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The OpenSciEd Instructional Model: Routines for Advancing Students Through a Storyline

Michelle Tindall

SCIENCE EDUCATION UPDATE CONFERENCE

The OpenSciEd Instructional Model: Routines for Advancing Students Through a Storyline

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WHO'S IN THE ROOM?

Welcome!

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Goals of the Session

1

Introduction to OpenSciEd

2

Experience an OSE Anchoring Phenomenon

3

Engage with the OSE five routines

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1

Introduction to OpenSciEd

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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

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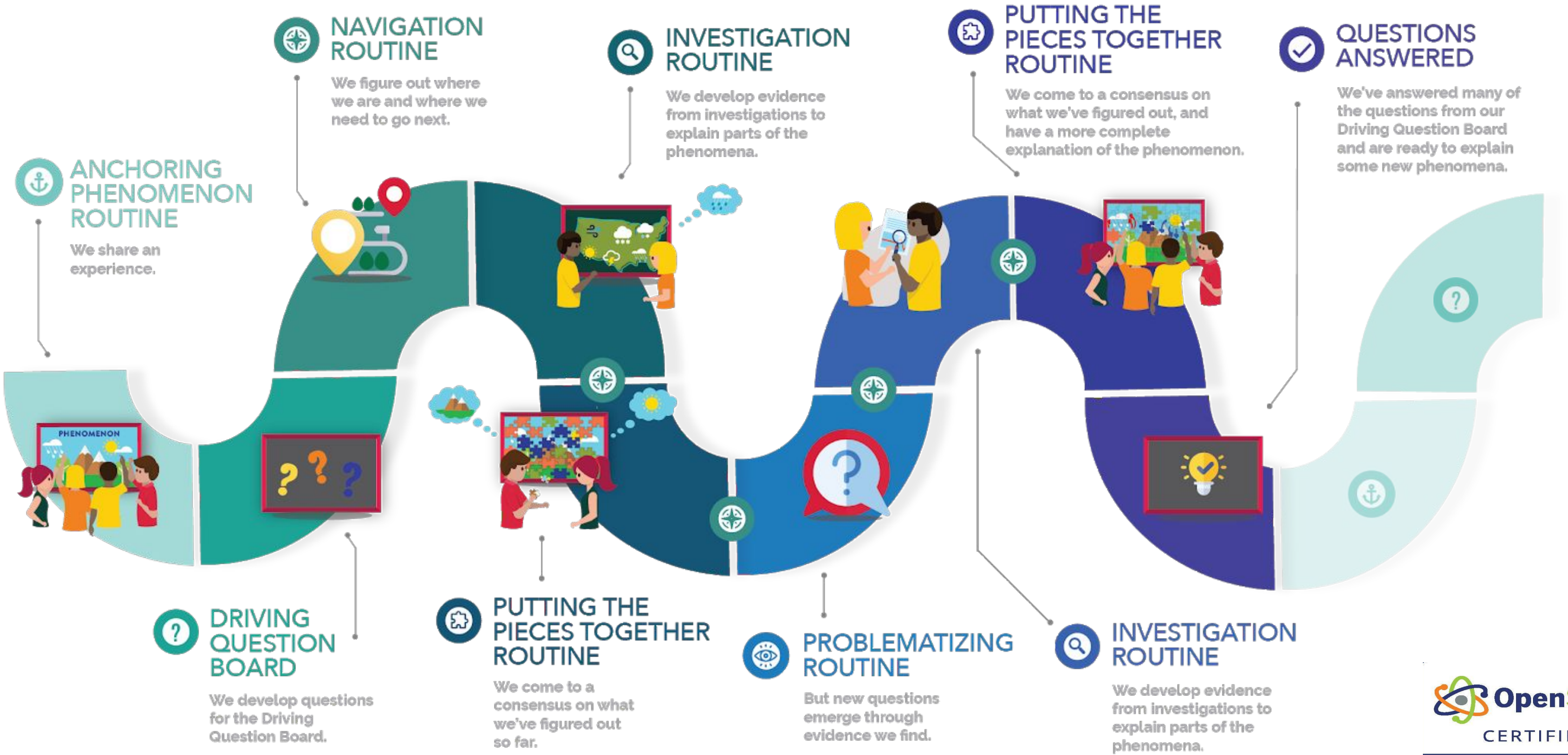
OpenSciEd Instructional Model

OpenSciEd units are based on a science storyline.

- Each step is driven by students' questions that arise from phenomena



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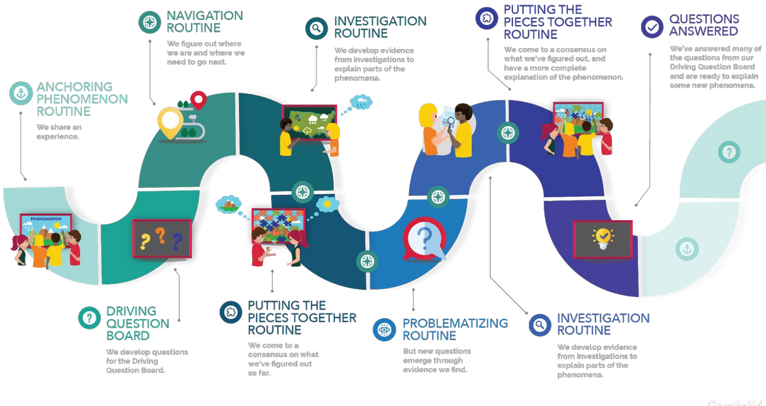
OpenSciEd Instructional Model

Question	Routine	Purpose
How do we kick off each unit?	Anchoring Phenomenon Routine	Common experience of a phenomenon, develop student curiosity and connect to students' lives
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
How do we help students use practices to build science ideas?	Investigation Routine	Support students in using science and engineering practices to make progress on our questions and problems
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
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



[Routines Table]

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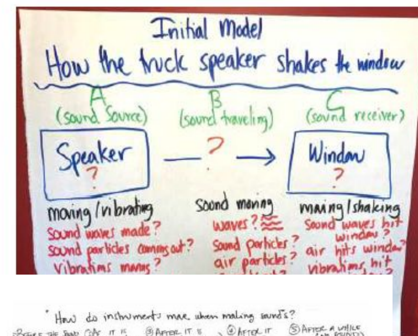
A coherent sequence of lessons in which each step is driven by students' questions that arise from their interactions with phenomena.

UNIT STORYLINE

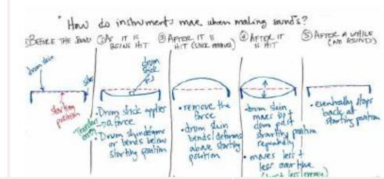
Unit Question: How can a sound make something move?

How students will engage with each of the phenomena

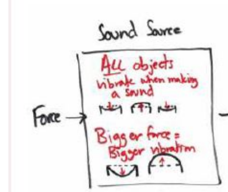
HANDS-ON/ LAB ACTIVITIES | VIDEOS OR IMAGES | DATA SETS | READINGS | COMPUTER INTERACTIVES

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 1 3 days **How does a sound source make something like this happen?** Anchoring Phenomenon		We observe a perplexing phenomenon: Sound from a truck appears to make a window move from the parking lot. We note observations of this phenomenon as well as of a speaker in the classroom. Our observations, models, and other sound-related phenomena lead us to add a broad set of questions about sound to our DQB and to list ideas for investigations to pursue. We figure out these concepts: • A speaker making sounds can be detected from a distance and can even cause things	

⇓ Navigation to Next
in what each does wh

LESSON 2 2 days **What is happening when speakers and other music makers make sounds?** Investigation		When an instrument vibrates (makes sounds) it includes the following actions: • A force is applied to a part of an object; that part bends or deforms and changes shape. Energy is transferred to the object. • When the force is removed, that part of the object springs back and overshoots its starting position. • That part of the object then repeatedly	

⇓ Navigation to Next Les
and forth (vibrating) when

LESSON 3 2 days **Do all objects vibrate when they make sounds?** Problematizing, Investigation	 *A laser directed at a mirror on a drum, table, and speaker lets us better see the vibrations that happen when those objects make sounds.*	We investigate whether different solid objects, even ones that don't appear to move, vibrate while making sounds. Since those vibrations are happening on a scale we can't easily see, we set up and use a simple device with a laser and a mirror to "zoom in" on those objects when they're making sounds. We observe how the same object vibrates differently when making different sounds and use claim, evidence, reasoning charts to argue for how solid objects move when they make sounds. We figure out: • All objects move back and forth (vibrate) when making sounds. • Objects vibrate further back and forth (deform more) when a greater force is applied, creating louder sounds.	

⇓ **Navigation to Next Lesson:** We wonder what do we mean by "more" vibrations and is there a way we can more clearly see how a solid object vibrates more?

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2

Experiencing a Phenomenon

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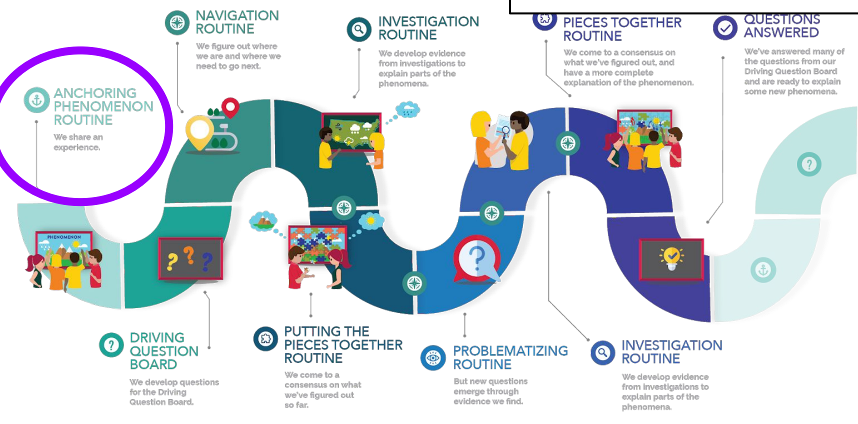
OpenSciEd Instructional Model

ANCHORING PHENOMENON ROUTINE

ANCHORING PHENOMENON 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.

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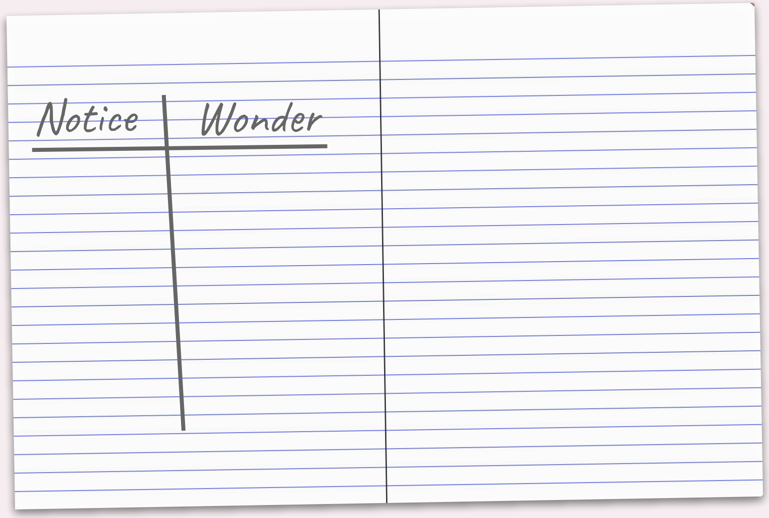
Slide A

What do you notice?

Video clip: https://youtu.be/rlrW3PgBHLc

Make a T-chart in your science notebook and record your noticings and wonderings.



Slide B

Share Observations With A Partner

Turn and Talk

As you share with a partner, be sure to reference specific moments in the video so everyone understands what you are talking about.

- What did you observe in the video?
- Why do you think those things happened?
- What was puzzling to you? What questions do you have about what you observed?

Slide C

Share Observations as a Whole Group

Whole-Group Discussion

As you share with the group, be sure to reference specific moments in the video so everyone understands what you are talking about.

- What did you observe in the video?
- Why do you think those things happened?
- What was puzzling to you? What questions do you have about what you observed?

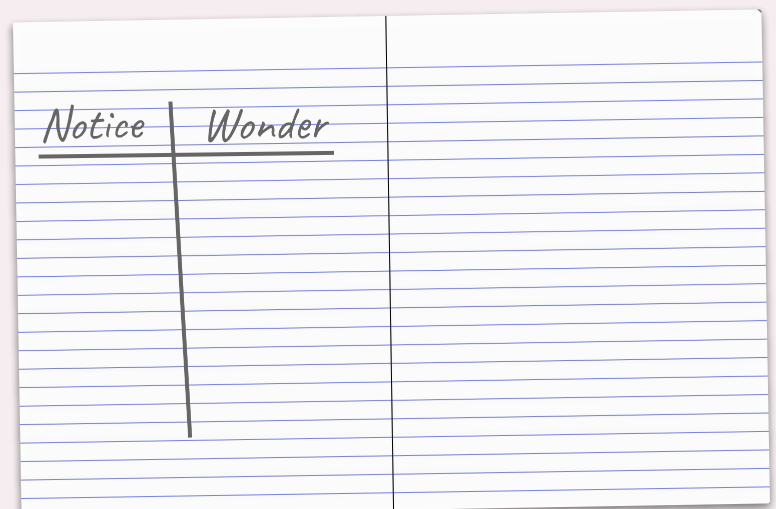
Slide D

Make Observations of a Speaker

As you observe a speaker like the one from the video, think about these questions:

- What is the speaker doing while it is making sounds?
- What do you see happening that might help us understand what's happening in the video of the truck and the window?

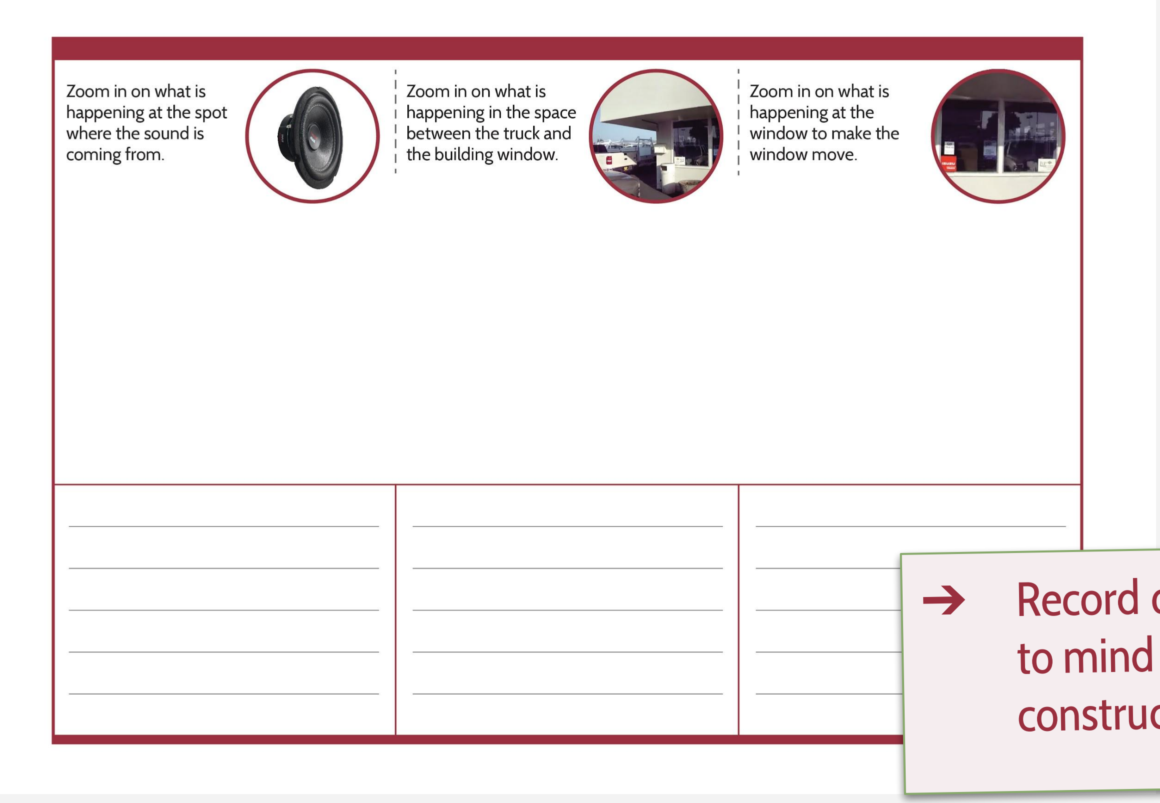
Make a T-chart in your science notebook and record your noticings and wonderings.



Slide E

Develop Initial Models

Develop an initial model to explain, "Why would a sound coming from one thing make another thing far away move?" Use *pictures*, *symbols*, and *words* in your model to help represent and further explain what you think is happening in each of the 3 locations on a zoomed-in scale.



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

Select a Norm for the Day

Review the community norms. Select a norm you want to practice today.

Turn and Talk

What community norm do you want to focus on during our work today?

Why did you choose this norm?

Slide G

Compare Initial Models

Turn and Talk

Share your model with a partner, looking for similarities and differences between your models.

Have one member of your team keep track of the similarities and differences between your models. Be prepared to share these patterns with the whole group.

Similarities between our models	Differences between our models

Slide H

Initial Class Consensus Model Discussion

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

- What do we all seem to agree on?
- What do we disagree on?
- What are some new ideas that we may want to consider?

Slide 1

Where have you seen something like this?

Add a "Related phenomena" section to your science notebook and jot down other experiences you have had that relate to what we've observed so far.

Use these questions to guide your brainstorming:

- When or where have you seen before a time where an object making sounds caused something to move or shake, like the window in the video?
- When or where have you seen sounds being made before? What was making those sounds?
- When or where have you experienced a sound being received before? What objects have you seen receiving sounds besides the window in the video?
- Have you ever experienced a sound going over a distance, like in the video?

Slide J

Share Related Phenomena

- Once you have finished brainstorming, find the posters hung up around the room with the brainstorming questions written on them.
- At each poster, write one of your responses somewhere on the poster around the question.
- What phenomena did you see multiple times on these posters? Which ones stood out to you the most? Were there any you have never encountered before?

What questions do you have?

Add a "Questions" section to your science notebook and jot down any questions you have that relate to what we have observed so far.

To help you brainstorm your questions, look back at these resources:

- your Notice and Wonder charts
- your initial model
- your lists of related phenomena
- the class's consensus model

Slide L

Revise Our Questions

Review the questions you brainstormed at the end of last class. Use these question starters to create two revised or new questions to post to our Driving Question Board:

- Why ...?
- How ...?
- How would it be different if ...?
- What if ...?
- What is the purpose of ...?
- What causes ...?

Then write one question per sticky note.

Write in marker--big and bold.

Put your initials on the back in pencil.

Slide M

Driving Question Board (DQB)

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

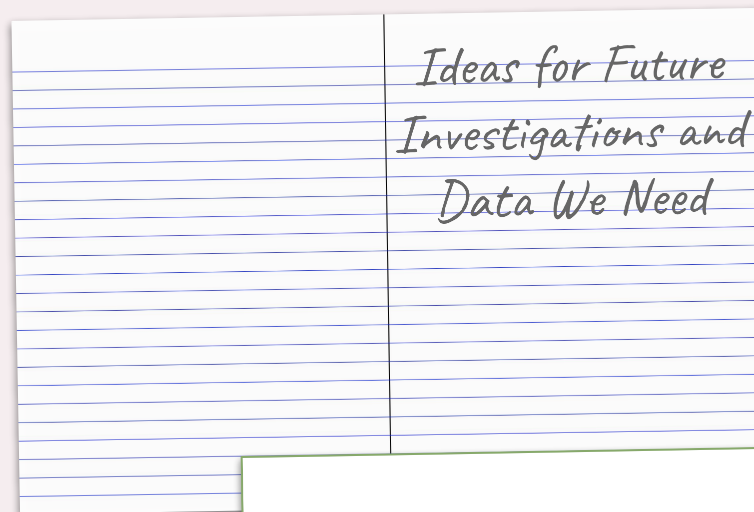
Let's build our Driving Question Board (DQB).

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?

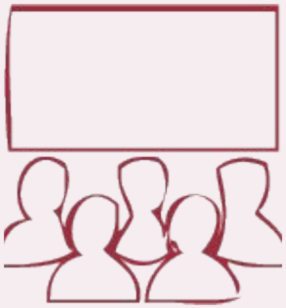
Add your ideas to a new notebook page titled:

Ideas for Future Investigations and Data We Need



→ Be prepared to share these with the whole class.

Where should we start?



Take a moment to look at our questions on our Driving Question Board.

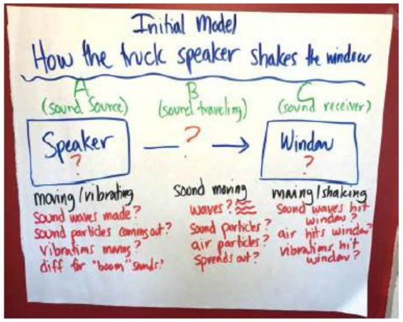
- What part of the model does it make sense to explore first? Why?
- What are we going to need to do to explore this part?

UNIT STORYLINE

How students will engage with each of the phenomena

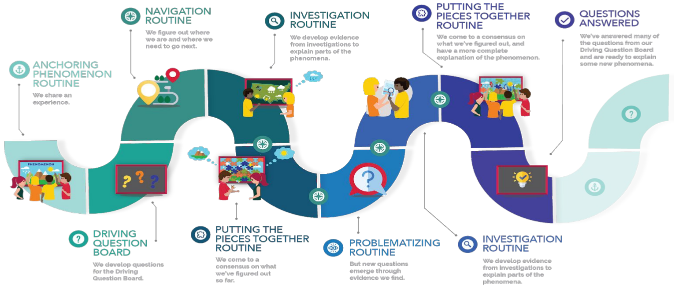
HANDS-ON/ LAB ACTIVITIES | VIDEOS OR IMAGES | DATA SETS | READINGS | COMPUTER INTERACTIVES

Unit Question: How can a sound make something move?

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 1 3 days **How does a sound source make something like this happen?** Anchoring Phenomenon	 *Loud music from a truck makes a window in the parking lot move. A speaker moved when it produced sound.*	We observe a perplexing phenomenon: Sound from a truck appears to make a window move from the parking lot. We note observations of this phenomenon as well as of a speaker in the classroom. Our observations, models, and other sound-related phenomena lead us to add a broad set of questions about sound to our DQB and to list ideas for investigations to pursue. We figure out these concepts: • A speaker making sounds can be detected from a distance and can even cause things like a nearby window to move. • The speaker moves back and forth when it is making sound. • Students agree that the sound source, how sound travels, and how sounds are received are important parts of explaining how sounds can make things move.	

⇓ **Navigation to Next Lesson:** After seeing how the speaker moves when it makes sounds, we wonder if other sound-makers show similar patterns. We decide to bring in other sound-makers to look for patterns in what each does when making sounds.

Where we started and where we are going…



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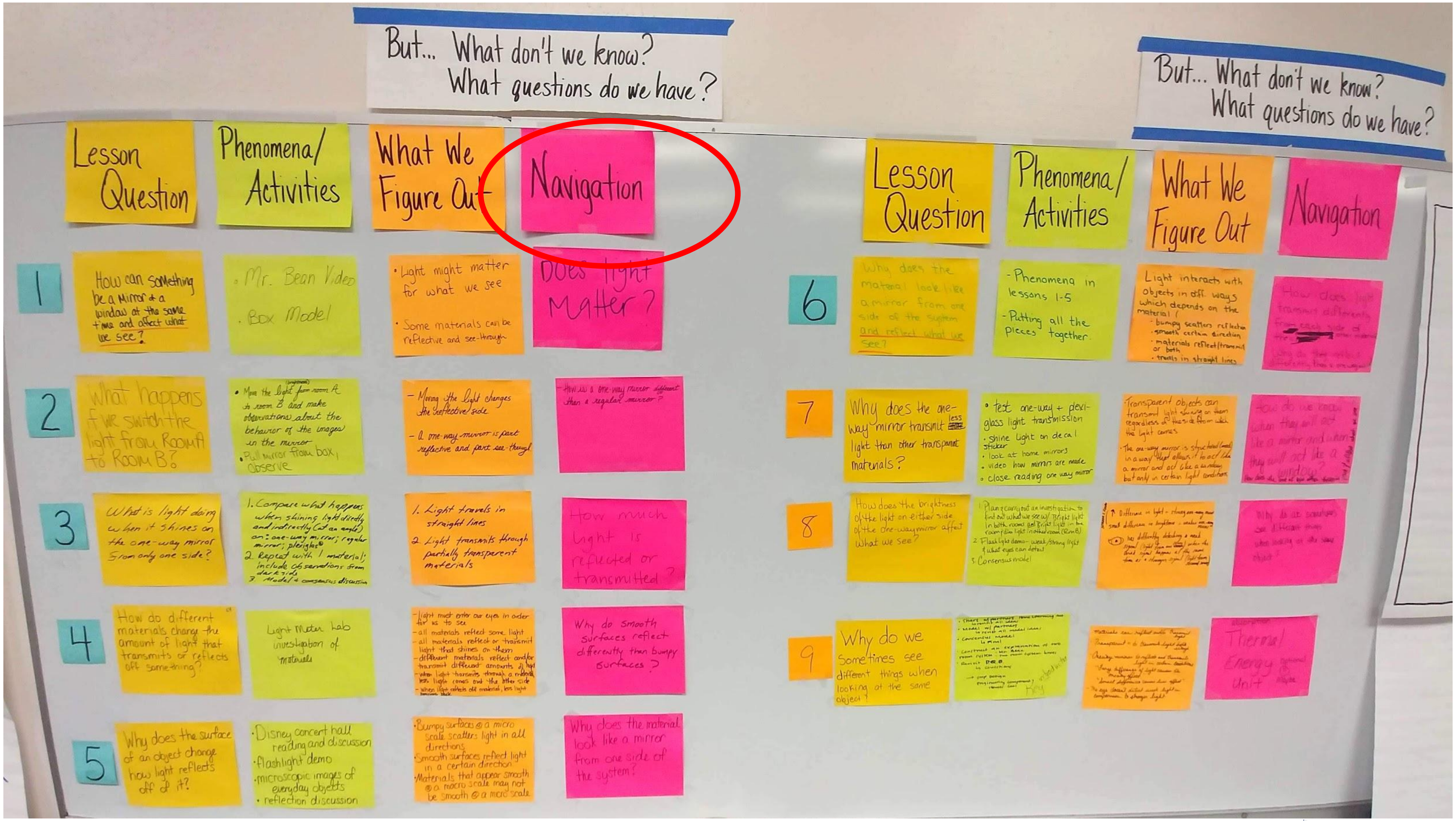
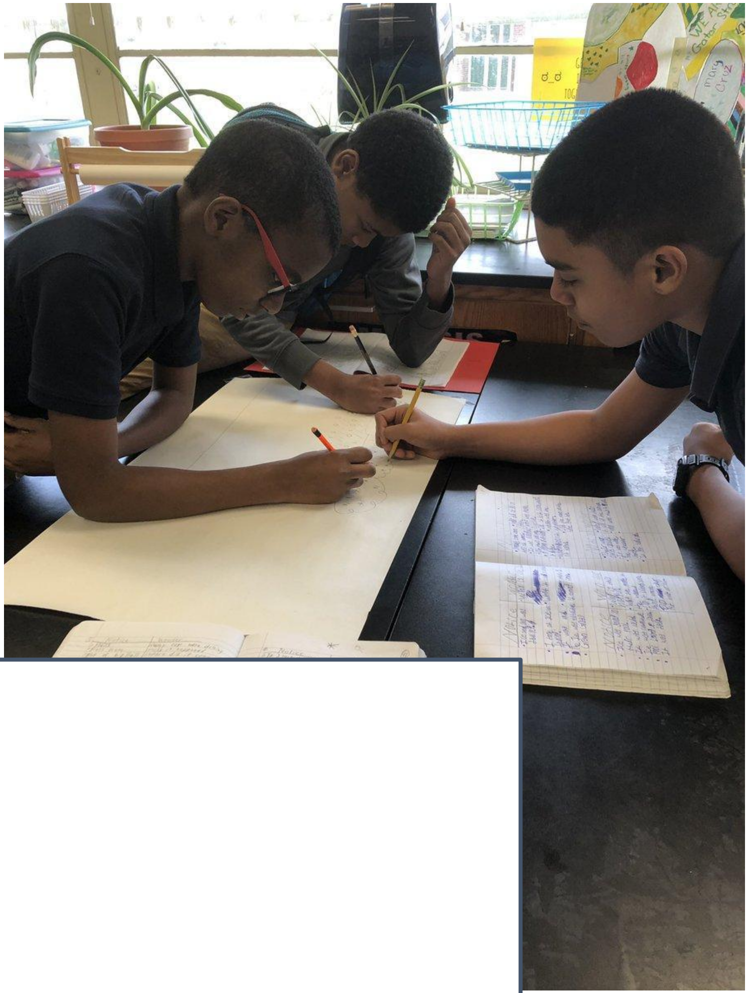
NAVIGATION ROUTINE

Navigation Routine – building towards coherence



Investigation Routine

INVESTIGATION ROUTINE



Planning an Investigation

In your digital notebook

3. Record the following question in the "Question" box at the top of the T-chart below:

    a. “Can we hear sounds coming from a container with no air inside?”

Tindall_OSE | View Student Work

B | Symbols | Play Student recording

Question:	
4a. What are the possible outcomes of our investigation?	4b. What would each outcome tell us about the question we’re investigating?

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Slide A

Navigation

We had a bunch of questions about what is happening at the sound source.

Turn and Talk

- How do think sound sources like instruments and speakers make all those different sounds?
- What would you expect to see if you looked closely at these sound sources while they are making sounds?

Slide B

Exploring Sound Sources

We will have the opportunity to observe a number of different sound sources making sounds.

Create an observation table in your science notebook like the one below.

Data source	Observations

- For each new station, make a new row in your observation table to record your observations.
- In the left column, record the name of the sound source you observe.
- In the right column, record observations that you make as you watch and touch the instrument or speaker while it's making sounds.

Slide C

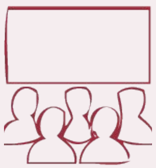
Exploring Sound Sources

Use the following prompts to guide your observations:

- How does the object look and feel **while it is being struck**?
- How does the object look and feel **while it is making sound**?
- How is what you notice **similar to or different than** what we saw the **speaker** do?
- Can the sound source make different sounds? If so, how?
- What patterns did you notice in how the objects make different sounds?

Slide D

Exploring Sound Sources



Share with the whole class your ideas about these questions:

- What patterns did you notice?
- What else could we do to figure out more about what is happening with these sound sources?

- How does the object look and feel **while it is being struck**?
- How does the object look and feel **while it is making sound**?
- How is what you notice **similar to or different than** what we saw the **speaker** do?
- Can the sound source make different sounds? If so, how?
- What patterns did you notice in how the objects make different sounds?

Slow-Motion Videos

Add each sound source to your observation table as they are played.

Data source	Observations

Slide F

Slow-Motion Speaker Video

Share your observations with with the class.

Slide G

Slow-Motion Guitar Video

Share your observations with with the class.

Slow-Motion Drum Video

Share your observations with with the class.

Slide L

Building a Consensus Model

Use this table to construct a model of how an instrument moves when it makes sounds.

Each box in the table, from left to right, will represent how the shape of a drum changes over time as it is making sounds.

3

OpenSciEd Routines

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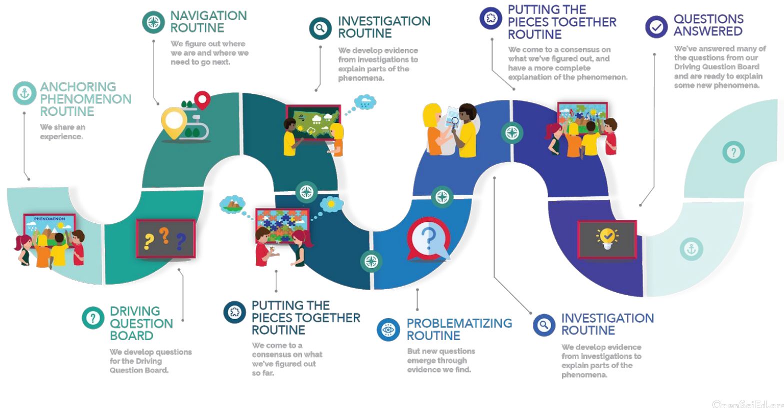
OpenSciEd Instructional Model

Question	Routine	Purpose
How do we kick off each unit?	Anchoring Phenomenon Routine	Common experience of a phenomenon, develop student curiosity and connect to students' lives
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
How do we help students use practices to build science ideas?	Investigation Routine	Support students in using science and engineering practices to make progress on our questions and problems
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
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



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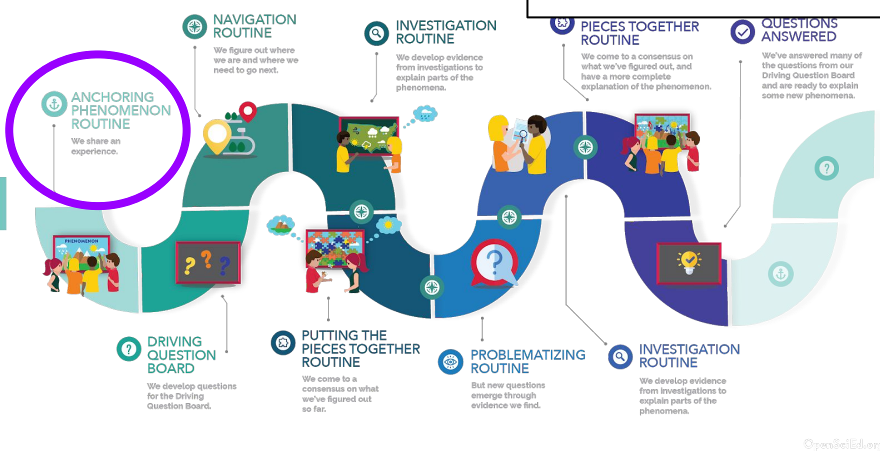
OpenSciEd Instructional Model

ANCHORING PHENOMENON ROUTINE

ANCHORING PHENOMENON 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.

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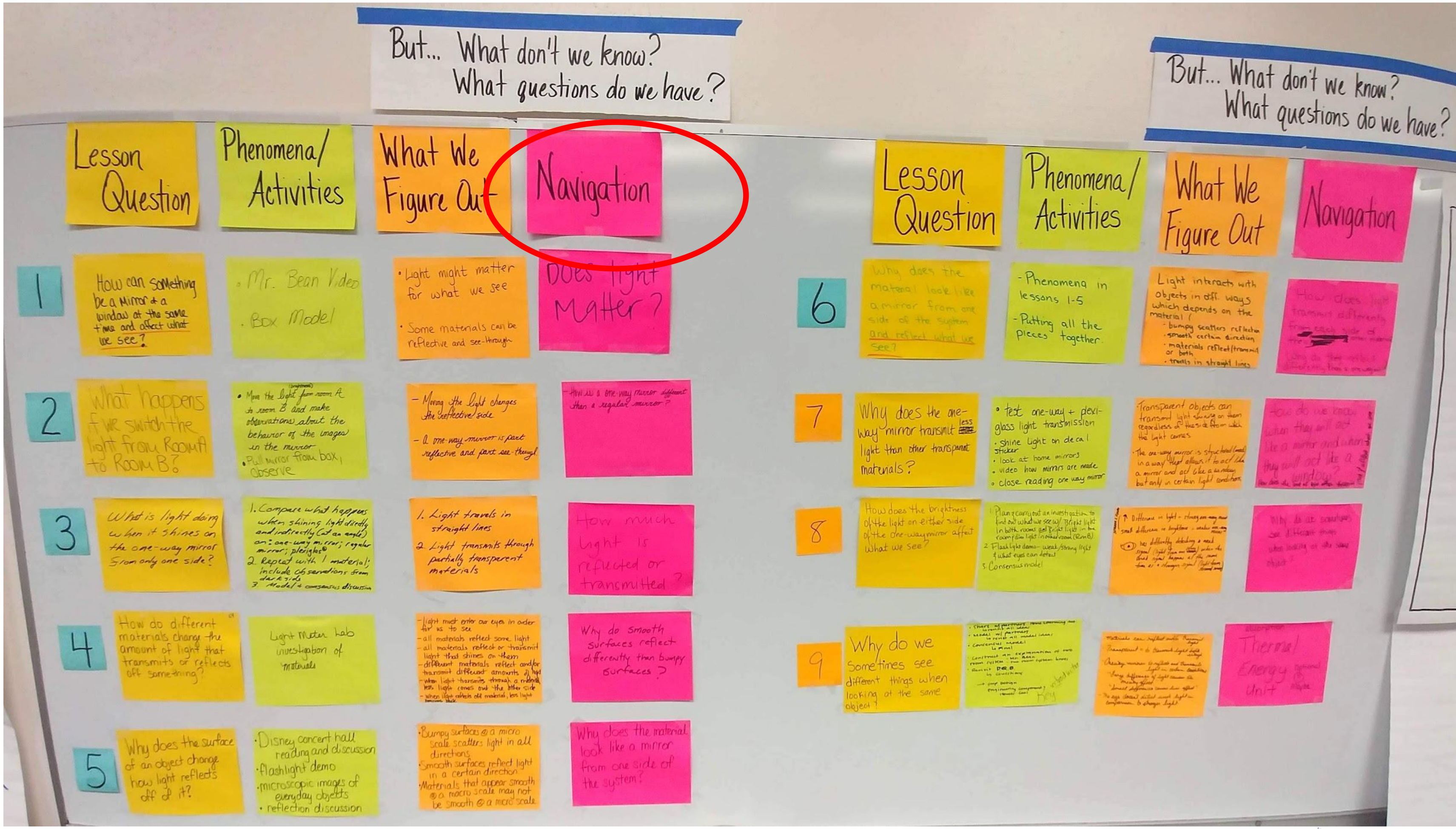
Navigation Routine – building towards coherence

NAVIGATION ROUTINE



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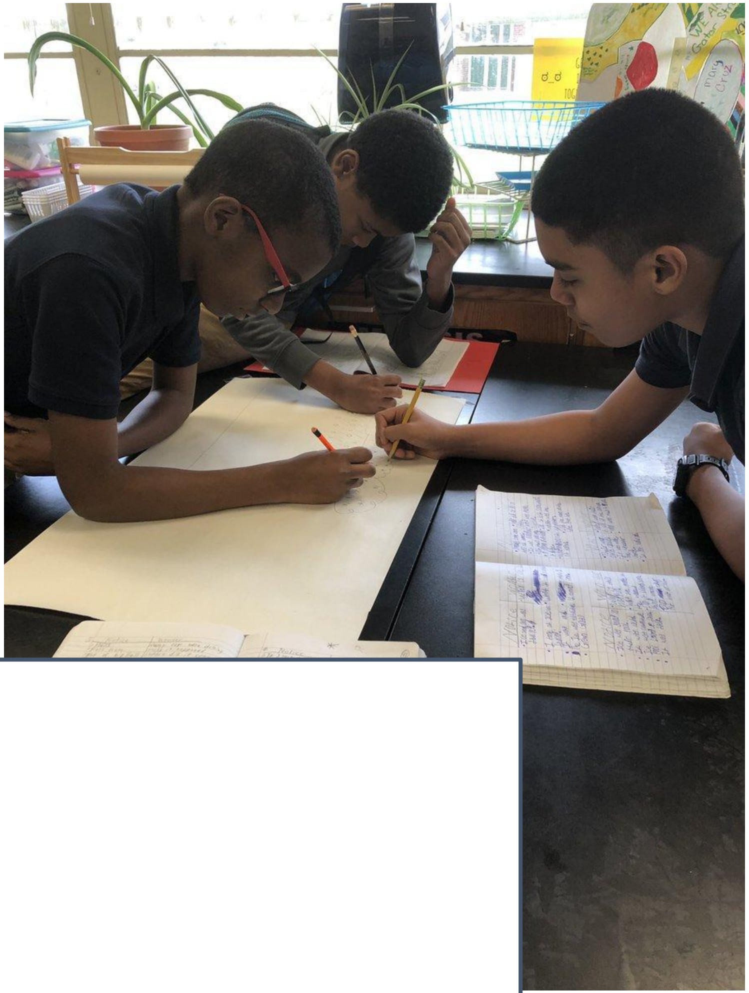
Investigation Routine

INVESTIGATION ROUTINE



Planning an Investigation

In your digital notebook

3. Record the following question in the "Question" box at the top of the T-chart below:

    a. "Can we hear sounds coming from a container with no air inside?"

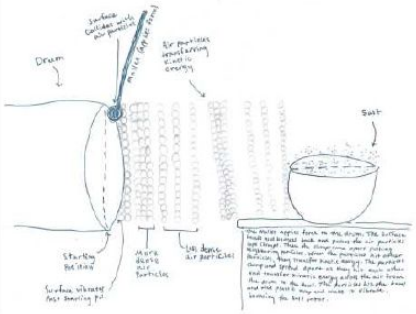
Tindall_OSE View Student Work

B x^2 x_2 Symbols Play Student recording

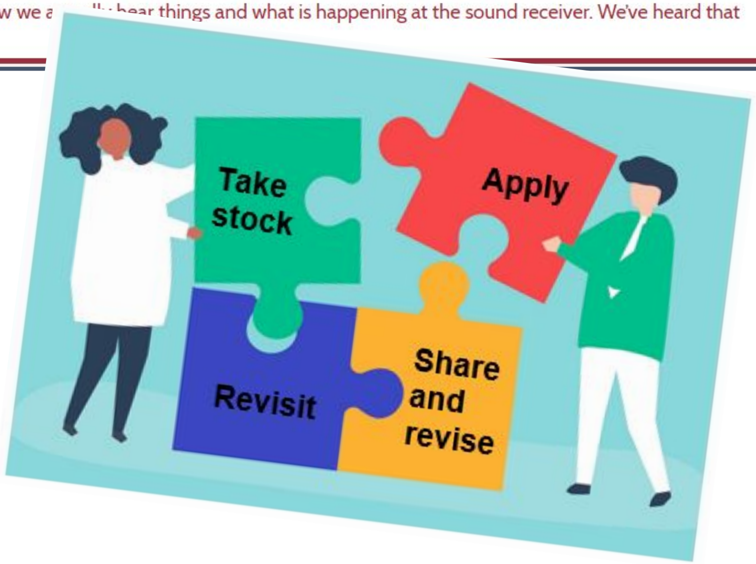
Question:	
4a. What are the possible outcomes of our investigation?	**4b. What would each outcome tell us about the question we're investigating?**

Putting the Pieces Together Routine

PUTTING THE PIECES TOGETHER ROUTINE

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 11 2 days **How does sound make matter around us move?** Putting Pieces Together	 *Salt on plastic wrap stretched over a bowl jumps up and down when a drum nearby is hit.*	We develop a model to explain a new phenomenon: salt jumping on plastic wrap when a drum is hit. We develop a checklist that includes the key ideas we have developed about how sounds are caused and how sound can cause other things to move. Then, we apply that checklist to revising the model that explains why a window near the parking lot moved when a truck speaker was blasting music.	

⇓ **Navigation to Next Lesson:** We have a good idea about how sound travels, but we still have a lot of questions about how we a ll hear things and what is happening at the sound receiver. We've heard that there's a body part called the eardrum, so we wonder how that might fit in with what we already know about sound.



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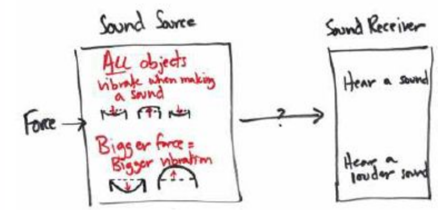
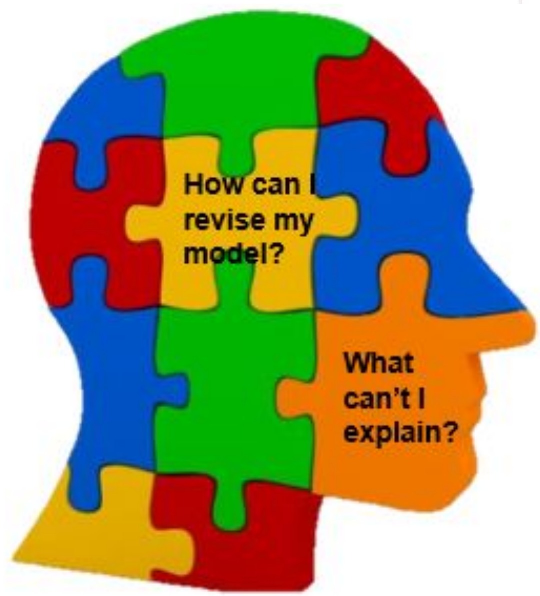
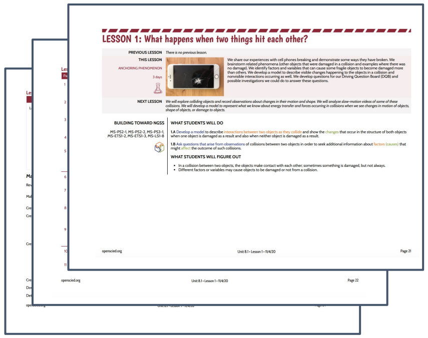
Problematizing Routine

PROBLEMATIZING ROUTINE

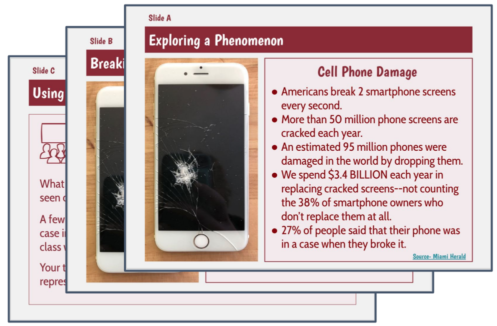
Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 3 2 days **Do all objects vibrate when they make sounds?** Problematizing, Investigation	 *A laser directed at a mirror on a drum, table, and speaker lets us better see the vibrations that happen when those objects make sounds.*	We investigate whether different solid objects, even ones that don't appear to move, vibrate while making sounds. Since those vibrations are happening on a scale we can't easily see, we set up and use a simple device with a laser and a mirror to "zoom in" on those objects when they're making sounds. We observe how the same object vibrates differently when making different sounds and use claim, evidence, reasoning charts to argue for how solid objects move when they make sounds. We figure out: • All objects move back and forth (vibrate) when making sounds. • Objects vibrate further back and forth (deform more) when a greater force is applied, creating louder sounds.	



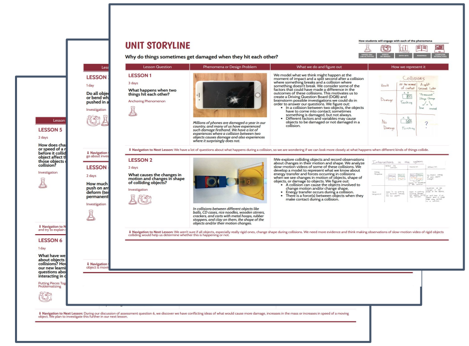
What resources make up each unit?



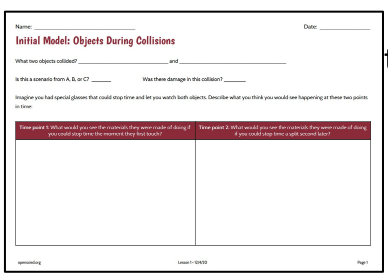
Teacher Guide



Class facing slides



Unit storyline
& teacher handbook

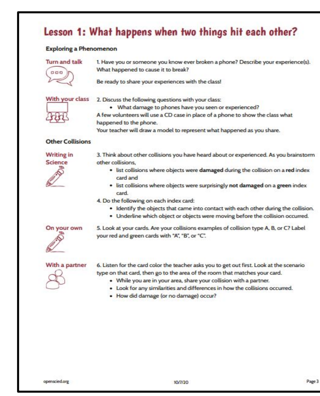


Added
to notebook

Student
Consumables

Student Notebook

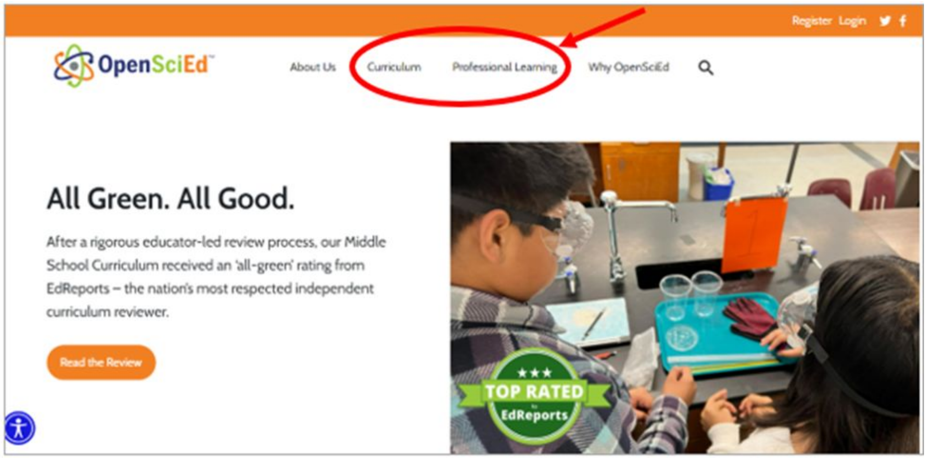
Provides
procedures,
directions, and
reference data



Student Non
Consumables

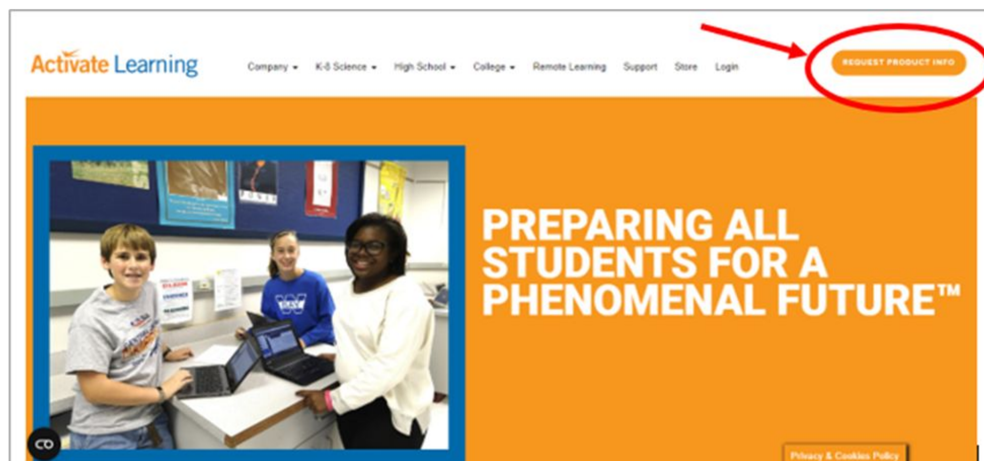
OpenSciEd + Activate Learning

https://www.openscied.org/



Open Education Resource =
FREE access

https://activatelearning.com/



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