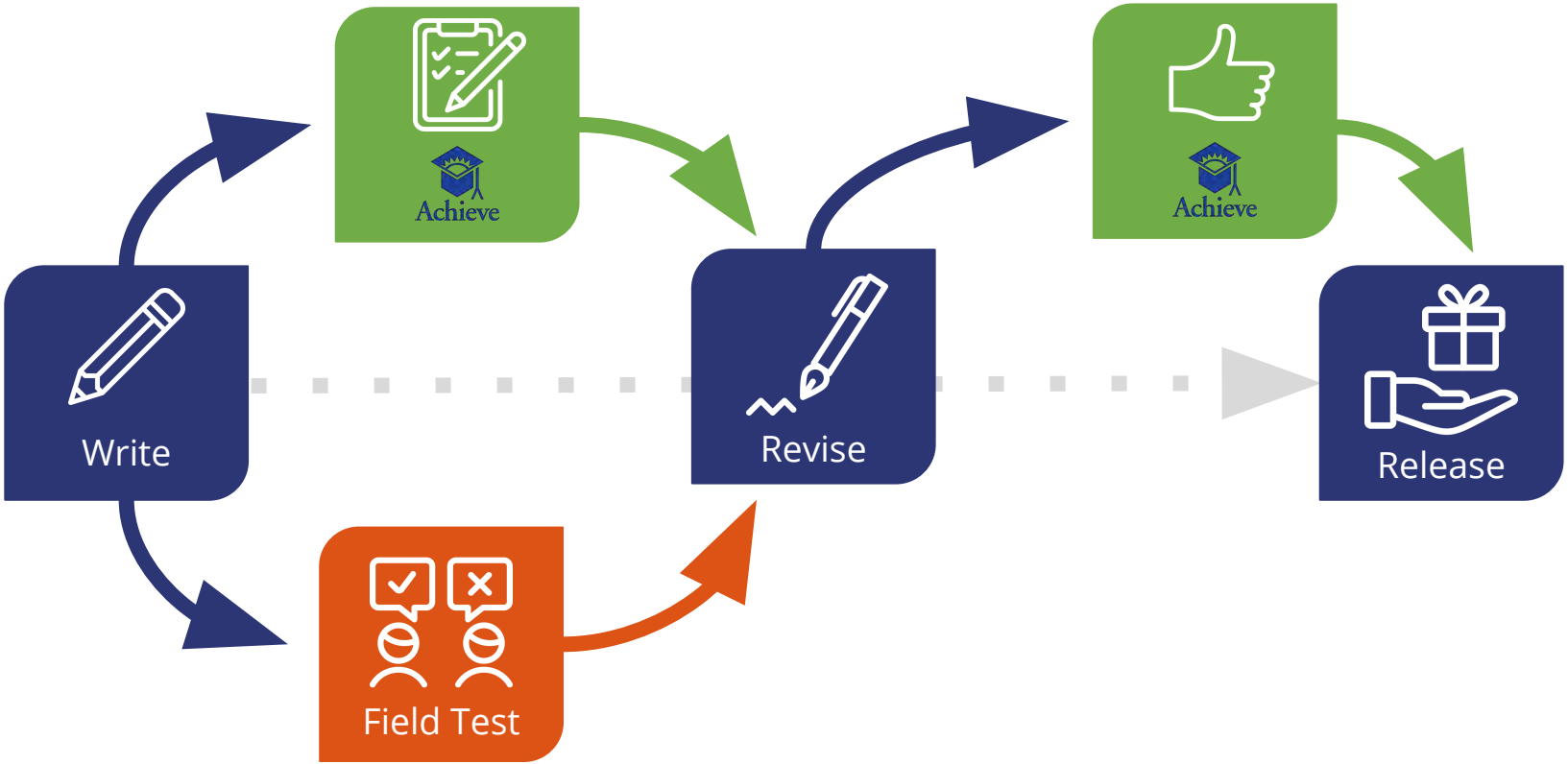
Starting with Middle School and then moving to Elementary & High School



Current Units at OpenSciEd.org



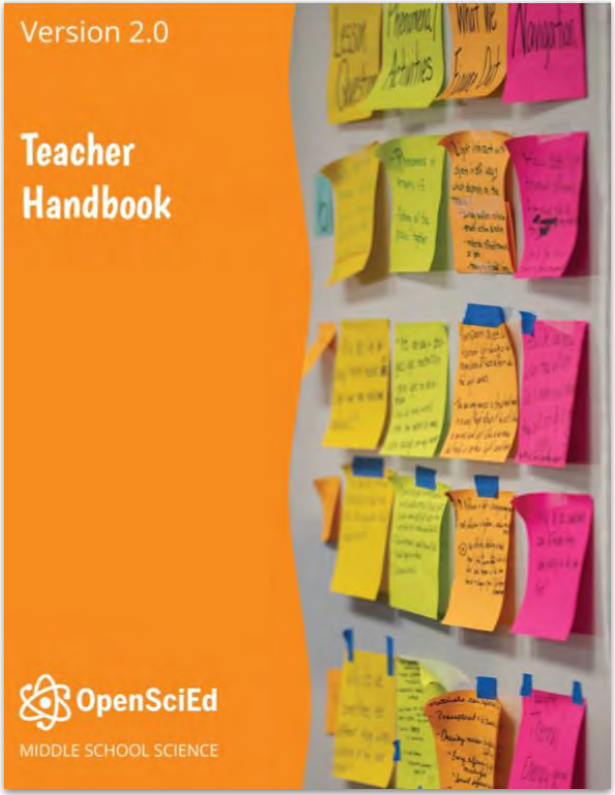
A Nine Month Development Period

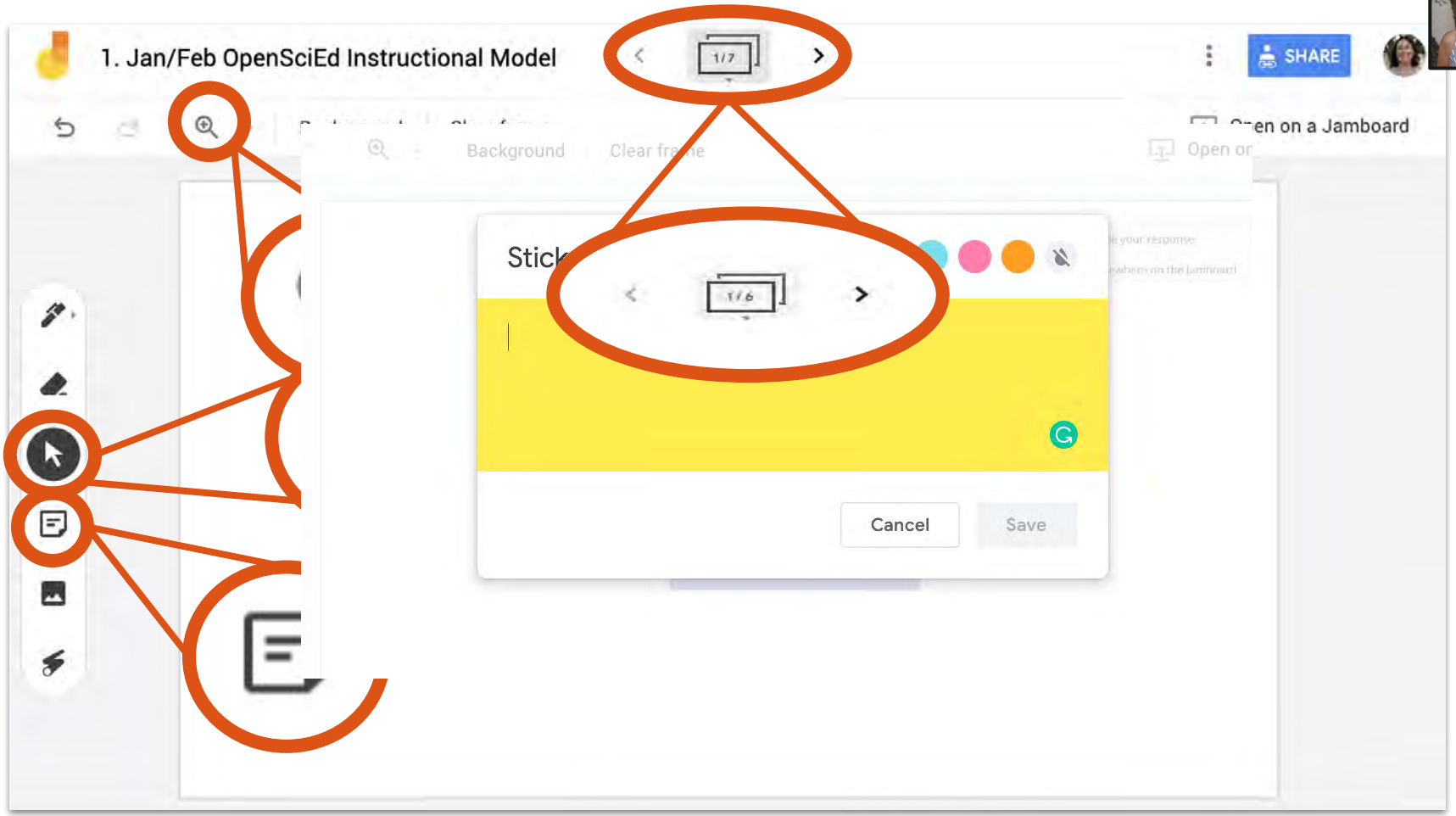


Teacher Handbook

www.openscied.org/resources

- Instructional Model - pg. 20
- Science & Engineering Practices - pg. 22
- Crosscutting Concepts - pg. 24
- Assessment - pg. 25
- Differentiation - pg. 40
- Attending to Equity - pg. 42
- Integrating ELA - pg. 44




1. Jan/Feb OpenSciEd Instructional Model
1/7
SHARE
Background
Clear frame
Open on a Jamboard
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1/6
Cancel
Save

Share on Jamboard

- Why were you interested in attending this webinar?
- Your Name & Role

To add a sticky note:
- Click on the icon and type your response
- Click save
- Move your sticky note somewhere on the Jamboard

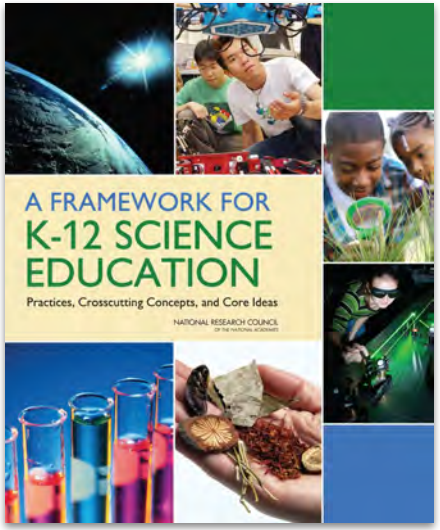
Birth Month	Jamboard Link
Jan & Feb	bit.ly/JanFebJamboard
March & April	bit.ly/MarchAprilJamboard
May & June	bit.ly/MayJuneJamboard
July & Aug	bit.ly/JulyAugJamboard
Sept & Oct	bit.ly/SeptOctJamboard
Nov & Dec	bit.ly/NovDecJamboard

Coherence from the students’ perspective

The Problem

"The framework is motivated in part by a growing national consensus around the **need for greater coherence**. Too often, standards are **long lists of detailed and disconnected facts**, reinforcing the criticism that science curricula in the United States tend to be **'a mile wide and an inch deep'** (Schmidt et al., 1997)."

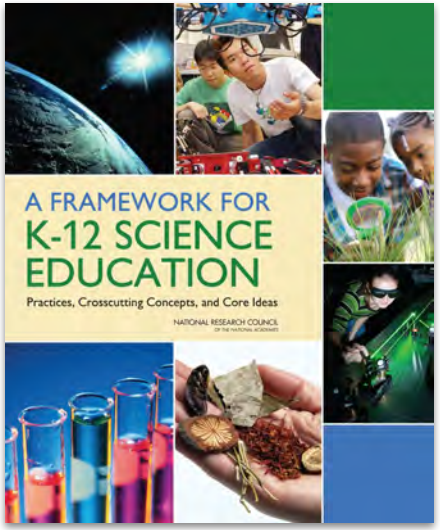
(National Research Council, 2012, p. 10)



Guidelines for the NGSS

Organize standards and curriculum in:

"developmental progression … designed to **help children continually build on and revise their knowledge and abilities**, **starting from their curiosity about what they see around them** and their initial conceptions about how the world works."



Start with Student Questions

Build on Prior Knowledge

Make Connections

How can we support students as partners in the science work?

The Storyline Approach

1. How do we kick off investigations in a unit?
2. How do we work with students to motivate the next steps?
3. How do we help students use practices to build science ideas?
4. How do we help students put science ideas together?
5. How do we push students to go deeper?

Adapted from Reiser, Novak, & McGill (2018)
bit.ly/reiserbose2017

NextGen Science Storylines

Storylines Instructional Model

Question	Routine	Purpose
1. How do we kick off investigations in a unit?	Anchoring Phenomenon Routine	Common experience of phenomenon; develop curiosity; connect to students' lives
2. How do we work with students to motivate the next steps?	Navigation Routine	Motivate next lesson from gaps in what the class figured out so far
3. How do we help students use practices to build science ideas?	Investigation Routine	Students use science and engineering practices to make progress on our questions and problems
4. How do we help students put science ideas together?	Putting Pieces Together Routine	Help students assemble ideas from multiple lessons and apply them to the class' questions
5. How do we push students to go deeper?	Problematizing Routine	Help students uncover limitations and unanswered questions in the explanations, solutions, and models so far

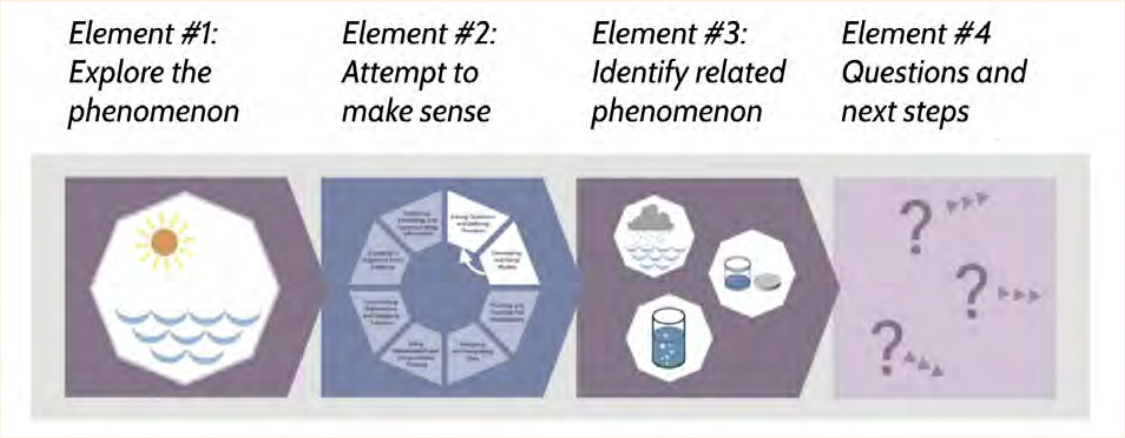
Videos and Artifacts from OpenSciEd Units

Plate Tectonics & Rock Cycling
(in field test)

Metabolic Reactions
(released)

The Anchoring Phenomenon Routine

1. How do we kick off investigations in a unit?	Anchoring Phenomenon Routine	Common experience of phenomenon; develop curiosity; connect to students' lives



Explore the Phenomena

Slide A

Explore an Interesting Phenomenon

Make a chart on a blank page on the **left side** of your science notebook and record what you notice and wonder about.

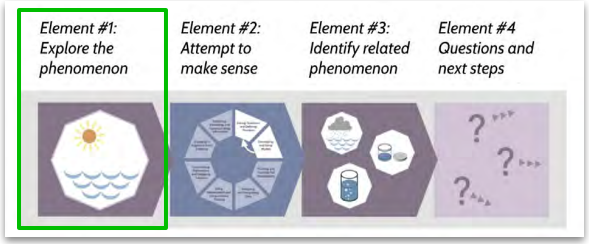
Mt. Everest Phenomena	
Notice	Wonder

Watch these videos closely and record things you notice and wonder about.

- Scary Day on Mt. Everest
- News Report: What Happened on Mt. Everest

INDIVIDUAL ➡ WHOLE GROUP

https://youtu.be/jFvThMDwIZc



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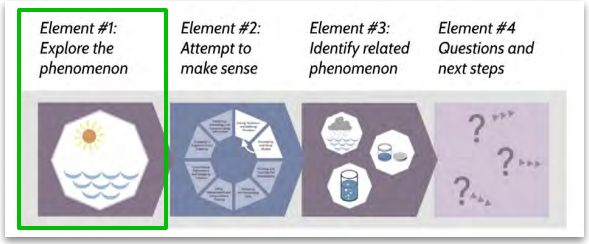

Explore the Phenomena

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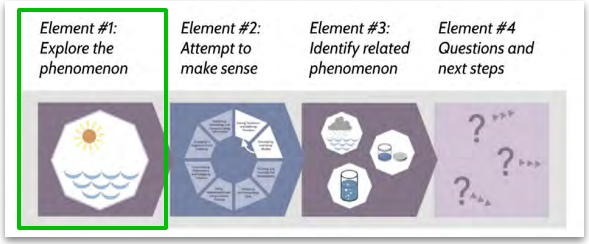

Attempt to make sense of the phenomena

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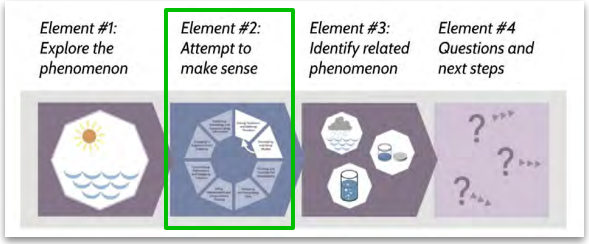

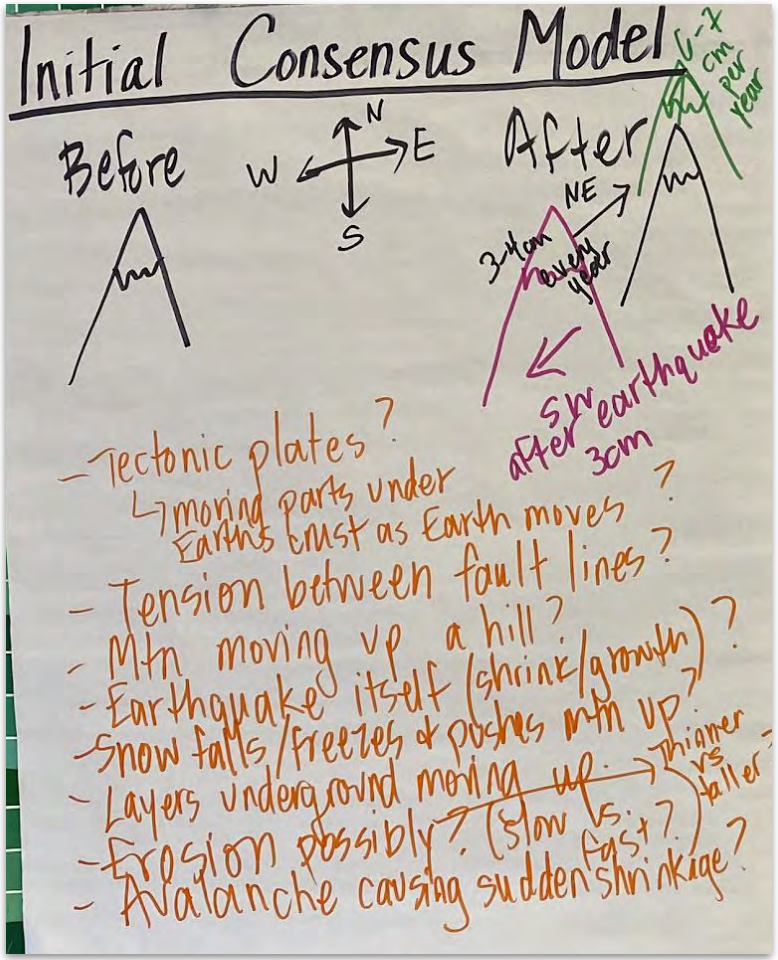

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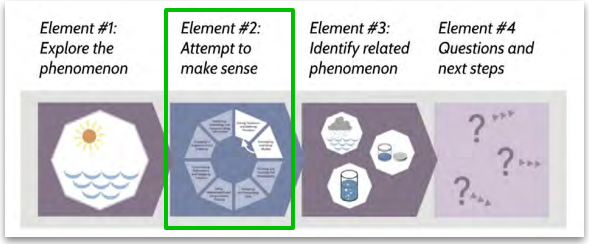


Identify related phenomena

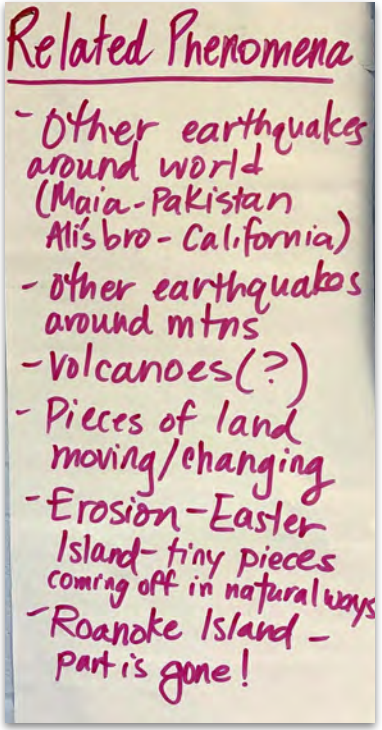
Slide P

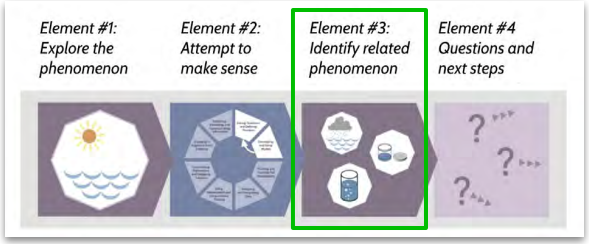
Related Phenomena

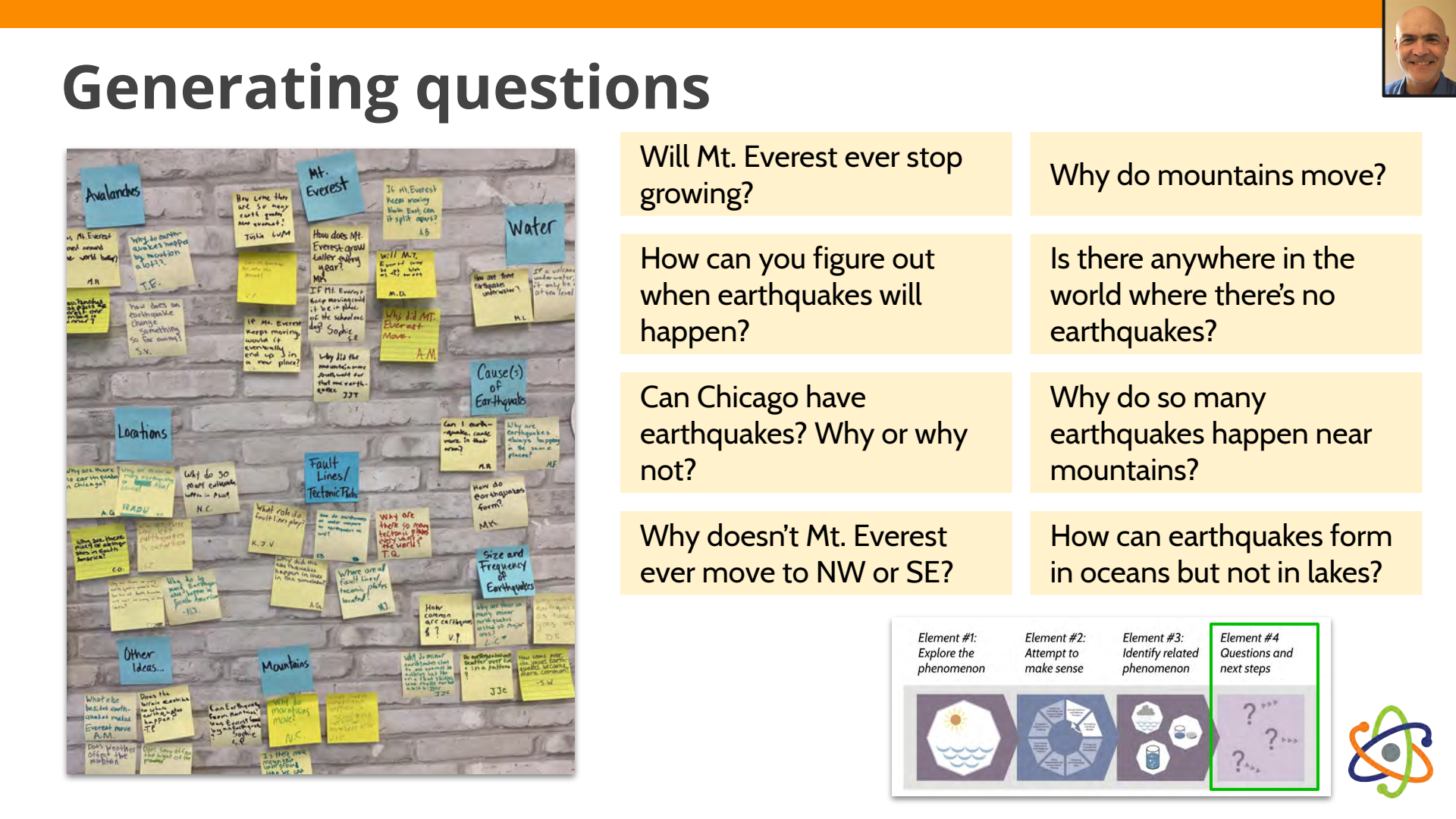
Turn and Talk

- What other experiences might help us explain what happened at Mt. Everest?
- Where else in the world does the land seem to change slowly or suddenly?

→ Be prepared to share these with the whole class.







Generating questions

Will Mt. Everest ever stop growing?	Why do mountains move?
How can you figure out when earthquakes will happen?	Is there anywhere in the world where there's no earthquakes?
Can Chicago have earthquakes? Why or why not?	Why do so many earthquakes happen near mountains?
Why doesn't Mt. Everest ever move to NW or SE?	How can earthquakes form in oceans but not in lakes?

Generating ideas for next steps

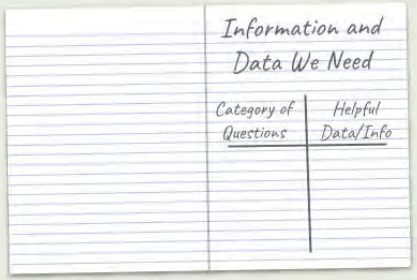
Slide S

Information and Data Needed

What additional sources of data might we need to figure out the answers to our questions? What information do we still need?

Add your ideas to a new notebook page titled:

Information and Data We Need



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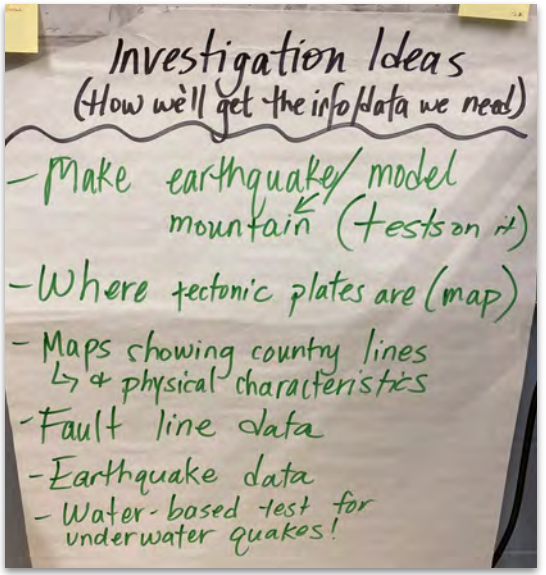
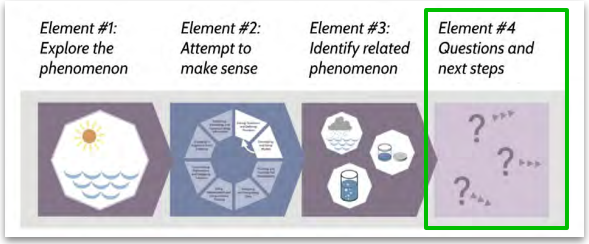
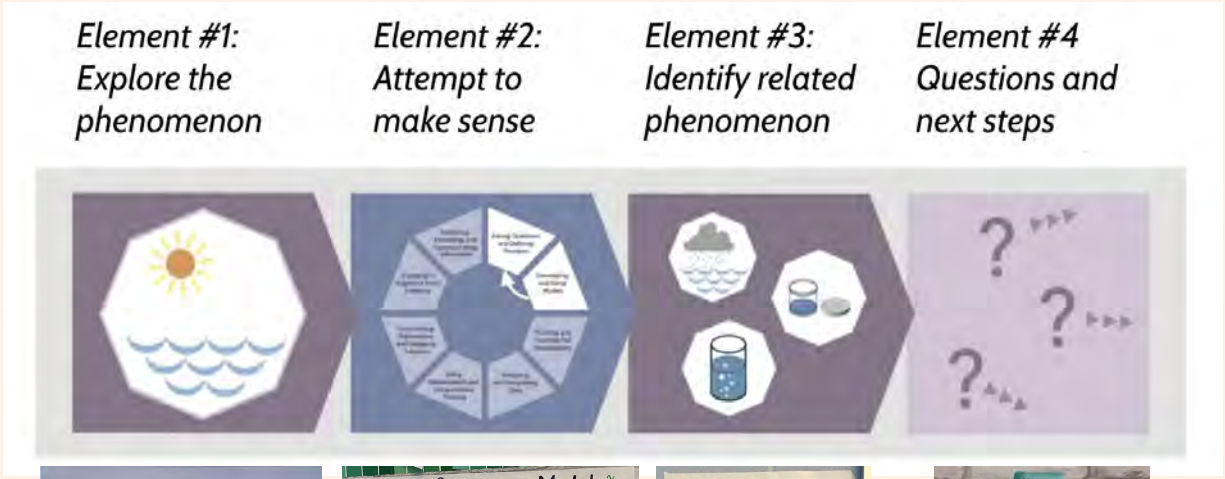
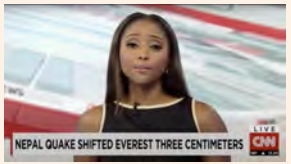
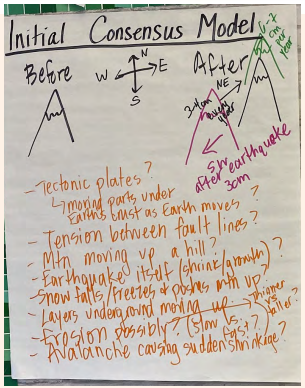


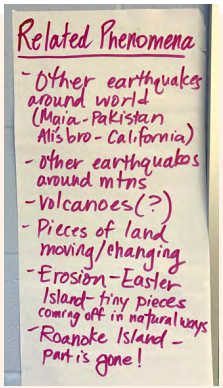


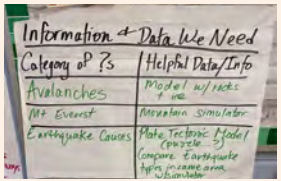
Summary: Anchoring Phenomenon Routine











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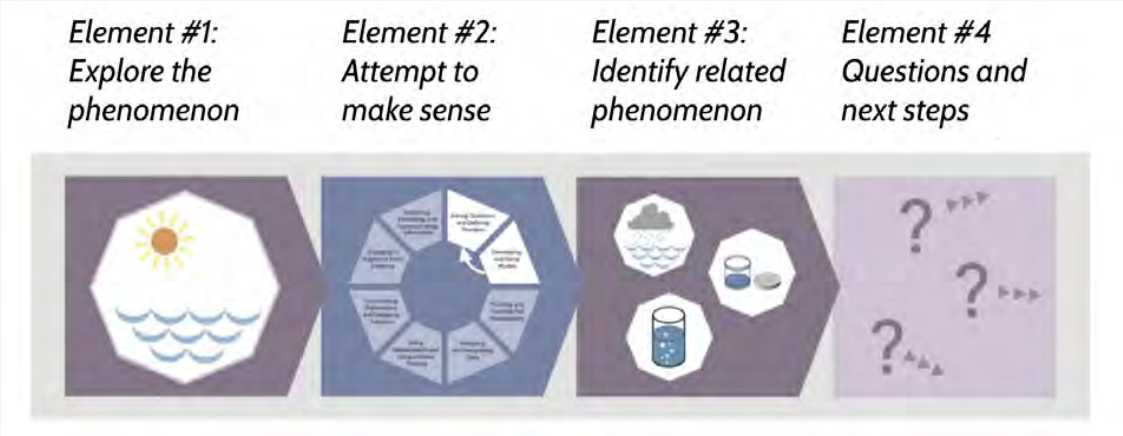


Explore the Phenomenon

Symptoms that started first

- ✓ Nausea
- ✓ Vomiting
- ✓ Abdominal cramps
- ✓ Diarrhea
- ❑ Constipation

Symptoms that started later

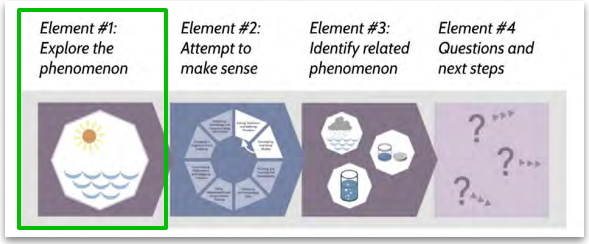
- ❑ Fever
- ✓ Fatigue
- ✓ Weight loss
- ❑ Fainting
- ❑ Weight gain
- ❑ Back pain
- ❑ Leg pain
- ✓ Muscle cramps
- ✓ Rapid heartbeat with exercise
- ❑ Swollen joints
- ❑ Difficulty walking or moving
- ❑ Confusion
- ❑ Dizziness
- ✓ Brain fog or difficulty concentrating
- ❑ Headaches
- ❑ Numbness
- ❑ Slow heartbeat
- ❑ Cold feet or hands
- ❑ Chest pain
- ❑ High blood pressure
- ✓ Difficulty breathing with exercise
- ❑ Difficulty breathing all the time
- ❑ Chest pain
- ❑ Wheezing
- ❑ Asthma

Notes

The patient complains that her stomach hurts after she eats and that she feels nauseated. Her parents say she eats regular meals but has suddenly started losing a lot of weight. The patient says she often has diarrhea and stomach cramping. She has a hard time breathing when she tries to play basketball and gets out of breath quickly. The patient complains of feeling tired and weak all the time.

irl Who Gets Sick

M'Kenna, who has recently started
laints are that her stomach hurts
d stomach cramping.

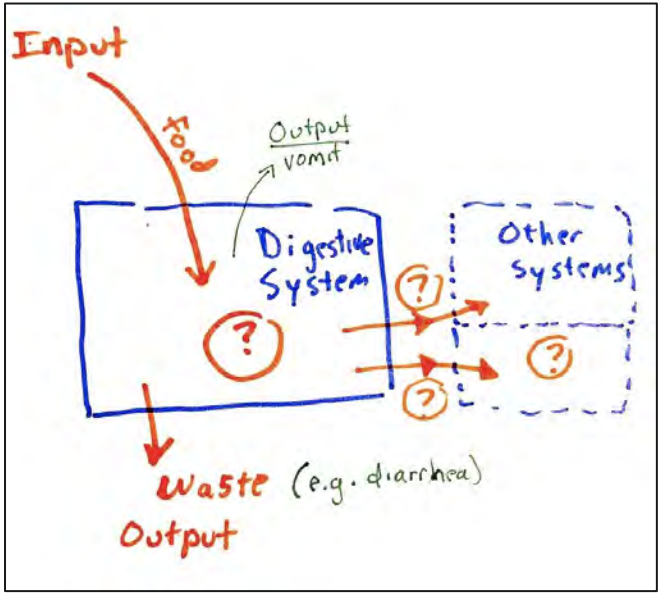


Attempt to make sense of the phenomenon

Developing Initial Models

Develop an initial model. Use *pictures*, *symbols*, and *words* in your model to further explain:

"How can M'Kenna be having symptoms in all of these different parts of her body?"

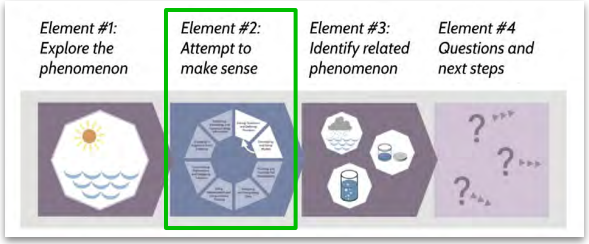


Areas in our model we agree

- Digestive system
- Other systems
- Connections between systems
- "It" moves from one system to another
- We have inputs, outputs in system

Areas in our models we have differences

- what causes all her symptoms
- components of the digestive system
- what are the inputs and outputs in her system
  - ie. food
    - nutrients
    - bacteria
    - energy



Identify related phenomena

Slide I

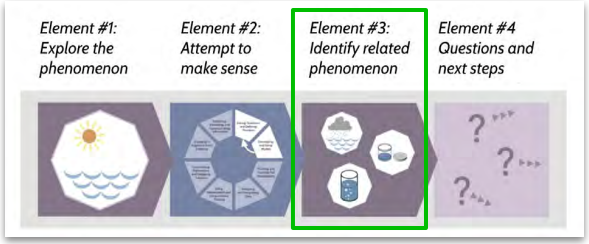
Sharing Related Phenomena

Stop and Jot then Turn and Talk

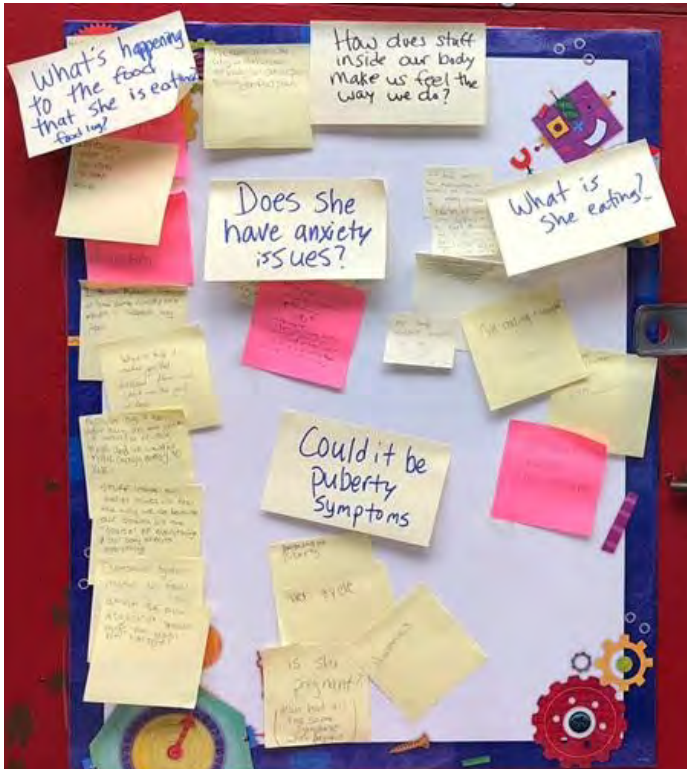
1. When have you or someone you know experienced more than one of these symptoms happening at the same time like M'Kenna?

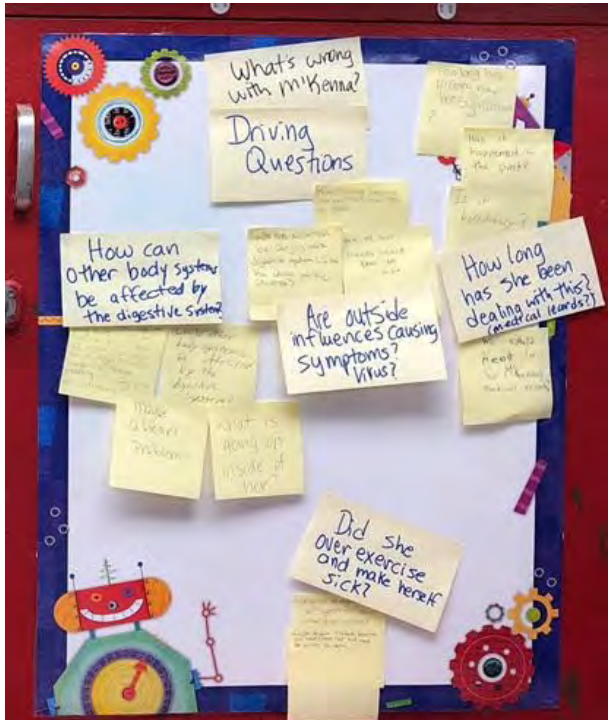
2. If you knew the cause of the symptoms, was the cause occuring in the same body part as the symptom or a different part of the body?
   For example, I had a headache and started to get tired, but what was actually causing it was that I didn't drink enough water (not actually something going on with my head).

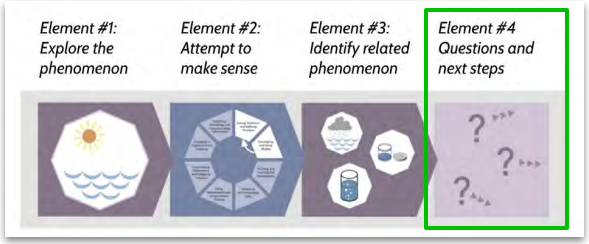
→ Be ready to share these ideas with the whole class.



Generating questions







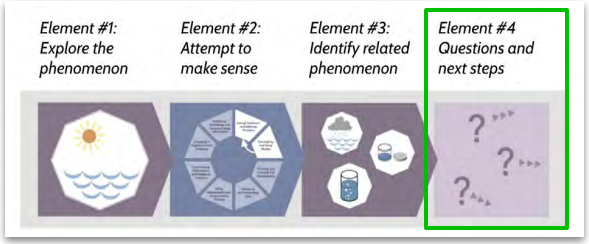
Generating Ideas for Investigations

Ideas for Investigations

What investigations could we do to help us figure out what is going on inside M'Kenna and to help us answer our DQB questions?

Possible Future Investigations

- Eat foods + see what they do
- Test to see what is in food
- Mash up food + put stomach acid on it
- Camera inside of M'Kenna
- Research what the digestive system is



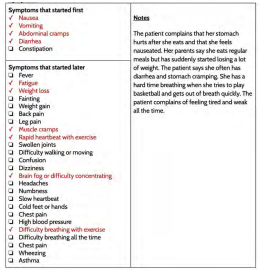
Summary: Anchoring Phenomenon Routine

Element #1: Explore the phenomenon

Element #2: Attempt to make sense

Element #3: Identify related phenomenon

Element #4 Questions and next steps



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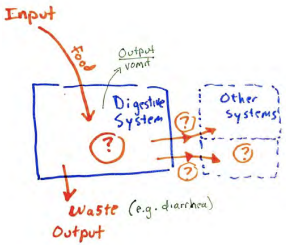
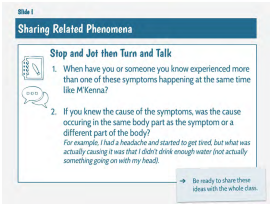




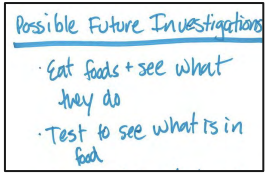
Slide 1

Sharing Related Phenomena

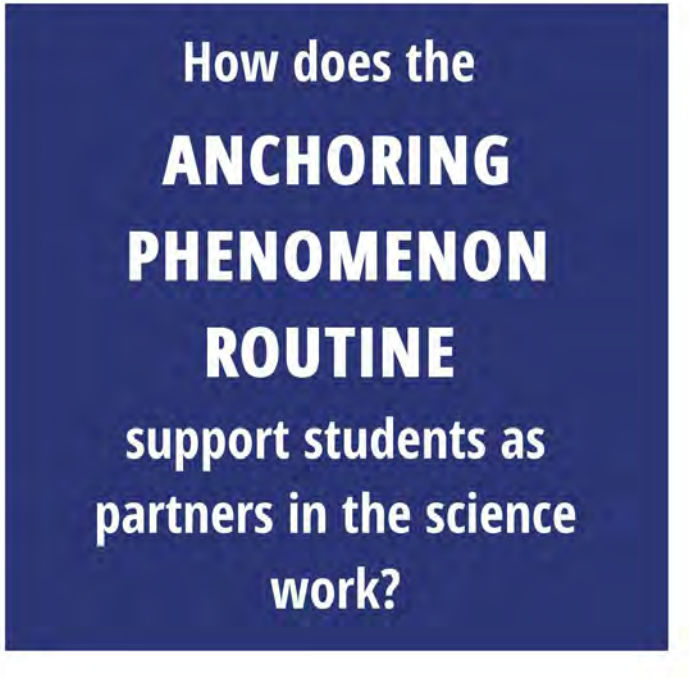
Stop and Jot then Turn and Talk

1. When have you or someone you know experienced more than one of these symptoms happening at the same time like M'Kenna?
2. If you knew the cause of the symptoms, was the cause occuring in the same body part as the symptom or a different part of the body?
   For example, I had a headache and started to get tired, but what was actually causing it was that I didn't drink enough water (not actually something going on with my head).

→ Be ready to share these ideas with the whole class.



1. How do we kick off investigations in a unit?



Birth Month	Jamboard Link *On Jamboard, Go to Frame 2*
Jan & Feb	bit.ly/JanFebJamboard
March & April	bit.ly/MarchAprilJamboard
May & June	bit.ly/MayJuneJamboard
July & Aug	bit.ly/JulyAugJamboard
Sept & Oct	bit.ly/SeptOctJamboard
Nov & Dec	bit.ly/NovDecJamboard

The Navigation & Investigation Routines

Question	Routine	Purpose
1. How do we kick off investigations in a unit?	Anchoring Phenomenon Routine	Common experience of phenomenon; develop curiosity; connect to students' lives
2. How do we work with students to motivate the next steps?	Navigation Routine	Motivate next lesson from gaps in what the class figured out so far
3. How do we help students use practices to build science ideas?	Investigation Routine	Students use science and engineering practices to make progress on our questions and problems

What happened in the previous lessons

- We figured out that burning food is a chemical reaction resulting in new products.
- We figured out that fuel and oxygen react when they burn to release energy, carbon dioxide gas, and water vapor.

This lesson: Navigation Routine

Navigation

Discuss with a partner:

- What did we figure out last class?
- What questions did this raise for us?

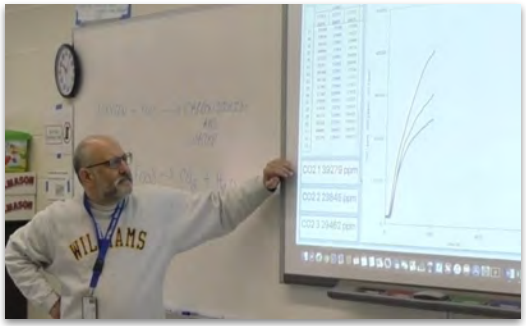
https://youtu.be/mLUfjeyLM1Q

This lesson: Investigation Routine

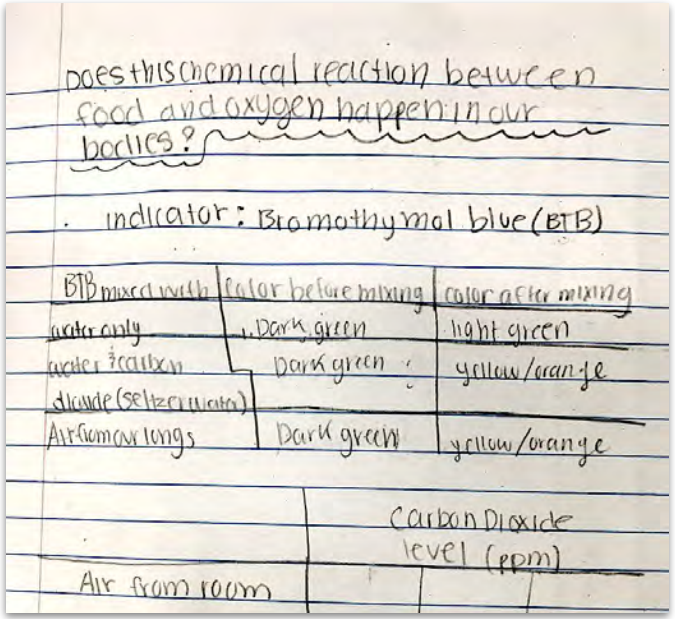
Is there carbon dioxide in the air coming out of our lungs?

Investigation #1: Bromothymol blue

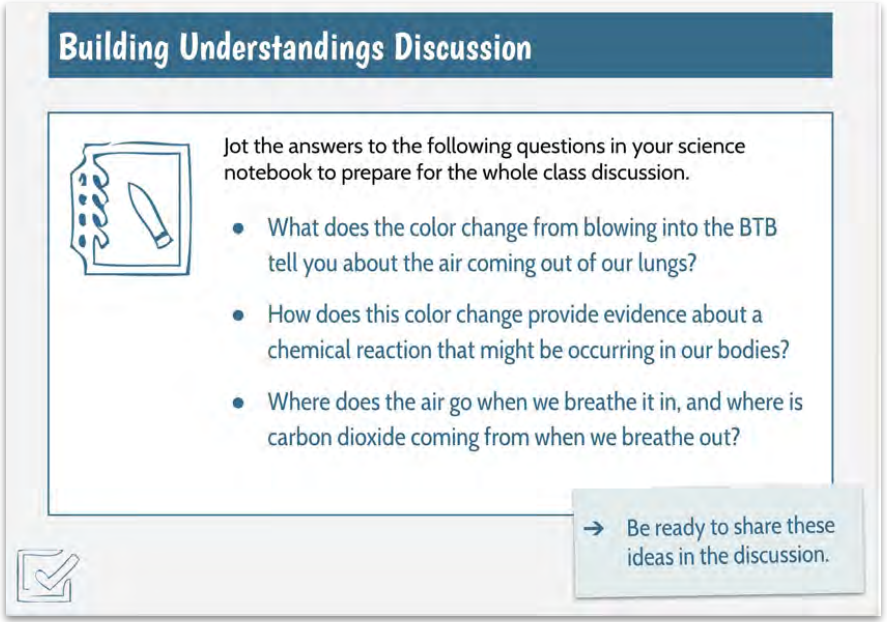
Investigation #2: Carbon Dioxide Sensors



This lesson: Investigation Routine



Sample student data from the two investigations



Small group sensemaking to prepare for whole-class discussion

This lesson: Investigation Routine

Jot the answers to the following questions in your science notebook to prepare for the whole class discussion.

- What does the color change from blowing into the BTB tell you about the air coming out of our lungs?
- How does this color change provide evidence about a chemical reaction that might be occurring in our bodies?
- Where does the air go when we breathe it in, and where is carbon dioxide coming from when we breathe out?

Storylines Instructional Model

Question	Routine	Purpose
1. How do we kick off investigations in a unit?	Anchoring Phenomenon Routine	Common experience of phenomenon; develop curiosity; connect to students' lives
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The Putting Pieces Together Routine

Question	Routine	Purpose
1. How do we kick off investigations in a unit?	Anchoring Phenomenon Routine	Common experience of phenomenon; develop curiosity; connect to students' lives
2. How do we work with students to motivate the next steps?	Navigation Routine	Motivate next lesson from gaps in what the class figured out so far
3. How do we help students use practices to build science ideas?	Investigation Routine	Students use science and engineering practices to make progress on our questions and problems
4. How do we help students put science ideas together?	Putting Pieces Together Routine	Help students assemble ideas from multiple lessons and apply them to the class' questions

Putting Pieces Together: Taking Stock

Slide A

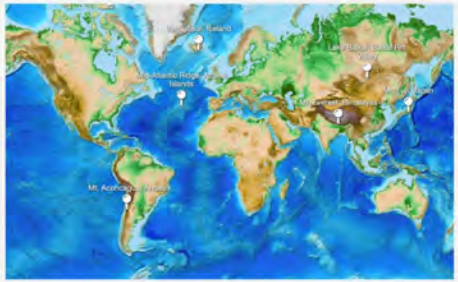
Taking Stock: What have we been up to?

Whole group

What patterns did we notice with where Earthquakes happen?

What did we find out about how plates move?

What did we learn that causes plate movement?



From Lesson 2 through Lesson 7

Putting Pieces Together: Modeling

Slide D

Develop a Model: Plate movement and Mt. Everest

Develop a model to show your thinking:

- How does plate movement explain movement at Mt. Everest?

Three types of movement:

- ❑ getting taller
- ❑ moving to the northeast each year
- ❑ moving backward during the earthquake

Gotta-Have-It Checklist

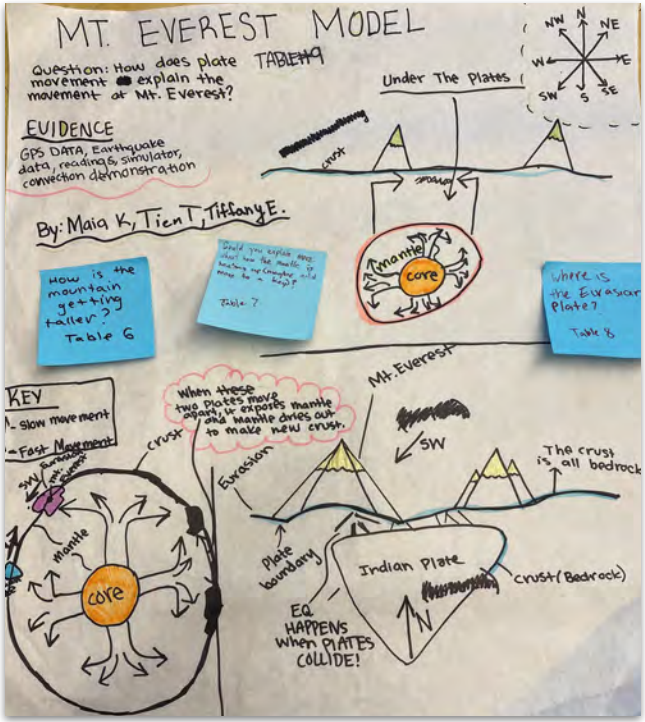
Mt. Everest Model

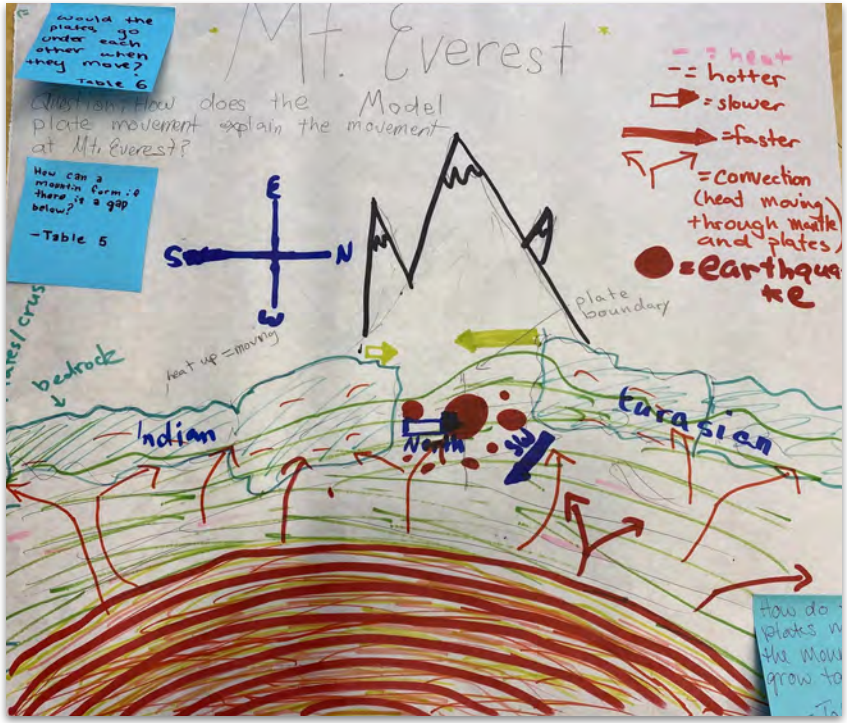
question | evidence

What we figured out in words/pictures

Include words, pictures, and anything else to capture your thinking.

Putting Pieces Together: Group models





Applying Our Model to A Different Phenomenon

Slide 1

Revise your Gotta-Have-It Checklist

Our question: How does plate movement explain what we observed in locations where plates spread apart?

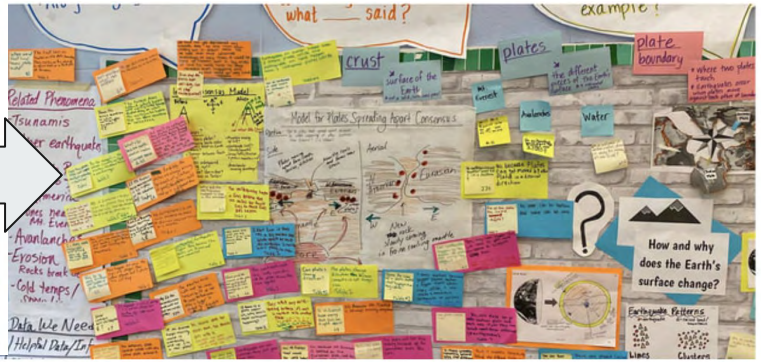
Use a different colored pencil.
Place a checkmark (✓) by ideas you still need.
Write down new ideas that you didn't need before, but you need now.

Iceland

Lake Baikal, Baikal Rift Valley

Mid-Atlantic Ridge

Revisiting Our Driving Question Board



Question	Routine	Purpose
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3. How do we help students use practices to build science ideas?	Investigation Routine	Students use science and engineering practices to make progress on our questions and problems
4. How do we help students put science ideas together?	Putting Pieces Together Routine	Help students assemble ideas from multiple lessons and apply them to the class' questions

Taking Stock

Slide B

What Can We Explain Now?

Look at the initial model that you developed to explain M'Kenna's symptoms. Then think about the investigations that we have done and what we have figured out.

Review all of the models that you developed in your Progress Tracker. If we think of the models from our Progress Trackers as smaller pieces of a larger model, our goal now is to compile the pieces into a larger model to answer :

What have we figured out so far?

- Individually, compile all of the models from your Progress Tracker into one model.
- Don't worry about depicting anything about the organs in the digestive system at this point. ***Just focus on the breakdown and absorption of large food molecules.***

→ Record questions that come to mind as you are reviewing your model.

Putting Pieces Together

Slide D

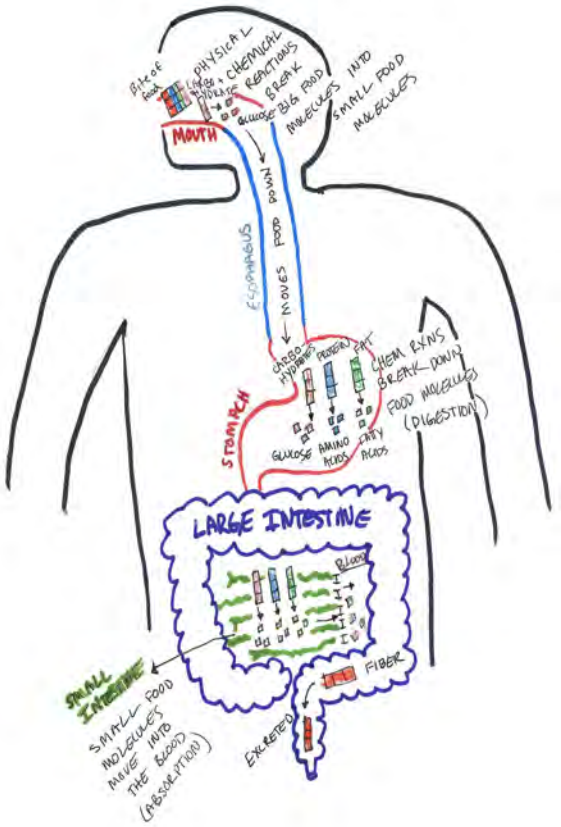
Develop Models in Small Groups

Develop a model to explain, "How does a healthy digestive system work?" Use your Gotta-Have-It Checklist to help you. Check off ideas on your list that you used or did not use to develop your model.

Use *pictures*, *symbols*, and *words* in your model to help represent and further explain the following:

- What are the different structures in the digestive system? How do the functions of each structure distinguish it from other structures in the digestive system?
- What happens to food when it enters the digestive system? What kinds of food molecules are broken down? Where are they broken down?
- What kinds of food molecules are absorbed? Where are they absorbed? What kinds of food molecules are excreted?

→ Record questions that come to mind as you are constructing your model.



The Problematizing Routine

Question	Routine	Purpose
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3. How do we help students use practices to build science ideas?	Investigation Routine	Students use science and engineering practic our questions and problems
4. How do we help students put science ideas together?	Putting Pieces Together Routine	Help students assemble ideas from multiple them to the class' questions
5. How do we push students to go deeper?	Problematizing Routine	Help students uncover limitations and unanswered questions in the explanations, solutions, and models so far

Foreground a new question or phenomenon

Slide E

Problematize M'Kenna's Symptoms in Other Systems

Look at your *Lesson 9 - Symptoms and Systems* handout.

- What do we notice about M'Kenna's other symptoms and systems?
- What else are we wondering about?
- How could something so small in one subsystem (the digestive system) have that much impact on other parts of the body?

Symptoms

Symptoms that started first	Notes
✓ Nausea ✓ Vomiting ✓ Abdominal cramps ✓ Diarrhea ❑ Constipation	The patient complains that her stomach hurts after she eats and that she feels nauseated. Her parents say she eats regular meals but has suddenly started losing a lot of weight. The patient says she often has diarrhea and stomach cramping. She has a hard time breathing when she tries to play basketball and gets out of breath quickly. The patient complains of feeling tired and weak all the time.
Symptoms that started later	
❑ Fever ✓ Fatigue ✓ Weight loss ❑ Fainting ❑ Weight gain ❑ Back pain ❑ Leg pain ✓ Muscle cramps ✓ Rapid heartbeat with exercise ❑ Swollen joints ❑ Difficulty walking or moving ❑ Confusion ❑ Dizziness ✓ Brain fog or difficulty concentrating ❑ Headaches ❑ Numbness ❑ Slow heartbeat ❑ Cold feet or hands ❑ Chest pain ❑ High blood pressure ✓ Difficulty breathing with exercise ❑ Difficulty breathing all the time ❑ Chest pain ❑ Wheezing ❑ Asthma	

Argue for competing ideas

Slide D

Revisit M'Kenna's Doctor's Note

With a partner, look back at our symptoms/systems mapping and think about which symptoms are connected to what we have figured out and which ones we still can't explain. Record your thinking on your Lesson 9 handout.

- Part 1: Which of M'Kenna's symptoms could be connected to what we've figured out?
- Part 2: Which of M'Kenna's symptoms have we not found a connection to yet?

→ Be prepared to share out your ideas with the class.

Determine a way to resolve this question

Slide B

Navigation: M'Kenna's other symptoms

Turn and Talk

What are your initial ideas about why M'Kenna is losing so much weight?

What sort of data could help us investigate this question?

Patient's Name: M'Kenna Age: 13

Symptoms

Symptoms that started first

- ✓ Nausea
- ✓ Vomiting
- ✓ Abdominal cramps
- ✓ Diarrhea
- ❑ Constipation

Symptoms that started later

- ❑ Fever
- ✓ Fatigue
- ✓ Weight loss
- ❑ Fainting
- ❑ Weight gain
- ❑ Back pain
- ❑ Leg pain
- ✓ Muscle cramps
- ✓ Rapid heartbeat with exercise
- ❑ Swollen joints
- ❑ Difficulty walking or moving
- ❑ Confusion
- ❑ Dizziness
- ✓ Brain fog or difficulty concentrating
- ❑ Headaches
- ❑ Numbness
- ❑ Slow heartbeat
- ❑ Cold feet or hands
- ❑ Chest pain
- ❑ High blood pressure
- ✓ Difficulty breathing with exercise
- ❑ Difficulty breathing all the time
- ❑ Chest pain
- ❑ Wheezing
- ❑ Asthma

Notes

The patient complains that her stomach hurts after she eats and that she feels nauseated. Her parents say she eats regular meals but has suddenly started losing a lot of weight. The patient says she often has diarrhea and stomach cramping. She has a hard time breathing when she tries to play basketball and gets out of breath quickly. The patient complains of feeling tired and weak all the time.

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Question	Routine	Purpose
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How do storyline routines support students as partners in science work?

Question	Routine
1. How do we kick off investigations in a unit?	Anchoring Phenomenon
2. How do we work with students to motivate the next steps?	Navigation
3. How do we help students use practices to build science ideas?	Investigation
4. How do we help students put science ideas together?	Putting Pieces Together
5. How do we push students to go deeper?	Problematizing

Birth Month	*Jamboard: Go to Frames 3-6 and pick the routine that stands out to you.*
Jan & Feb	bit.ly/JanFebJamboard
March & April	bit.ly/MarchAprilJamboard
May & June	bit.ly/MayJuneJamboard
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Sept & Oct	bit.ly/SeptOctJamboard
Nov & Dec	bit.ly/NovDecJamboard

“But like in this, we were the ones who came up with it. So we were able to understand… We had similar ideas or different ideas. So we were able to come up with this one model that we could ALL understand. Because WE came up with it.”

OpenSciEd Middle School Student

“I’m really excited for this unit because I feel like last time we had a whole bunch of crazy ideas, and then at the end we pretty much made all of them happen. So I am excited to see what we do for this unit.”

OpenSciEd Middle School Student

Q&A

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Thanks to Today's Presenters

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Program's Collection

This program's collection includes the slides (as PDF) and reference materials.

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Thanks to the NSTA Web Seminars Team

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