NGSS and OpenSciEd: Transform your instruction to put your students in the role of scientists

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Today’s Agenda

How does OpenSciEd support the implementation of the Next Generation Science Standards to put students in the role of scientists?

- Introduction
  - Reflect on our goals for science instruction
  - Share key elements of the OpenSciEd instructional model that support NGSS
- Unit Specific
  - Experience anchoring phenomena for 8.1: Contact Forces
- Debrief activity with NGSS in mind
- Review OpenSci Ed Instructional Model
Key Goals in Science Instruction
Reflect on Goals for Science Instruction

- Quickwrite:
  - Why do you think it is important for all students to learn science?
  - What are your goals for your students in science?

- Whole Group Discussion
  - Share out key ideas.
Key Goals in the NRC Framework and NGSS

- Engages all students in scientific thinking and moves from *learning about* science to *figuring things out* through phenomena-driven instruction.
- Content is no longer the memorization of science facts, but is three-dimensional, incorporating the *disciplinary core ideas*, *cross-cutting concepts* and *science practices* that build over time.
- Supports an *equity vision* of science instruction in which all students are known, heard and supported with access and opportunities for learning.
Integrating the Goals in Classrooms

<table>
<thead>
<tr>
<th>LESS OF</th>
<th>MORE OF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rote memorization of facts and terminology</td>
<td>Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning</td>
</tr>
<tr>
<td>Learning of ideas disconnected from questions about phenomena</td>
<td>Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned</td>
</tr>
<tr>
<td>Teachers providing information to the whole class</td>
<td>Students conducting investigations, solving problems, and engaging in discussions with teachers’ guidance</td>
</tr>
</tbody>
</table>

(Adapted from NRC, 2015 Table 1-1)
How Do We Support Equitable Sensemaking?

“Realizing this potential [of the NGSS] is particularly important in relation to students of color, students who speak first languages other than English, and students from low-income communities who, despite numerous waves of reform, have had limited access to high-quality, meaningful opportunities to learn in science.” (p. 33)

-Bang, Brown, Calabrese Barton, Rosebery & Warren (2017)
Introduction to 3-dimensional Learning

*A Framework for K-12 Science Education* brought several shifts for science education

- Phenomena and designing solutions to problems
- 3-dimensional learning
- Progression of ideas and skills across time
- Science is for all students
3-Dimensions

The Framework focuses on students explaining phenomena and designing solutions to problems.

• Disciplinary Core Ideas
• Science and Engineering Practices
• Crosscutting Concepts
Disciplinary Core Ideas

The big ideas of science disciplines

What big ideas of science are related to this picture?
Crosscutting concepts

1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change
Science & engineering Practices

1. Ask questions and define problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
3-Dimensions

The Framework focuses on students explaining phenomena and designing solutions to problems.

• Disciplinary Core Ideas
  • What students should be able to explain about phenomena

• Science and Engineering Practices
  • Doing science to investigate phenomena

• Crosscutting Concepts
  • Lens used to examine phenomena
Introduction to OpenSciEd Instructional Model
The Design of OpenSciEd Curriculum

- **Phenomenon based:** An anchoring phenomenon and related phenomena motivate building ideas over time.

- **Coherent from the Students’ Perspective:** Coherence is grounded in the initial anchoring phenomenon and driven by students’ ideas and questions.

- **Driven by Evidence:** Students seek and use evidence to figure out phenomena as they build new science ideas.

- **Collaborative:** Students figure out ideas together as a classroom community.

- **Equitable:** The class community values the diversity of resources students bring to science class and understand how the learning is relevant to their own lives and communities.
OpenSciEd units are based on a science storyline.

- Each step is driven by students’ questions that arise from phenomena.
This is the first routine of the OpenSciEd curriculum to position students in making sense of a phenomenon, grounding all students in a common experience and raising student questions.

**Element #1:** Explore the phenomenon

**Element #2:** Attempt to make sense

**Element #3:** Identify related phenomenon

**Element #4:** Questions and next steps
Anchoring Phenomena Routine Tracker

<table>
<thead>
<tr>
<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>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>

Notes about what you or the students did.

How does this support figuring out?

How does this support a classroom culture where all students have access?
Switching hats

**Student hat:** Thinking like a kid. What do you anticipate a middle school student might think? What might they say? Channel your inner middle schooler.

**Teacher hat:** Reflecting on pedagogical approach, instructional routines, classroom culture, logistics/supports, NGSS, etc...

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**Related Phenomena - Other Collisions**

List examples you have experienced where something fragile collided with something else and you were surprised that it did not get damaged.

- Identify the objects that came into contact with each other during the collision.
- Underline which object or objects were moving before the collision occurred.

On the right hand page, record your ideas about collisions that did not damage a fragile thing.

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**Focal Science Practices**

- Target SEPs for entire unit:
  - Planning and Carrying out an Investigation and Analyzing/Interpreting Data
  - Constructing Explanations and Designing Solutions
  - Engaging in Argument from Evidence

- Lesson-specific SEPs can be different from these

**Focal Crosscutting Concepts**

- Target CCCs for entire unit:
  - Systems and system models
  - Energy and matter
  - Structure and function
  - Stability and change

- Lesson-specific CCCs can be different from these.
OpenSciEd Launch Professional Development

Unit Introduction
3 of 6 Target PEs for Contact Forces Unit (8.1)

**MS-PS2-1** Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.

**MS-PS2-2** Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.

**MS-PS3-1** Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
MS-LS1-8* Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

MS-ETS1-2* Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

MS-ETS1-3* Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
Focal Science & Engineering Practices

- Target SEPs for entire unit:
  - Planning and Carrying out an Investigation and
  - Analyzing/Interpreting Data
  - Constructing Explanations and Designing Solutions
  - Engaging in Argument from Evidence
- Lesson-specific SEPs can be different from these

Focal Crosscutting Concepts

- Target CCCs for entire unit:
  - Systems and system models
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- Lesson-specific CCCs can be different from these.
OpenSciEd Launch Professional Development

Experiencing Anchor Phenomenon
Organize science notebook to use in student hat

1. Table of Contents:
2. Progress Tracker: Number the pages so that we can reference sources of evidence for what we figure out.
Exploring a Phenomenon

Cell Phone Damage

- Americans break 2 smartphone screens every second.
- More than 50 million phone screens are cracked each year.
- An estimated 95 million phones were damaged in the world by dropping them.
- We spend $3.4 BILLION each year in replacing cracked screens--not counting the 38% of smartphone owners who don’t replace them at all.
- 27% of people said that their phone was in a case when they broke it.

Source - Miami Herald
Have you or someone you know ever broken a phone? What caused it to break? Describe your experience(s).

Be ready to share your experiences with the class!
Element #1: Explore the Phenomenon

- **Small Group Discussion:**
  - Notes about what you or the students do
  - How does this support figuring out?
  - How does this support a classroom culture where all students have access?

- **Whole Group Discussion:**
  - Share out key ideas from your small group.
Slide C

Using a CD Case to Model Phone Damage

With Your Class

What damage to phones have you seen or experienced?

A few volunteers will use this CD case in place of a phone to show the class what happened to the phone.

Your teacher will draw a model to represent what happened as you share.
Element #2: Attempt to Make Sense

● Small Group Discussion:
  ○ Notes about what you or the students do
  ○ How does this support figuring out?
  ○ How does this support a classroom culture where all students have access?

● Whole Group Discussion:
  ○ Share out key ideas from your small group.
Related Phenomena - Other Collisions

**Partner Share**

In a moment, we will go to the areas of the room that go with our cards. First we will do red cards (damage), then green cards (no damage).

- While you are in your area, share your collision with a partner.
- Look for any similarities and differences in how the collisions occurred.
- How did damage (or no damage) occur?

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The object that was damaged OR that you were surprised wasn’t damaged.

- **A** (damaged)
  - was moving at first

The other object.

- **B** (not damaged)
  - was motionless at first
  - was motionless at first

- **C** (not damaged)
  - was moving at first
  - was moving at first
Related Phenomena - Other Collisions

Sharing Examples

Share your collision examples with the whole group

As you share, state if your example is scenario A, B, or C and add the collision to our whole-class chart.

The object that was damaged OR that you were surprised wasn’t damaged

The other object

A

was moving at first

B

was motionless at first

C

was motionless at first

was moving at first

was moving at first
Element #3: Identify Related Phenomena

- **Small Group Discussion:**
  - Notes about what you or the students do
  - How does this support figuring out?
  - How does this support a classroom culture where all students have access?

- **Whole Group Discussion:**
  - Share out key ideas from your small group.
Identifying Factors in a Collision

Looking for Patterns and Variables

Create a T-chart in your notebook. Label one side “Patterns in collisions” and the other side “Factors and variables that might cause damage in a collision.”

Record any patterns you notice between collisions and collision types.

List any factors or variables that you think contributed to why some items got damaged and other items did not get damaged in a collision.
**Modeling Collisions**

<table>
<thead>
<tr>
<th>Name: __________________________</th>
<th>Date: __________</th>
</tr>
</thead>
</table>

**Initial Model: Objects During Collisions**

What two objects collided? __________________________ and __________________________

Is this a scenario from A, B, or C? ______

Was there damage in this collision? ______

Imagine you had special glasses that could stop time and let you watch both objects. Describe what you think you would see happening at these two points in time:

<table>
<thead>
<tr>
<th>Time point 1: What would you see the materials they were made of doing if you could stop time the moment they first touch?</th>
<th>Time point 2: What would you see the materials they were made of doing if you could stop time a split second later?</th>
</tr>
</thead>
</table>
Crosscutting concepts

1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change
Changes we could see: Now think about what you would see happening in between time point 1 and time point 2. Would you see any changes happening in each of the objects? How does that help explain why the object was damaged or not?

Interactions we cannot see: Now think about the interactions between time point 1 and time point 2 that you cannot see happening. What interactions would be happening? How does that help explain why the object was damaged or not?

- If you picked a collision with no damage, then how would the interactions between the same objects have to change to cause damage in a collision?
- If you picked a collision that caused damage, then how would the interactions between the same objects have to change to not cause damage in a collision?

Be ready to share your models with a partner.
How did you represent things similarly or differently as they collided? Why did you represent them acting the way they do?

Compare the factors and variables that you each identified that may have contributed to the damage (or lack of damage).

Put a ✔️ on your paper where you and your partner agree on ideas.

Put a ✉️ next to areas where you disagree on ideas or have questions.
Science & engineering Practices

1. Ask questions and define problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Co-develop norms for consensus building discussion

1. **Respectful**: Our classroom is a safe space to share
2. **Equitable**: Everyone’s participation and ideas are valuable
3. **Committed to our community**: We learn together
4. **Moving our science thinking forward**: We work to figure things out
Initial Consensus Model Discussion

Develop a whole-group record of what we agree on and where we have competing ideas across the initial models.

As your classmates share their models, mark your model like this:

- If something is similar, place a small check mark (✓) near what is similar on your own model.
- If something is different, place a question mark (?) near what is different on your own model.
Looking back at your Patterns in collisions chart.

Share any factors or variables that might affect the amount of damage in a collision.

<table>
<thead>
<tr>
<th>Patterns in collisions</th>
<th>Factors or variables that might cause damage in a collision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
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</tbody>
</table>
Developing Additional Questions

On Your Own

- Look at the Patterns in collisions chart.
- What new questions do you have about the factors and variables that might affect damage in a collision?
- Write the question(s) down on your index card or sticky note.

Write one question per sticky note or index card.
Write in marker--big and bold.
Put your initials on the back of each note in pencil.
Driving Question Board (DQB)

Take out your sticky notes with questions. Bring those with you to our Scientists Circle along with your science notebook.

- The first student reads a question aloud to the class, then posts it on the DQB.
- Students who are listening should raise their hands if they have a question that relates to the question that was just read aloud.
- The first student selects the next student whose hand is raised.
- The second student reads a question, says why or how it relates, and posts it near the question it most relates to on the DQB.
- That student selects the next student.
- If another student has shared the same question that you have, try to share a different question that has not been shared.
- We will continue until everyone has at least one question on the DQB.
OpenSciEd units are based on a science storyline.

- Each step is driven by students’ questions that arise from phenomena.
Ideas for Investigations

What kinds of investigations could we do and/or what additional sources of data might we need to figure out the answers to our questions?

Add your ideas to a new notebook page titled “Ideas for future investigations and data we need”.

Be prepared to share these with the whole class.
We have a mission to accomplish as a class!
Our questions represent what it is we hope to be able to figure out.
Our ideas for investigations and sources of data will help us try to figure this all out.
Let's get started exploring in our next class!
Element #4: Questions/Next Steps

● Small Group Discussion:
  ○ Notes about what you or the students do
  ○ How does this support figuring out?
  ○ How does this support a classroom culture where all students have access?

● Whole Group Discussion:
  ○ Share out key ideas from your small group.
Reflect on What/Who is driving instruction
Coherence for Students
OpenSciEd Instructional Model

OpenSciEd units are based on a science storyline.

- Each step is driven by students’ questions that arise from phenomena
OpenSciEd Instructional Model Routines

ANCHORING PHENOMENON ROUTINE

NAVIGATION ROUTINE

INVESTIGATION ROUTINE

PUTTING THE PIECES TOGETHER ROUTINE

PROBLEMATIZING ROUTINE
All units have an anchoring phenomenon or problem. This results in student-driven questions, ideas and initial explanations that are then explored in future lessons.
OpenSciEd Launch PD

Using Storylines to Address Lack of Coherence

www.activatelearning.com
Students often experience science class as a series of disconnected activities that lack coherence or connection both between and within lessons.
OpenSciEd
Interactive Digital Edition

URL: https://pd.activatelearningdigital.com/webapp/v2/

Username: osepd1@aldp.com

Password: OSE
Reflections and Questions