Welcome!

Making Sense of Three-Dimensional Teaching and Learning-Grade 8 Unit 1

Day 1

July 23-24, 2024
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<th>Welcome! Goals for Students in Science/STEM What is Sensemaking?</th>
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<td>Segment 2</td>
<td>8:45-11:30</td>
<td>Experience Sensemaking In Unit 1 Lesson 1; Reflect on Experiences</td>
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<td>15 Min Break</td>
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<td>Segment 3</td>
<td>11:30-12:00</td>
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<td>Closing</td>
<td>2:40-3:00</td>
<td>Update Sensemaking Posters; Gots and Needs; CMS Survey</td>
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Today’s Presenter

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Learning Goals

● Build an understanding of what three-dimensional teaching and learning looks like, feels like, and sounds like in the classroom.

● Be able to foster a community of evidence-based thinkers and position students as the “knowers” in the classroom.

● Gain strategies to leverage students’ assets (experiences, prior learning, curiosity, etc.) to learn science.

● Experience as learners and learn how to teach Grade 8 Unit 1.
Housekeeping

- This will be an interactive, action/thinking-packed two days. Please engage as an active participant to maximize your own and other’s experiences.
- Please tell me how I can support you along the way. There is a parking lot for questions and requests.
- Lunch is 1 Hour - from 12-1 ish
- There will be an AM Break.
- Take care of your own needs along the way.
Meet Our Learning Community

**Alone Zone** (independent thinking time)

❖ Why do you think it is important for all students to learn science?

❖ What are your goals for your students in science?
Meet Our Learning Community

**Alone Zone** (independent thinking time)
- Why do you think it is important for all students to learn science?
- What are your goals for your students in science?

**Small Group**
- Share your thinking with your group.
- What is your group’s top science goal for students in your school district?
Sensemaking
A Framework for K-12 Science Education

The framework is designed to help realize a vision for education in the sciences and engineering in which students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields.

The learning experiences provided for students should engage students with their own fundamental questions about the world and with how scientists have investigated and found answers to those questions.
Meet Ms. Katsanos’ Third-Graders

Students experienced the phenomenon of kidney beans germinating. (The beans look like kidney beans one day and then a few days later some kidney beans look like plants.)

Students have completed an investigation in which kidney beans with water and kidney beans without water were placed in sunny places and dark places.
Elementary Students Sensemaking

Students complete two tasks in this classroom video

Task 1. **Reach a consensus** [using patterns in data] on what it means for a seed to *germinate* (0:24-3:25)

Task 2. **Make a claim** in answer to the question about the phenomenon, “What do kidney beans need to successfully *germinate*?” (3:40-6:25)
Elementary Students Sensemaking

Alone Zone

1. What are the students doing?

2. What is the teacher doing?

3. Based on what you observed, what is sensemaking?

https://www.teachingchannel.org/video/lesson-claims-evidence-reasoning
Elementary Students Sensemaking

Small Group

1. What are the students doing?

2. What is the teacher doing?

3. Based on what you observed, what is *sensemaking*?

https://www.teachingchannel.org/video/lesson-claims-evidence-reasoning
High school biology students explore the question, “Can nature change populations?”

Task 1: Use a simulation to identify cause-and-effect relationships between an organism’s ability to avoid prey and changes in that organism’s population over time.

Task 2: Construct an explanation(s) using science ideas and cause-and-effect relationships to help answer the question about what causes population change. (2:53-7:11)
High School Students Sensemaking

Alone Zone

1. What are the students doing?
2. What is the teacher doing?
3. Based on what you observed, what is sensemaking?

Video not available to the public
What is Sensemaking?

Small Group

• Discuss with your group members:
  o What were the students doing?
  o What was the teacher doing?

  Cite specific examples from the classroom video.

• As a group, define sensemaking.
Supports for Sensemaking

Small Group Discussion:

Together, identify your agreed upon:

- **top 5 supports that a student needs** to engage in a sensemaking lesson,
- and, **top 5 supports that teachers need** to engage students in a sensemaking lesson.

Record these on your poster.
Supports for Sensemaking

Small Group Discussion:
Think of classes you have had (as a student or a teacher) that you have enjoyed being in.

● Can you identify **5 things** that made that classroom enjoyable or comfortable/safe?
● How do these overlap with the necessary supports for sensemaking?
Supports for Sensemaking

Small Group Discussion:

Think of classes you have had (as a student or a teacher) that you have enjoyed being in.

- Can you identify **5 things** that made that classroom enjoyable or comfortable/safe?
- How do these overlap with the necessary supports for sensemaking?

On your poster, identify supports for sensemaking that are essential for making students feel comfortable/safe.
Supports for Sensemaking

Science is a social endeavor! Your classroom is a community of learners in which students and teachers actively try to make sense of the natural and built worlds.

- We figure out the science ideas.
- We figure out where we are going at each step.
- We figure out how to put the ideas together over time.

Source: Next Generation Science Storylines
Co-Constructing Norms for Equitable Sensemaking

Small Group

Consider the **GOAL**: Our classroom environment needs to be safe/comfortable for students to engage in sensemaking.

- How do we (students and teachers) achieve these goals together (**norms**)? *Think: words and actions - What do we do?*
- Develop 1-2 classroom norms with your group.

Be ready to share how the norms your group created support this community with figuring things out.
Lesson Immersion
Anchor
Phenomenon
Student Hat/Teacher “Hat”

Student Hat: Think like a student.

Student/Teacher Hat: Think like a student, but note teacher guidance.

Teacher “Hat”: Reflect on student experience and educator moves.
Lesson 1

Intro to Chemistry
Have you heard of bath bombs before? What is your experience with bath bombs?

What do you predict will happen when the bath bomb from the store is placed in a bowl of water?
**I Notice...**
- Observations
- Don’t interpret

**I wonder...**
- What are you curious about?
- What are you wondering?

Use the table to record what you notice and wonder about the store-bought bath bomb, **before we add it to water.**
## Notice & Wonder

<table>
<thead>
<tr>
<th>I Notice…</th>
<th>I wonder…</th>
</tr>
</thead>
</table>

- What are some things you see happening to the water?
- What kinds of observations do you hear?
- Do you notice any odors?
- If you feel the liquid what do you observe?
- What happens to the bath bomb?

Use the table to record what you notice and wonder about the store-bought bath bomb, **during and after we add it to water**.
Turn & Talk Protocol

Look at your partner

Listen to your partner

Be ready to Speak when it’s your turn (at an appropriate voice level)
Share with a partner what you NOTICE and what you WONDERED.
Essential Question

What happens when a bath bomb is added to water (and what causes it to happen)?
Show what you saw happened to the solid bath bomb and where the gas bubbles appeared in the system.
Create a Model

Label the following locations in your diagram with the corresponding letter:

A. A spot in the bath bomb before adding it to the water.
B. A spot in the water right before adding the bath bomb to it.
C. A spot in the liquid remaining in the cup a few minutes after adding the bath bomb to the water.
1. What happened to the solid bath bomb?

2. What do you think caused the gas bubbles to appear?

3. What do you think caused the other changes you observed?
Before putting these together

A: A tiny sample of the bath bomb

B: A tiny sample of the water

A couple seconds after adding the bath bomb to water

C: A tiny sample of the liquid left over after a couple of minutes

As gas bubbles appear

D: A tiny sample of the gas in a bubble

Key:
Please return at 11:00
Small-Group Discussion Protocol

- Give each group member an opportunity to share their model and explanation with the group.
- When it is your turn, turn your model around so that it faces others in your group.
- As your group notices things about each diagram, record the following in pencil (lightly):
  - Place a ✓ by parts of your model or explanations that are similar to those shown on other diagrams from the group.
  - Place a ? by parts of your model or explanations that are different or where your group is less certain.
Norms are something that we all agree to try and work on so that we have a productive and respectful learning environment.
With your **small group**, share ideas for norms that you think are essential for us all to meet these goals.

**Be prepared to share with the whole class.**
Choose a Focal Norm

Look at our class norms. Which of the norms do you think might be particularly challenging to follow if we are out of practice? Which do we need to intentionally work on to get good at?

- Choose one norm from the sheet that you personally will work on for the rest of class.

- Share the norm you decided to work on with a partner, and tell them why it is important for you.
Raise your hand and wait to be called on.

Look at the person that is speaking.

Listen to everyone’s ideas.

Speak loudly and clearly.
Let’s develop a whole-group record of what we agree on and where we have competing ideas across the initial models and explanations.

- What do we all seem to agree on?
- What do we disagree on?
- What are some new ideas we might want to consider?
Before putting these together

A: A tiny sample of the bath bomb

B: A tiny sample of the water

A couple seconds after adding the bath bomb to water

Key:

C: A tiny sample of the liquid left over after a couple of minutes

As gas bubbles appear

D: A tiny sample of the gas in a bubble
Add a “Related Phenomena” title to your science notebook and record:

- What experience have you had with other phenomena (events that we can’t explain but know that it happens) that reminds you of what you saw happen with the bath bombs?

Whole Class Shares Out &
Teacher records on
poster paper

→ Be prepared to share these with the whole class.
We will watch 2 brief videos on similar phenomena.
As you watch the videos add to your notice and wonder chart
● What was similar between these phenomena and the bath bomb?
● What was different between these phenomena and the bath bomb?
Based on what you saw in the videos and what we discussed as a group, what revisions do you want to make to your initial model? Remember to show what you think was happening to this matter that explains:

1. What happened to the solid bath bomb?
2. What do you think caused the gas bubbles to appear?
3. What do you think caused the other changes you observed?
On a sticky note, jot down any questions you have that relate to what we have observed so far about bath bombs. Write down one question per sticky note. Put your name on the back side (sticky side)

To help you brainstorm your questions, look back through your I notice, I wonder observations.

Possible Sentence Starters
Why...?
How...?
What causes...?
Bring your sticky notes with questions to our Scientists Circle, along with your science notebook.

Either stand or sit in a circle facing each other. One volunteer will share their question and place it on the Driving Question Board.

Any student that has a similar question to the first one, raises their hand. The first student will choose which student will share their question next. Repeat until all questions are on the Driving Question Board.
Driving Question: Can we make something new that wasn’t there before?

Let’s organize our questions on the Driving Question Board so that they are near questions that are similar to each other.

What connections do you see?
What patterns do you notice?
What kind of investigations could we do and/or what additional sources of data might we need to figure out how bath bombs work?

Let’s make a record of ideas for future investigation we can do to answer some of our questions on the DQB.
Based on our DQB, what should we explore first to better help us understand what happens to a bath bomb in the water?

I think we should explore _____ because _________________.

*Be sure to use complete sentences.
Anchor
Phenomenon
Routine Reflection
Anchoring Phenomenon Routine

<table>
<thead>
<tr>
<th>Anchoring Phenomenon Routine Tracker</th>
<th>Element 1: Explore the Phenomenon</th>
<th>Element 2: Attempt to Make Sense of the Phenomenon</th>
<th>Element 3: Identify Related Phenomena</th>
<th>Element 4: Develop Questions and Next Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes about what you or the students did.</td>
<td>What do we notice?</td>
<td>How can we explain this? Do our explanations agree?</td>
<td>Where else does something similar happen?</td>
<td>What should we do to figure out how to explain this?</td>
</tr>
</tbody>
</table>

How do the elements of the Anchoring Phenomenon Routine support all students in figuring things out?
Individually jot down some notes about what you did as students in Elements 1-4.

### Anchoring Phenomenon Routine Tracker

<table>
<thead>
<tr>
<th></th>
<th>Element 1: Explore the Phenomenon</th>
<th>Element 2: Attempt to Make Sense of the Phenomenon</th>
<th>Element 3: Identify Related Phenomena</th>
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<td>What should we do to figure out how to explain this?</td>
</tr>
<tr>
<td>Notes about what you or the students did.</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>How does this support figuring out?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does this support a classroom culture where all students have access?</td>
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*Image credits: [OpenSciEd](https://openscied.org)*

*Image credits: [NSTA](https://www.nsta.org)*
Supports for Sensemaking

In your **Small Group**, discuss the following:

- What types of **support** might **students** need to engage in a sensemaking lesson like the ones you observed and participated in?
How can the steps of the Anchoring Phenomenon Routine support all students in figuring things out?

• Work with a partner to reflect on each element using the Anchoring Phenomenon Routine Tracker.
Constructing Classroom Norms
Supports for Sensemaking

In the **Alone Zone**, consider the following:

- What types of *support might students need* to engage in a sensemaking lesson like the ones you observed and participated in?
Co-Constructing Norms for Equitable Sensemaking

7. ESTABLISH SHARED NORMS

MATERIALS: Science Classroom Norms, science notebook, scissors, tape

**Introduce the idea of coming to consensus as a class.** Tell students, *Soon, we'll try to come to agreement with all our diagrams.* The purpose of introducing the consensus task before talking about classroom norms is to get students thinking about how difficult it will be to get all members of the learning community to agree and how we want to make sure everyone is included and all voices are heard.

**Introduce science classroom norms.** Tell students that before the class moves on with further investigations, it is time to set up some norms for how the class wants to work and learn together. You may want to reiterate productive behaviors you witnessed in the first day of Lesson 1 as a way of communicating to students that they were already operating using some positive norms, but they had not yet talked about them.

Display slide K and pass out the handout Science Classroom Norms. Note: Edit the handout and slide as desired for your classroom.

Remind students that in prior units we have used norms to help develop a productive and respectful learning environment. They are similar to rules but are intended to ensure that all students have a positive learning experience in science class.

The norms on the handout and the slide are a starting point for the class.** It is important to talk through each one with students and ask them to provide an example or paraphrase the norm. The purpose of this is to develop a shared understanding of each norm. Also, provide opportunities for students to clarify a norm, ask for a modification, or develop a new norm. Allow students to write on their handouts if the class decides to change something. Norms are intended to be shared by the students and teacher, so even though a set has been provided, it is just a starting point.

**ATTENDING TO EQUITY**

**Universal Design for Learning:** It is important to use this norm-building time to begin to cultivate an equitable learning community that promotes trusting and caring relationships that foster student engagement. The norms should remind students to value the diversity of classroom community members and equity in the sensemaking work they will do together this school year. It is critical that the norms support safe and fair participation and interrupt cultural norms or stereotypes that could make science experiences feel uncomfortable to students (e.g., being someone who is not intelligent).
## 7 · ESTABLISH SHARED NORMS

### Self Assessment: Giving Feedback

**How well did you give feedback today?**

<table>
<thead>
<tr>
<th>Today, I...</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gave feedback that was specific and about science ideas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared a suggestion to help improve my peer's work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used evidence from investigations, observations, activities, or readings to support the feedback or suggestions I gave.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One thing I can do better next time when I give feedback is:

667x502

## 6 · JIGSAW FEEDBACK GROUP DISCUSSION

### Self Assessment: Receiving Feedback

**How well did you receive feedback today?**

<table>
<thead>
<tr>
<th>Today, I...</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read the feedback I received carefully</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asked follow up questions to better understand the feedback I received</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Said or wrote why I agreed or disagreed with the feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revised my work based on the feedback</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is one piece of feedback you received?
Revising Norms with Intention

10 · NAVIGATION

MATERIALS: Science Classroom Norms, science notebook

Choose a norm to work on today. Display slide O. Tell students, *We will spend all day in our Scientists Circle again, working on turning our ideas into questions that we can investigate.* Direct them to look over the Classroom Norms chart again. Ask students to nominate a norm that the class should work on as a group. Take a vote and choose a norm to focus on together today.

14 · REVISITING NORMS

MATERIALS: Science Classroom Norms, science notebook

Debrief how we did with our focal norm. Display slide U. Have students turn and talk and share how they did with the norm they selected. Ask students, *How did the norms help us talk together and come up with some ideas of what we think is happening?* Allow a few students to share and tell students they will continue to work on the norms.

Sometimes students might be directed to choose a norm they want to work on individually.

Say, *Remember, one of our norms is that we work together to figure things out, and it is OK if we are unsure at this point. It doesn't matter if our original claim is right or wrong, right now it is important for us to determine what evidence we need to collect in order to support or refute our claims. We can always change our claims if we need to as we gather more evidence. That's what scientists do!"
Fostering Belonging with Classroom Norms
Guidelines for Watching Videos of Teaching

● These are real classrooms-teaching and the classrooms we will see are complex.

● Ground rules:
  ○ There is much we do not know about the students and teacher and their history together.
  ○ Presume positive intentions and expertise on the part of the teacher.
  ○ Assume what the kids are saying makes sense to them.
  ○ Focus on how the classroom talk (teacher and students) is serving the learning goals of the lesson and the science and engineering practices involved.

Norms-on-the-Go

Alone Zone
In each of the following classrooms

● What caused the teacher to redirect students’ attention to the norms?

● How did the teachers help students connect the need to attend to the norm(s) to sensemaking?

● What might you do the same and/or different (with the benefit of thinking time)?
Norms-on-the-Go

Student 2: What if it means that...(inaudible)

Play video 1:30 - 2:25
Norms-on-the-Go

Teacher: Interesting. Those seem like different ideas. Right. And that’s interesting and puzzling too, right?

Play video 1:11 - 2:18
Norms-on-the-Go

Student, you want to grab a stool from the table?

Play video 6:51 - 8:19
Small Groups
What pattern(s) emerge across the three classrooms with respect to attending to norms “in the moment?”

- What caused the teacher to redirect students’ attention to the norms?
- How did the teachers help students connect the need to attend to the norm(s) to sensemaking?
- What might you do the same and/or different (with the benefit of thinking time)?
Students Doing Science

Lesson 3 Immersion SEP Reflection
Students DOING Science
Lesson 3
As you come in, bring your science notebook and gather around our Driving Questions Board. Review the DQB and your science notebook for:

- What questions did we have about where the gas bubbles came from?
- What ideas did we have about where the gas bubbles came from?

Let’s share some of our thinking.
What additional information did we learn about the bath bomb?

What do we still need to figure out about our bath bombs?
Let’s share some of our responses from last class about where the gas in the bath bomb came from.
Essential Question

Where does the gas in the bath bomb come from?
One of our claims is: The gas is part of the bath bomb itself, trapped inside it.

- How can we investigate whether the gas is trapped inside the bath bomb?
- What do we need to measure?
- What data should we record? How should we collect and organize that data?
- What would we see if the gas is trapped in the bath bomb itself? What would you see if the gas does not come from inside the bath bomb?
One way we can test whether the gas is a part of the bath bomb is by crushing it, making close observations, and recording the mass before and after it is crushed.

Your group should have the following materials:
- 1 - ziploc bag
- 3 - small bath bomb
- 1 - digital scale

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Starting mass in closed system (g)</th>
<th>Ending mass in closed system (g)</th>
<th>Ending mass in open system (g)</th>
<th>Change in mass (g)</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushing the bathbomb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Discuss the following questions with your group:

1. What did you observe about the bag after we crushed the bath bombs in it?
2. What did you notice about the mass of the system?
3. Can we use any of this data as evidence to support the claim that the gas is trapped inside the bath bombs themselves.
Another of our claims is: The gas is something new, made from the bath bomb.

• How can we investigate whether the gas is new matter or not?
• Should we test an open system, closed system, or both?
• What do we need to measure? How? When should we measure it?
• How should we record that data?
Instead of testing bath bombs, we’re going to test some similar materials.

Your group should have the following materials:

- 1 - 200mL Erlenmeyer Flask
- Water
- 2 effervescent tablets
- 1 balloon
- Access to a Digital Scale
**Water & Bath Bomb - Open System Procedure**

1. Calibrate, or set the balance to zero.
2. Fill a clean Erlenmeyer flask with 50 mL of water.
3. Unwrap 1 effervescent tablet and place it on a square of paper. Crush the tablet.
4. Place the flask and 1 unwrapped effervescent tablet on the balance and record the starting mass.
5. Place the tablet into the flask of water. Gently swirl for 3 minutes.
6. Once the reaction is complete, put the flask back onto the scale and record the ending mass.
7. Calculate the amount of mass changed.

**Water & Bath Bomb - Closed System Procedure**

1. Thoroughly rinse out the flask and fill it with 50 mL of water.
2. Unwrap 1 effervescent tablet and place it on a square of paper. Crush the tablet.
3. Place the crush tablet inside the balloon.
4. Place the balloon around the rim of the flask, but DO NOT let the tablet fall into the water.
5. Find and record the starting mass of the flask & balloon with tablet.
6. Lift the balloon and allow the tablet to fall into the water. Gently swirl for 3 minutes.
7. Once the reaction is complete, record the ending mass.
8. Calculate the amount of mass changed.
Discuss the following questions with your group:

1. What did you observe during our investigation of the bath bombs in the open system? The closed system?
2. Does this data provide evidence to support or refute either of our claims?
What did we observe during our investigations?

Does this data provide evidence to support or refute either of our claims?
Turn and Talk

Based on the evidence gathered, where do you think the gases came from?
How does our evidence support or refute each of these claims?

- **Claim 1:** The gas is new matter that was not there to start with.
- **Claim 2:** The gas is not new matter, but comes from what was already there.

Consider your evidence and reasoning.

A. *Evidence:* referencing data that support (or refute) the claim and

B. *Reasoning:* explaining what these data mean by connecting them to key ideas.
How does our evidence support or refute each of these claims?

- Claim 1: The gas is new matter that was not there to start with.
- Claim 2: The gas is not new matter, but comes from what was already there.

Consider your evidence and reasoning.

A. Evidence: referencing data that support (or refute) the claim and

B. Reasoning: explaining what these data mean by connecting them to key ideas.
Let’s take another look at our initial model and make revisions as needed.

- How do the particles of a bath bomb change during the reaction with water?
Before putting these together:

A: A tiny sample of the bath bomb

A couple seconds after adding the bath bomb to water:

B: A tiny sample of the water

Key:

As gas bubbles appear:

C: A tiny sample of the liquid left over after a couple of minutes

D: A tiny sample of the gas in a bubble
In the closed systems:

• How much mass did we start with?
• How much mass did we end with?

So, what happened to the mass in the open systems?
Key Ideas:

- Gas is matter and has mass.
- Matter cannot be created or destroyed, even when it changes forms - **Law of Conservation of Mass**
Our lesson question was “Where does the gas in the bath bomb come from” Record that under the column that says lesson question.

What did we figure out from the Phet activity?

What new questions do you have?
Teacher Hat Reflection

In the **Alone Zone**, consider:

- From the student perspective, what was the **goal** of the lesson?
- How did students engage in the **process of science**?
- What science ideas (or pieces of science ideas) did students build?
Teacher Hat Reflection

With your Small Group, discuss the following:

• From the student perspective, what was the goal of the lesson?

• How did students engage in the process of science?

• What science ideas (or pieces of science ideas) did students build?
Science and Engineering Practices (SEPs)

1. Asking Questions (Science) and Defining Problems (Engineering)
2. Developing and Using Models

A focus on practices (in the plural) avoids the mistaken impression that there is one distinctive approach common to all science—a single “scientific method.”

6. Constructing Explanations (Science) and Designing Solutions (Engineering)
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information
Students-as-Scientists

As you watch the video, think about:

• What is the phenomenon scientists are trying to explain?

• Which science and engineering practices (SEPs) do they engage with to build or use science ideas (DCIs) to explain how or why the phenomenon occurred?

• What are some of the ways the scientists share and build on other’s ideas?

https://www.youtube.com/watch?v=Jj9iNphbY88
Consider what scientists did to explain the phenomenon they observed. How does this compare to what we are asking students to do in our science classrooms?

List the similarities you notice in the chat.

https://www.youtube.com/watch?v=Jj9iNphbY88
CLOSING

Update
Sensemaking
Posters

Gots & Needs
CMS PD Survey

Please complete the following survey before you leave:

Gots and Needs

As you walk out the door, please add one post it to each of the “Gots” and “Needs” posters

**GOTS**
An “aha!” or something new I understand.

**NEEDS**
A question I still have or something am hoping to learn tomorrow.
See you tomorrow!
Anchor Phenomenon Routine Reflection
Welcome!

Making Sense of Three-Dimensional Teaching and Learning-Grade 8 Unit 1

Day 2

July 23-24, 2024
<table>
<thead>
<tr>
<th>Segment</th>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 5</td>
<td>8:00-9:00</td>
<td>Welcome! Lessons 4-5 Deep Dive</td>
</tr>
<tr>
<td>Segment 6</td>
<td>9:00-10:30</td>
<td>Experience Sensemaking In Unit 1 Lesson 11</td>
</tr>
<tr>
<td></td>
<td>15 Min Break</td>
<td></td>
</tr>
<tr>
<td>Segment 7</td>
<td>10:30-12:00</td>
<td>Student Final Model &amp; Evaluating Unit 1</td>
</tr>
<tr>
<td>Lunch</td>
<td>12:15 – 1:30</td>
<td>NSTA Survey - Lunch</td>
</tr>
<tr>
<td>Segment 8</td>
<td>1:15-2:15</td>
<td>Productive Talk</td>
</tr>
<tr>
<td>Segment 9</td>
<td>2:15-2:45</td>
<td>Revisit Sensemaking Posters</td>
</tr>
<tr>
<td>Closing</td>
<td>2:45-3:00</td>
<td>Exit Survey; Gots and Needs</td>
</tr>
</tbody>
</table>
Today’s Presenter

Brianna Reilly Oliveira
NSTA Professional Learning Specialist

breilly39@gmail.com
Learning Goals

● Build an understanding of what three-dimensional teaching and learning looks like, feels like, and sounds like in the classroom.

● Be able to foster a community of evidence-based thinkers and position students as the “knowers” in the classroom.

● Gain strategies to leverage students’ assets (experiences, prior learning, curiosity, etc.) to learn science.

● Experience as learners and learn how to teach Grade 8 Unit 1.
Housekeeping

- This will be an interactive, action/thinking-packed two days. Please engage as an active participant to maximize your own and other’s experiences.
- Please tell me how I can support you along the way. There is a parking lot for questions and requests.
- Lunch is 1 Hour - from 12-1 ish
- There will be an AM Break.
- Take care of your own needs along the way.
SEGMENT 5

FINAL MODELS

Storyline Activity (Lessons 3-10)
Engaging in Science

With your **Small Group**, discuss where we left off at the end of Lesson 3.

- What did we figure out about the Bath Bomb phenomenon?
- What science ideas did we build?

What did **students do** to build these ideas?
Science and Engineering Practices (SEPs)

1. Asking Questions (Science) and Defining Problems (Engineering)
2. Developing and Using Models

A focus on practices (in the plural) avoids the mistaken impression that there is one distinctive approach common to all science—a single “scientific method.”

6. Constructing Explanations (Science) and Designing Solutions (Engineering)
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information
Evaluate Lessons 4 & 5

Making Connections

With your partner, describe how the warm up video connects to the bath bomb model that you created in the first lesson.

What similarities and differences did you notice?

Gallery Walk

Leave your lab sheet on your desk and walk around to see what other students have drawn.

As a class, discuss what patterns you saw in everyone’s pictures.

What was similar?

What was different?

Look For/Listen For:
- Did students look at the molecular level or macro level?
- Did students consider how one moves vs the other?
- Did students consider how

Teacher Notes:
After time is up, do a gallery walk where students will leave their models on their table and walk around the room to look for patterns in everyone’s models of solids, liquids, and gases. If you’re not comfortable having the students walk around the room, you can adjust this activity by having students hold up their model for each state of matter. Another alternative is you can convert this activity to a small group activity or turn & talk activity.

Class Discussion:
Have students share out what they observed in the gallery walk and teacher could make 3 posters or one poster with 3 columns to record down student ideas/thoughts/models.

Image Credit:
5 Minute Timer: With Relaxing Ocean Waves • https://youtu.be/0Dyj5Vg9l0c; #fliphtml5

NSTA
Evaluate Lessons 4 & 5

Complete a close read of Lessons 4 and 5. As you read, consider the following:

● What are students figuring out in each lesson?
  ○ About science ideas?
  ○ About the Bath Bomb phenomenon?
● What do students do in each lesson (SEPs)?
● What motivates students to move to the next lesson?
Evaluating Lessons 4 & 5

Access lessons on Canvas or by using the links below:

**Teacher Edition:**

**Student Sheets**

As you read, consider the following:

- What are students figuring out in each lesson?
  - About science ideas?
  - About the Bath Bomb phenomenon?
- What do students do in each lesson (SEPs)?
- What motivates students to move to the next lesson?
Evaluating Lessons 4 & 5

Access lessons on Canvas or by using the links below:


With your Small Group, discuss your ideas for each lesson:

- What are students figuring out in each lesson?
  - About science ideas?
  - About the Bath Bomb phenomenon?
- What do students do in each lesson (SEPs)?
- What motivates students to move to the next lesson?
Traditional View and Contemporary View

**Information Frame**

- Scientists and Teachers
- Knowledge of Science Disciplines
- Some Students

**Sensemaking Frame**

- Students as Scientists and Engineers
- Making Sense of Phenomena
- Teachers Facilitate
- All Students
“WE” Culture

- We figure out the science ideas
- We figure out where we are going at each step
- We figure out how to put the ideas together over time
Making Connections

With your partner, describe how the warm up video connects to the bath bomb model that you created in the first lesson.

What similarities and differences did you notice?

CMS Provided Curriculum

Gallery Walk

Leave your lab sheet on your desk and walk around to see what other students have drawn.

As a class, discuss what patterns you saw in everyone’s pictures.

What was similar?
What was different?

Looking for/Let’s have:
- Did students look at the molecular level or macro level?
- Did students consider how one moves vs the other?
- Did students consider how

Teacher Notes
After time is up, do a gallery walk where students will leave their models on their table and walk around the room to look for patterns in everyone’s models of solids, liquid and gases. If you’re not comfortable having the students walk around the room, you can adjust this activity by having students hold up their model for each state of matter. Another alternative is you can convert this activity to a small group activity or turn & talk activity.

Close Discussions:
How students share out what they observed in the gallery walk and teacher could make 3 posters or one poster with 3 columns to record down student ideas/thoughts/models.

Image Credit:
5 Minute Timer - With Relaxing Ocean Waves - https://youtu.be/0D7u1t5gq3c

NSTA
Assessment Examples

PS.8.1 Understand the properties of matter and changes that occur when matter interacts in open and closed systems.
PS.8.1.1 Construct an explanation to classify matter as elements, compounds, or mixtures based on how the atoms are arranged in various substances.

A scientist performed an investigation with a solution of Silver Nitrate ($\text{AgNO}_3$) and water ($\text{H}_2\text{O}$). She heated the sample until all of the water in the solution evaporated and a colorless powder remained.

How would she construct an explanation to correctly classify Silver Nitrate as a compound?
A. Silver Nitrate is a compound because it is a colorless powder.
B. Silver Nitrate is a compound because it has five atoms that are chemically combined.
C. Silver Nitrate is a compound because it can form a solution with water.
D. Silver Nitrate is a compound because it forms when three elements are combined chemically.

Which is a compound?
A. sodium
B. sugar
C. nitrogen
D. air

Which is classified as an element?
A. carbon dioxide
B. iron
C. vinegar
D. water
Classroom Immersion - Lesson 11
Lesson 11

Chemical Equations
Earlier, we discover that Citric Acid and Bicarbonate of Soda were the ingredients in a bath bomb that, when mixed, caused the gas to form.

Below is a molecular model of each.

Are these elements, compounds, or mixtures? How do you know?

Citric Acid

Bicarbonate of Soda
Last class we figured out the differences between mixtures, elements, and compounds at a molecular level and updated our consensus model.

Did we have enough evidence to update how we would represent each substance?
Examine the properties of common gases and the results of investigations about the gas in a bath bomb.

Make a claim about which gas (or gases) are produced by the bath bomb.

<table>
<thead>
<tr>
<th>Some Common Gases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substances in row A—H</strong> (here is a mixture and K is an unknown)</td>
</tr>
<tr>
<td><strong>Approximated % of the gas in the bath bomb</strong></td>
</tr>
<tr>
<td><strong>Boiling point (°C)</strong></td>
</tr>
<tr>
<td><strong>Density (g/L measured at 0°C)</strong></td>
</tr>
<tr>
<td><strong>Flammability</strong></td>
</tr>
<tr>
<td><strong>Notes on how the gas interacts with flame</strong></td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>G</td>
</tr>
<tr>
<td>H</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>J</td>
</tr>
<tr>
<td>K</td>
</tr>
</tbody>
</table>
What does the evidence tell us about what gas(es) could be created by the bath bomb?

### Some Common Gases

<table>
<thead>
<tr>
<th>Substances in rows A–I (row J is a mixture, row K is an unknown)</th>
<th>Approximate % of this gas in the air outside</th>
<th>Boiling point (in °C)</th>
<th>Density (g/L) measured at 0°C</th>
<th>Flammability Notes on how the gas interacts with flame</th>
</tr>
</thead>
<tbody>
<tr>
<td>A nitrogen</td>
<td>78%</td>
<td>-196</td>
<td>1.250</td>
<td>Will extinguish a flame.</td>
</tr>
<tr>
<td>B oxygen</td>
<td>21%</td>
<td>-183</td>
<td>1.430</td>
<td>Will increase a flame or cause a glowing ember to burst into flame.</td>
</tr>
<tr>
<td>C argon</td>
<td>-1%</td>
<td>-186</td>
<td>1.780</td>
<td>Will extinguish a flame.</td>
</tr>
<tr>
<td>D carbon dioxide</td>
<td>-0.04%</td>
<td>N/A</td>
<td>1.960</td>
<td>Will extinguish a flame.</td>
</tr>
<tr>
<td>E neon</td>
<td>-0.0018%</td>
<td>-246</td>
<td>0.900</td>
<td>Will extinguish a flame.</td>
</tr>
<tr>
<td>F helium</td>
<td>-0.0005%</td>
<td>-268</td>
<td>0.179</td>
<td>Will extinguish a flame.</td>
</tr>
<tr>
<td>G methane (natural gas)</td>
<td>-0.0002%</td>
<td>-161.5</td>
<td>0.714</td>
<td>Will increase a flame. Can create an explosion.</td>
</tr>
<tr>
<td>H hydrogen</td>
<td>0.0001%</td>
<td>-252</td>
<td>0.090</td>
<td>Will increase a flame. Can create an explosion.</td>
</tr>
<tr>
<td>I propane</td>
<td>&lt;0.0001%</td>
<td>-42</td>
<td>2.000</td>
<td>Will increase a flame. Can create an explosion.</td>
</tr>
<tr>
<td>J air</td>
<td>N/A</td>
<td>N/A</td>
<td>1.160</td>
<td>Can maintain an open flame.</td>
</tr>
<tr>
<td>K Unknown Gas from Bath Bomb</td>
<td>unknown</td>
<td>unknown</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How could Citric Acid and Bicarbonate of Soda combine to make one (or more) of the gases we identified?

What questions do we need to answer in order to figure this out?

KEY
Red - Oxygen Atoms
Gray - Carbon Atoms
White - Hydrogen Atoms
Purple - Sodium Atoms

Citric Acid

Bicarbonate of Soda
We learned about what makes elements, compounds, and mixtures different on a microscopic level.

What are we trying to figure out?
How can a new substance form out of particles of an old substance?
Create a Model to show your ideas about how Citric Acid and Bicarbonate of Soda could create a new substance when mixed together.

KEY
Red - Oxygen Atoms
Gray - Carbon Atoms
White - Hydrogen Atoms
Purple - Sodium Atoms
Create a Model to show your ideas about how Citric Acid and Bicarbonate of Soda could create a new substance when mixed together.

**KEY**
- Red - Oxygen Atoms
- Gray - Carbon Atoms
- White - Hydrogen Atoms
- Purple - Sodium Atoms

Citric Acid

Bicarbonate of Soda
What did we discover about matter changing forms in Lesson 3?

How can that idea be used to support which type of gas is produced when Bicarbonate of Soda and Citric Acid mix?
Use the physical models of citric acid and bicarbonate of soda to create Carbon Dioxide.

What do you **Notice and Wonder** about how Carbon Dioxide is created?
What Evidence do we have to explain how a new substance can form out of particles of an old substance?

Citric Acid

Bicarbonate of Soda

Carbon Dioxide Gas
Citric Acid

Carbon Dioxide Gas

Bicarbonate of Soda
With your group, use your physical models to create **water**, **Carbon Dioxide Gas**, and **Sodium Citrate** molecules from **Citric Acid** and **Bicarbonate of Soda**.
With your group, use your physical models to create water, Carbon Dioxide Gas, and Sodium Citrate molecules from **Citric Acid** and Bicarbonate of Soda.

What science ideas must be included?
Walk around the room and observe your classmates' models.
Use post-its to make comments on your peers’ models.

-I like that you included...
-I forgot to add ___ to my model
-I disagree with ____ because______
What questions do you have for other classmates’ posters?
What made sense to you?
What didn’t make sense to you?

Update your posters with your group.
Let’s build this model together - What do we all agree should be included in our model?

- Citric Acid
- Bicarbonate of Soda
- Carbon Dioxide Gas
- Sodium Citrate
- Water
Citric Acid

Bicarbonate of Soda

Water

Carbon Dioxide Gas

Sodium Citrate
Citric Acid  Bicarbonate of Soda  Water  Carbon Dioxide Gas  Sodium Citrate
Citric Acid + Bicarbonate of Soda → Water + Carbon Dioxide Gas + Sodium Citrate

\[ \text{C}_6\text{H}_8\text{O}_7 + 3\text{NaHCO}_3 \rightarrow 3\text{H}_2\text{O} + 3\text{CO}_2 + \text{Na}_3\text{C}_6\text{H}_5\text{O}_7 \]
Chemical equations are models that show how atoms are rearranged during a chemical reaction.

The Law of Conservation of Mass says that during a chemical reaction, matter cannot be created or destroyed, in only changes forms.
Elephant Toothpaste
Occurs when Hydrogen Peroxide \((\text{H}_2\text{O}_2)\) breaks down very quickly into water \((\text{H}_2\text{O})\) and Oxygen gas \((\text{O}_2)\). The addition of dish soap makes a large number of bubbles.

Create a model to show this reaction at a molecular scale.
Record the Lesson Question in the correct column of your Growing Ideas Chart:

“How do chemical changes form new compounds?”

What have you figured out as a result of this lesson?

What new questions do I have?
Okay, okay, I get it. Different chemicals can react to create new substances and during the reaction elements aren’t created or destroyed, they’re just rearranged.

But my question is why? Why do some substances react like bath bombs and water and others don’t? If you put your pencil on your desk, nothing happens. What do you think is happening? Why do some things react and others don’t?
Lesson 11 targeted the following objective:

**Objective PS.8.1.5** Use models to illustrate how atoms are rearranged during a chemical reaction so that balanced chemical equations support the Law of Conservation of Mass (in both open and closed systems).

**Clarification Statement:**
- Models include equations, graphical representations, drawings, diagrams, computer models, conceptual models, or physical models (two-dimensional or three-dimensional).
- Emphasis is on students determining if a chemical equation obeys the law of conservation of mass based on a given chemical equation or particle diagram. Students are not expected to determine coefficients for an unbalanced chemical equation.

**Dimension 3: Disciplinary Core Ideas (DCI):**

- **PS1.B: Chemical Reactions**
  Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change. Some chemical reactions release energy, others store energy. *(NRC Framework, p. 111)*

**Benchmarks for Science Literacy**
- **4D/M13** The idea of atoms explains chemical reactions: When substances interact to form new substances, the atoms that make up the molecules of the original substances combine in new ways.
- **4D/M7b** The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how the same atoms are rearranged, then their total mass stays the same.
Teacher Hat Reflection

With your **Small Group**, discuss the following:

- What motivates students to build these science ideas?
- What do students **do** in the lesson to build the science ideas (SEPs)?

---

**Objective PS.8.1.5** Use models to illustrate how atoms are rearranged during a chemical reaction so that balanced chemical equations support the Law of Conservation of Mass (in both open and closed systems).

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Grade 8 Unit 1 Target Objectives

- **PS.8.1.1** Construct an explanation to classify matter as elements, compounds, or mixtures based on how the atoms are arranged in various substances.

- **PS.8.1.2** Use models to illustrate the structure of atoms in terms of the protons, electrons, and neutrons (using the location, charges and comparative size of these subatomic particles), without consideration of isotopes, ions, and energy levels.

- **PS.8.1.3** Analyze and interpret data to explain how the physical properties of elements and their reactivity have been used to produce the current model of the Periodic Table of Elements.

- **PS.8.1.4** Construct an explanation to classify changes in matter as physical changes (including changes in size, shape, and state) or chemical changes that are the result of a chemical reaction (including changes in energy, color, formation of a gas or precipitate).

- **PS.8.1.5** Use models to illustrate how atoms are rearranged during a chemical reaction so that balanced chemical equations support the Law of Conservation of Mass (in both open and closed systems).
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- **PS.8.1.5** Use models to illustrate how atoms are rearranged during a chemical reaction so that balanced chemical equations support the Law of Conservation of Mass (in both open and closed systems).

North Carolina 8th Grade Support Document
Whole Group Discussion

From a student’s perspective, what is the goal of Unit 1?

To explain what happens when a bath bomb is added to water (and what causes it to happen).
Final Student Models

In the **alone zone**, create a final version of a student’s explanatory model and a written explanation of the anchor phenomenon. Consider the following:

- Based on the **science ideas** described in the NC Standards Support Document, what would you expect student final models to look like?
- **What evidence** would you look for in final models and explanation to show understanding of the targeted unit objectives?
Grade 8 Unit 1 Target Objectives

- **PS.8.1.1** Construct an explanation to classify matter as elements, compounds, or mixtures based on how the atoms are arranged in various substances.

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- **PS.8.1.5** Use models to illustrate how atoms are rearranged during a chemical reaction so that balanced chemical equations support the Law of Conservation of Mass (in both open and closed systems).

**Share and discuss with your small group:**

- For each objective, what evidence of understanding would you expect to see in students’ final models?

- What similarities do you have? What differences? What does this tell you about the acceptable differences in student models?
Small Group: Final Consensus Models

What would you expect student final models to look like?

What evidence would you look for in final models to show understanding of the targeted unit objectives?

Share your final consensus model with your group.

What similarities can you find in the models? What differences do you see?
Building Coherence

Discuss with your small group:

● What types of investigations or tasks might you expect students to engage with to gather evidence to explain the bath bomb and develop these necessary science ideas across the unit?
Evaluating the Unit

Look through the remaining lessons for evidence of students engaging in activities similar to those you discussed with your group.
Science and Engineering Practices (SEPs)

1. Asking Questions (Science) and Defining Problems (Engineering)
2. Developing and Using Models

A focus on practices (in the plural) avoids the mistaken impression that there is one distinctive approach common to all science—a single “scientific method.”

6. Constructing Explanations (Science) and Designing Solutions (Engineering)
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information
Feedback Survey

Your feedback is valuable to us! We use it to provide follow-up support as well as inform choices about future professional learning opportunities.

Presenter 1: Brianna Reilly Oliveira
Presenter 2/3: BLANK
Where this workshop took place: Charlotte, NC Grade 8

OR
https://www.surveymonkey.com/r/NSTA3DPD
IT'S LUNCH TIME
Phenomena & Coherence
What are phenomena?

Natural phenomena are *observable events* that *occur in the universe* and that we can use our *science knowledge to explain or predict*.
Think about your experience with the phenomenon in our immersion.

How did experiencing the phenomenon create for you a *need to engage* in sensemaking?
Continuum of Science Instruction

**Information Frame**
- Teacher is focused on disseminating information.
- Students are focused on knowing information.
- Science is portrayed as a body of established facts.
- Assessments are focused on “right” answers.

**Sensemaking Frame**
- Teacher is focused on developing conceptual understanding.
- Students are focused on understanding something.
- Science is portrayed as a way to make sense of something.
- Assessments are focused on use of evidence to support conclusions/generalizations.

**Knowing about..**

**Figuring out...**

From: Cynthia Passmore, NSTA Virtual PD, Nov. 15, 2014
Continuum of Science Instruction

**Information Frame**
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- Assessments are focused on use of evidence to support conclusions/generalizations.

From: Cynthia Passmore, NSTA Virtual PD, Nov. 15, 2014
Shifting Toward the Sensemaking

Information Frame

Less Like

Sensemaking Frame

More Like

CH₄ + 2O₂ → CO₂ + 2H₂O

Properties of Matter

Physical Properties:
- Observed and measured without changing chemical identity of sample

- Color
- Length
- Volume
- Opacity

Chemical Properties:
- Observed and measured as sample changes chemical identity

- Acidity
- Reactivity
- Flammability
- Toxicity
Shifting Toward the Sensemaking

Information Frame  Sensemaking Frame

Less Like  More Like
Shifting Toward the Sensemaking

Information Frame

Sensemaking Frame

Less Like

More Like

\[ \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \]
Phenomena

Using Phenomena in NGSS-Designed Lessons and Units

WHAT ARE PHENOMENA IN SCIENCE AND ENGINEERING?
- Natural phenomena are observable events that occur in the universe and that we can use science knowledge to explain or predict. The goal of building knowledge in science is to develop general ideas, based on evidence, that can explain and predict phenomena.
- Engineering involves designing solutions to problems that arise from phenomena, and using explorations of phenomena to design solutions.
- In this way, phenomena are the context for the work of both the scientist and the engineer.

WHY ARE PHENOMENA SUCH A BIG DEAL?
- Despite their centrality in science and engineering, phenomena have traditionally been a missing piece in science education, which too often has focused on teaching general knowledge that students can struggle to apply to real-world contexts.
- Anchoring learning in explaining phenomena supports student agency for wanting to build science and engineering knowledge. Students are able to identify an answer to “why do I need to learn this?” before they even know what the “this” is. In contrast, students might not understand the importance of learning science ideas that teachers and curriculum designers know are important but that are disconnected from phenomena.
- By centering science education on phenomena that students are motivated to explain, the focus of learning shifts from learning about a topic to figuring out why or how something happens. For example, instead of simply learning about the topics of photosynthesis and mitosis, students are engaged in building evidence-based explanatory ideas that help them figure out how a tree grows.
- Explaining phenomena and designing solutions to problems allow students to build general science ideas in the context of their application to understanding phenomena in the real world, leading to deeper and more transferable knowledge.
- Students who come to see how science ideas can help explain and model phenomena related to competing real-world situations learn to appreciate the social relevance of science. They get interested in and identify with science as a way of understanding and improving real-world contexts. Focusing investigations on competing phenomena can help sustain students’ science learning.

HOW ARE PHENOMENA RELATED TO THE NGSS AND THREE-DIMENSIONAL LEARNING?
- The Next Generation Science Standards (NGSS) focus on helping students use science to make sense of phenomena in the natural and designed world, and use engineering to solve problems.
- Learning to explain phenomena and solve problems is the central reason students engage in the three dimensions of the NGSS. Students explain phenomena by developing and applying the Disciplinary Core Ideas (DCIs) and Crosscutting Concepts (CCCs) through use of the Science and Engineering Practices (SEPs).
- Phenomena-centered classrooms also give students and teachers a context in which to monitor ongoing progress toward understanding all three dimensions. As students are working toward being

Understanding of DCI ESS1.A, which, at the 5th grade level, focuses on the relationship between star brightness and distance from Earth:
- The process of developing an explanation for a phenomenon should advance students’ understandings. If students already need to know the target knowledge before they can inquire about the phenomenon, then the phenomenon is not appropriate for initial instruction (although it might be useful for assessment).
- Students should be able to make sense of anchoring or investigative phenomena, but not immediately, and not without investigating it using sequences of the science and engineering practices. With instruction and guidance, students should be able to figure out, step by step, how and why the phenomenon works.
- An effective phenomena does not always have to be flashy or unexpected. Students might not be intrigued by an everyday phenomenon right away because they believe they already know how or why it happens. It takes careful teacher facilitation to help students become dissatisfied with what they can explain, helping them discover that they really can’t explain it beyond a simple statement.

Authentic engagement does not have to be fun or flashy. Instead, engagement is determined more by how the students generate compelling lines of inquiry that create real opportunities for learning.

Students need to be able to engage deeply with the material in order to generate an explanation of the phenomena using target DCIs, CCCs, and SEPs.

Phenomena (e.g., a sunburn, vision loss) are specific examples of something in the world that is happening—an event or a specific example of a general process. Phenomena are NOT the explanations or scientific terminology behind what is happening. They are what can be experienced or documented.

Phenomena can drive the lesson, learning, and reflection/monitoring throughout. Using phenomena in these ways leads to deeper learning.

Teaching science ideas in general (e.g., teaching about the process of photosynthesis) may work for some students, but often leads to decontextualized knowledge that students are unable to apply when relevant. Anchoring the development of general science ideas in investigations of phenomena helps students build more usable and generative knowledge.

Phenomena are observable occurrences. Students need to use the occurrence to help generate the science questions or design problems that drive learning.

Engagement is a crucial access and equity issue. Students who do not have access to the material in a way that makes sense and is relevant to them are disadvantaged. Selecting phenomena that students find interesting, relevant, and consequential helps support their engagement. A good phenomenon builds on everyday or family experiences: what students are, what they do, where they come from.
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<tr>
<th>Prior Thinking About Phenomena</th>
<th>Thinking About Phenomena Through the NGSS</th>
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<tr>
<td>If it’s something fun, flashy, or involves hands-on activities, it must be engaging.</td>
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<td>Anything students are interested in would make a good “engaging phenomenon”</td>
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Choose one characteristic/ description of thinking about phenomena that resonates with you.

How does the Bath Bomb phenomenon exemplify this characteristic/ description?

Be ready to share the connection you made between the description (#) and your experience with Bath Bomb phenomenon.
Choose one characteristic/description of thinking about phenomena that resonates with you.

How does the Bath Bomb phenomenon exemplify this characteristic/description?

Be ready to share the connection you made between the description (#) and your experience with Bath Bomb phenomenon.
Phenomena: Engagement

• Students have a common experience with the phenomenon (no one student is at an advantage or disadvantage)

• Students connect to the phenomenon through their experience with related phenomena.

• Students’ experience with related phenomena valued by learning community.

• In trying to explain the phenomenon, students recognize gaps in their knowledge which leads to questions they want to answer
Sensemaking: Putting the Pieces Together

Alone Zone

Look and listen for evidence that students have been/are currently focused on explaining the phenomenon of the Channeled Scablands.

How is the teacher supporting students in tracking their own progress in explaining the phenomenon over time?

https://vimeo.com/558835896
The point of using phenomena to drive instruction is to help students engage in practices to develop the knowledge necessary to explain or predict the phenomena.

It is the phenomenon plus the student-generated questions about the phenomenon that guides the learning and teaching.

STEM Teaching Tool 42
Consider what scientists did to explain the phenomenon they observed. How does this compare to what we are asking students to do in our science classrooms?
Productive Talk
Sensemaking Discussions

How can we support students in sensemaking discussions?
Each of the eight practices, as it is introduced and elaborated and experienced in the classroom, requires that students **externalize their reasoning**. It requires that they **work with the reasoning of other students**. ...teacher and student talk is the **vehicle** by which every student can make his or her way into a deep and productive relationship with the science and engineering practices.
Reflect on Current Science Talk

Alone Zone

- What kinds of science talk happen most frequently in your classroom?
- What kinds of science talk would you like students to engage in within your classroom?
Productive Talk

Being able to identify and support productive talk is an important part of building a culture of equitable sensemaking.

Productive talk allows students to:

- make their thinking public
- reason about complex ideas
- develop arguments and evidence-based explanations
Goals for Productive Talk

- **Goal 1**: Help individual students share, expand, and clarify their own thinking
- **Goal 2**: Help students listen carefully to one another
- **Goal 3**: Help students deepen their reasoning
- **Goal 4**: Help students think with others
Goals and Talk Moves

Alone Zone

- Read through the Goals and Talk Moves Handout.
- Reflect: Have you observed an instance of one or more of these moves today?

Productive Talk Goals and Moves

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Other Observations:

Adapted from TERC (2012), Talk Science in the Inquiry Project
Goals and Talk Moves

Share with a partner:

• Which Goal (1, 2, 3, or 4) is most in use in your own classroom?

• Which Goal (1, 2, 3, or 4) is newest or newer to you?

### Productive Talk Goals and Moves

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Other Observations:

Adapted from TERC (2012). Talk Science in the Inquiry Project
Explore a Phenomenon

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

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

- [Scary Day on Mt. Everest](#)
Scary Day on Mt. Everest

Michele Battelli
Climber

Smithsonian Channel

- Scientists monitor using satellites (GPS)
- Everest has been moving NE at 4 cm/year
- Earthquake moved it 3 cm SW (same position as 9 months ago)
Develop a model to show your thinking:

- How does Mt. Everest get 6-7 cm taller each year?
- How could Mt. Everest move to the northeast 4 cm each year?

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

Record observations related to the Goals and Moves.

Video Context:
After previously creating individual models, students now share ideas and the class begins to develop their initial class consensus model. (Everest unit)

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Other Observations:

Adapted from TERC (2012). Talk Science in the Inquiry Project
Classroom Video Analysis

Alone Zone

- What talk moves do you notice from this video clip?
- What other strategies do you notice the teacher using?

Use the transcript as evidence of the talk or other moves.

Classroom Transcript: Make Sense of the Phenomenon

1 Teacher: Can somebody share out not what they said was puzzling, but o partner said was puzzling about their model? As a way to show listening to our partners. (Student 1), go ahead.

4 Student 1: The tectonic plates make it grow bigger.

5 Teacher: What do you mean the tectonic plates?

6 Student 1: So how they shift and then points it up and there.

7 Teacher: So I heard you say it was puzzling. And who did you say this?

8 Student 1: (Student)

9 Teacher: Okay, so it was puzzling about tectonic plates you say? Great, thank you for sharing about that.

10 Student 2: So this was kind of I had two partners so both tectonic plates actually worked and like what?

13 Teacher: Okay, yeah. And to be honest with you too, they people saying, and looking at people’s initial or something we have to figure out about too. Or what’s your partner say?

17 Student 3: I had two partners and (Student 4) said, though push the mountain up because it would all call.

18 Teacher: Okay.

20 Student 3: And then [Student] said that it would be raised mountain might go up a hill, and that’s how it’s.

22 Teacher: Interesting. Those seem like different ideas. Right? And I see you guys laughing, why are you conclusion?

24 Student 4: Cause the ideas are not the best.

25 Teacher: Hold on a second, but we have to recognize, I knows how this works. We have a lot of questions different, are different ideas in our classroom.

26 Teacher: Can somebody share out not what they said was puzzling, but o partner said was puzzling about their model? As a way to show listening to our partners. (Student 5), go ahead.

28 Students: Yeah.

Productive Talk Goals and Moves

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Other Observations:

Adapted from TERC (2012), Talk Science in the Inquiry Project
Observing Productive Talk

Teacher: Interesting. Those seem like different ideas. Right. And that's interesting and puzzling too, right?
Observing Productive Talk

Small Group:

• What talk moves do you notice from this video clip?

• What other strategies did you notice the teacher using?

• How did the talk moves and other strategies support all students in engaging in equitable sensemaking?
Observing Productive Talk

Small Group:

• What talk moves do you notice from this video clip?
• What other strategies did you notice the teacher using?
• How did the talk moves and other strategies support all students in engaging in equitable sensemaking?

Whole Group:

• Share some key ideas from your small group
Rationale for Talk Moves
Teacher Interview
Productive Talk Goals and Moves - Scientists Circle

and what I'm thinking is that the magnet isn't the main thing that's making the sound.
Productive Talk Goals and Moves - Scientists Circle - Teacher Reflection

Watch 0:47 - 2:26
https://youtu.be/E4NNvHbfYMw?si=TwDJB9lReyLljkry
Promoting excellence and innovation in science teaching and learning for all
Reflecting on Talk Moves and Other Strategies

What are talk moves and/or strategies you would like to try to support productive talk in your own classroom? Why?
Update
Sensemaking
Posters
Gots & Needs
What is Sensemaking?

Small Group

Revisit your initial ideas about sensemaking and discuss the following with your group members:

- What ideas might you want to add?
- What ideas might you want to say more about?
- What ideas might you want to change?

Consider what new examples of student and teacher actions you have from our immersion experiences.
What is Sensemaking?

Small Group

Revisit your initial ideas about sensemaking and discuss the following with your group members:

- What ideas might you want to add?
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- What ideas might you want to change?

Consider what new examples of student and teacher actions you have from our immersion experiences.
What is Sensemaking?

Whole Group Gallery Walk

- Observe each group’s poster.
- What are some patterns in our ideas about how we describe sensemaking?
Please complete the following survey before you leave:
Thank you