4-12-2024

Promoting Productive Discussions with OpenSciEd

Michelle Tindall

SCIENCE EDUCATION UPDATE CONFERENCE

Promoting Productive Discussions with OpenSciEd

Michelle Tindall

mtindall@activatelearning.com

Professional Learning Facilitator

OpenSciEd CERTIFIED

Activate Learning VERSION

WHO'S IN THE ROOM?

Welcome!

OpenSciEd CERTIFIED

Activate Learning VERSION

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.

OpenSciEd CERTIFIED
Activate Learning VERSION

1

Intro to OpenSciEd Routines

2

Experiencing a Phenomenon

3

Discourse in OpenSciEd

4

Questioning Tools

OpenSciEd CERTIFIED

Activate Learning VERSION

1

Intro to OpenSciEd Routines

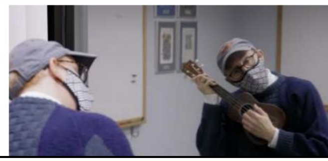
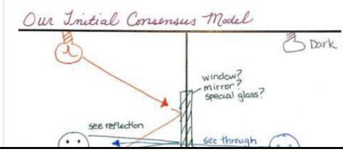
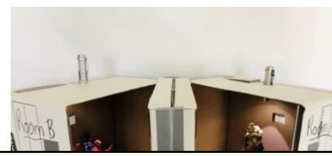
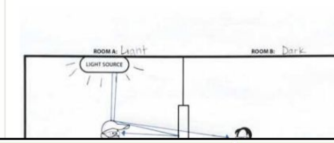
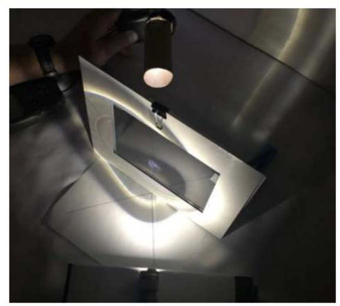
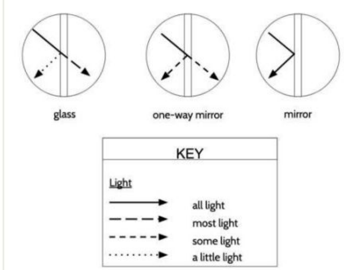
OpenSciEd
CERTIFIED
Activate Learning
VERSION

The goal of a science storyline approach is to provide students with a coherent experience that is motivated by the students' own desire to explain something they don't understand or to solve a problem.

UNIT STORYLINE

Unit Question: Why do we sometimes see different things when looking at the same object?

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 4 days **How can something act like a mirror and a window at the same time?** Anchoring P...		We watch a puzzling video of a music student who can see his reflection in what seems to be a mirror. The student doesn't see the teacher on the other side of the mirror, but the teacher can see through it like a window. We wonder how something can act like a mirror and window at the same time. We investigate the system using a box model that represents it. We develop an Initial Class Consensus Model, brainstorm related phenomena, and develop a Driving Question ...	
LESSON 2 3 days **What happens if we change the light?** Investigation		In this lesson, we observe the one-way mirror in and out of the box model. We move the flashlight to Room B, make both rooms light, and make both rooms dark. We figure out these things: • When we change the location of light in the box system, the phenomenon reverses. • Reflection happens on the side that is lit, while the side that is dark is see-through.	
LESSON 3 3 days **What happens when light shines on the one-way mirror?** Investigation	 *Different materials reflect and transmit different amounts of light, as measured quantitatively by a light meter.*	We know that the one-way mirror acts like a mirror in a brightly lit room and acts like a window in a dark room. To figure out why it behaves this way, we compare what happens when light shines on the one-way mirror, a pane of glass, and a regular mirror. We record initial observations and then use a light meter to measure the amount of light transmitted through and reflected off each of those materials. We use a tool to develop an experimental question and then plan the investigation. We document our observations and analyze data to figure out what happens when light shines on the one-way mirror. We figure out these things: • Light travels in straight lines. (reinforcing 4th grade) • When light shines on an object, it is reflected (bounces off), transmitted (passes through), or some combination of these, depending on the object's material.	

⇓ Navigation ... from Room ...

⇓ Navigation to Next Lesson: ... phenomenon would change if ...

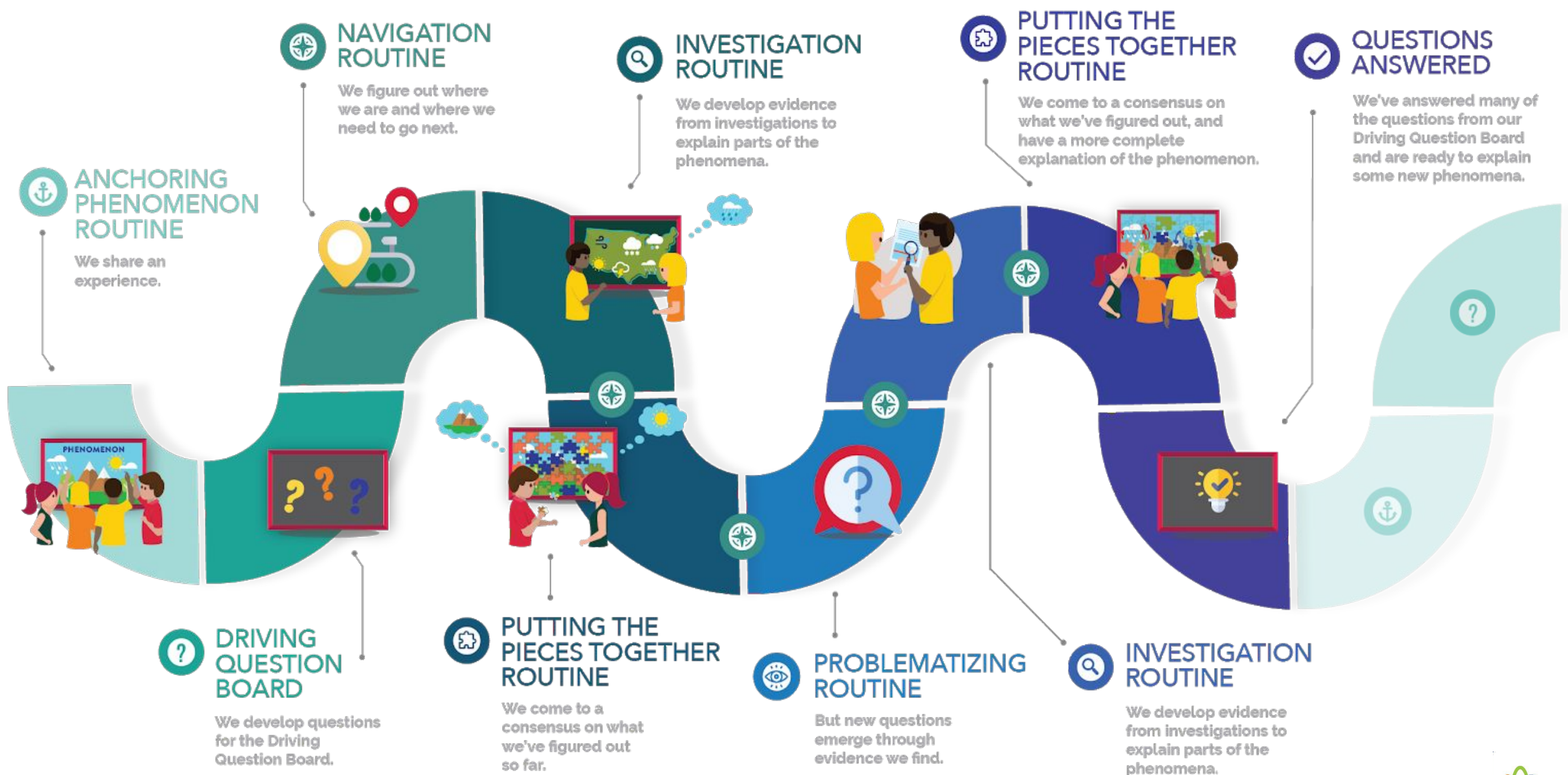
⇓ **Navigation to Next Lesson:** We think the one-way mirror acts like a regular mirror because the two materials have something in common. But, we know they are not exactly the same, since the one-way mirror lets some light transmit and the mirror doesn't. Our next step is to try to figure out what the one-way mirror and the regular mirror have in common.

OpenSciEd CERTIFIED

Activate Learning VERSION

OpenSciEd Instructional Model

All units are based on a science storyline



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

OpenSciEd CERTIFIED

Activate Learning VERSION

Instructional Model

Routine	Purpose
Anchoring Phenomenon routine	Develop curiosity to drive learning throughout the unit based on a common experience of a phenomenon and connections to any related phenomena students have experienced.
Navigation routine	Establish and reinforce the connections between what we have previously done in a unit, what we are about to do, what we will do in the future, and what our driving purpose is in the context of the unit.
Investigation routine	Use scientific practices to investigate and make sense of a phenomenon.
Putting Pieces Together routine	Take the pieces of ideas we have developed across multiple lessons and figure out how they can be connected together to account for the phenomenon we have been working on.
Problematizing routine	Evaluate the adequacy of our scientific ideas to explain a phenomenon in order to identify what we still need to understand.

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

2

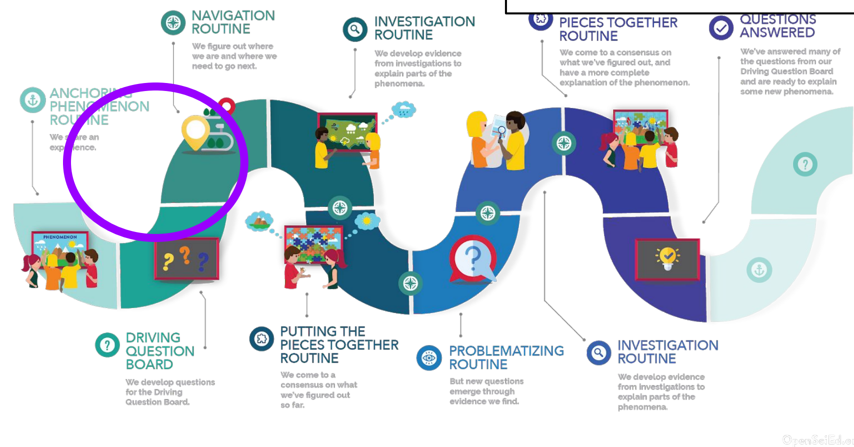
Experiencing a Phenomenon

OpenSciEd
CERTIFIED
Activate Learning
VERSION

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.

How can something act like a mirror and a window at the same time?

Activate Learning

www.activatelearning.com

OpenSciEd CERTIFIED Activate Learning VERSION

Welcome Students

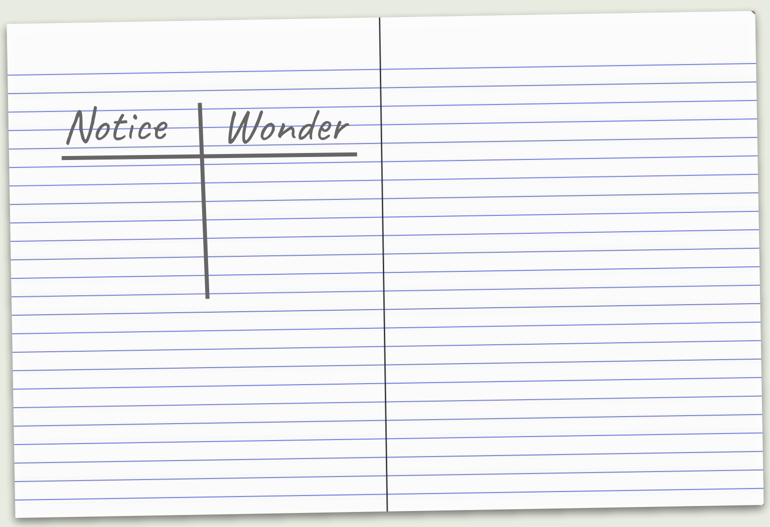
Let's DO Science!

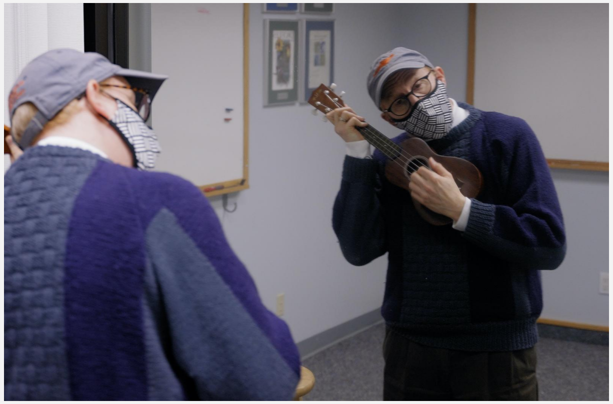
OpenSciEd
CERTIFIED
Activate Learning
VERSION

Slide A

Explore an Interesting Phenomenon

Make a 2-column chart on a blank page on the **left side** of your science notebook and record what you notice and wonder about.





Watch the video closely and record things you notice and wonder about.

INDIVIDUAL → WHOLE CLASS

Share Noticings and Wonderings

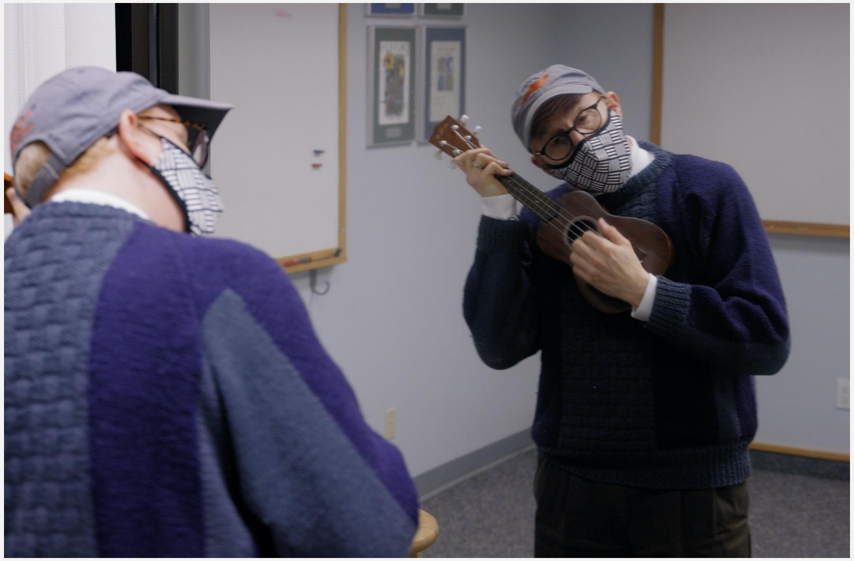
What did you notice happening in the video?
What did you wonder about?

Slide C

What do we think is happening?

Turn and Talk

- Why do the adults see the music student?
- Why does the music student see themself and not the adult?



Slide D

Initial Explanations

What "parts" or "components" from the scene in the video do we think are important for explaining the phenomenon?

What's not important?

What are we not certain about?

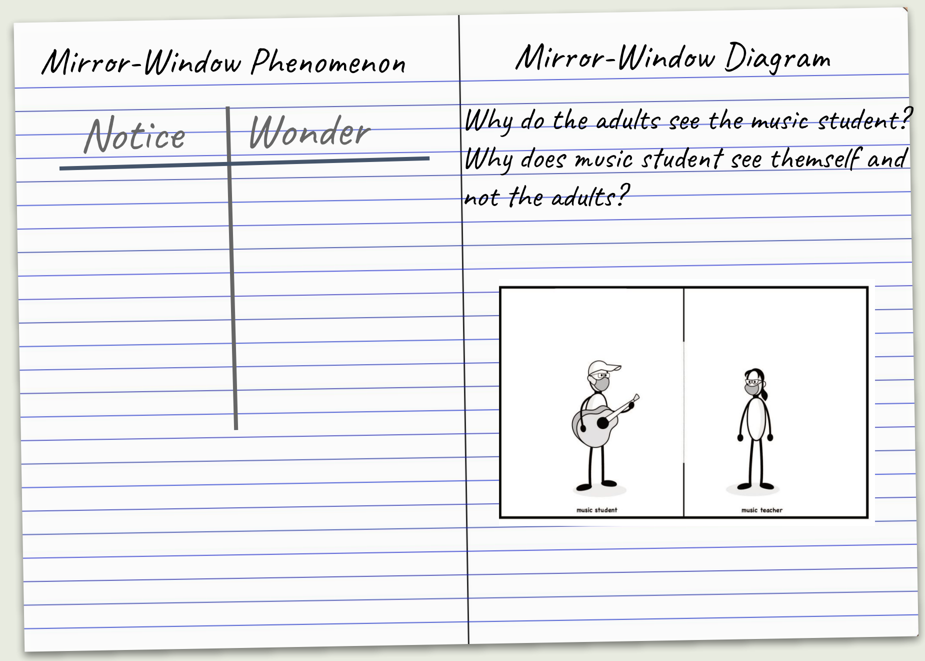
Develop a Diagram

Write these two questions in your science notebook:

- Why do the adults see the music student?
- Why does the music student see themself and not the adults?

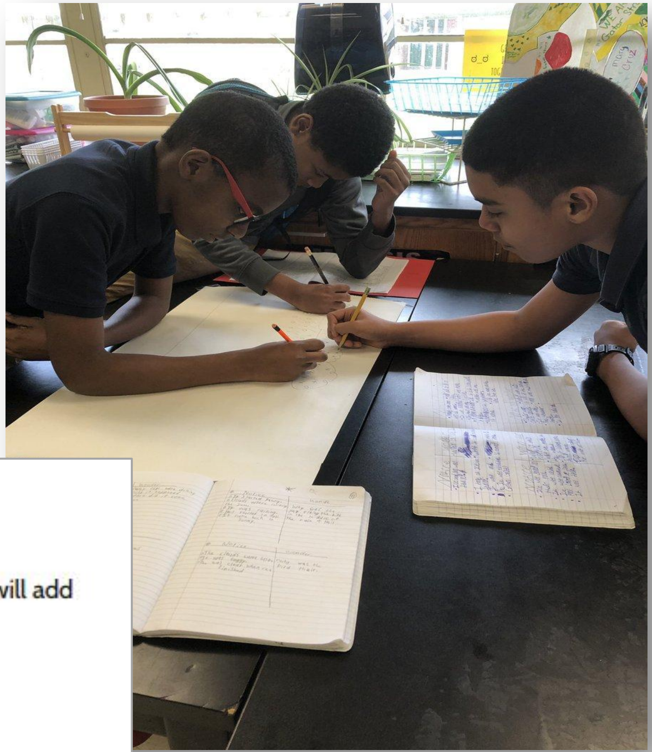
Create a diagram to explain as much as you know about the two questions.

- ❏ Include all the important parts we agreed on and label them.
- ❏ Use pictures, symbols, and words to explain **how the parts interact** to cause the phenomenon.
- ❏ Record questions that you have if you become stuck.



Investigation Routine

INVESTIGATION ROUTINE



Investigate Using the Box Model

In your notebook

13. Locate your Notice and Wonder chart.
14. Draw a line below your last noticing from the video. Below this line you will add noticings from the *Box Model Investigation*.

With your group

15. Turn on the flashlight for Room A.
16. Peek through the viewing hole for Room A. Record noticings to your Notice and Wonder chart.
17. Peek through the viewing hole for Room B. Record noticings.
18. Turn off the flashlight.
19. Add wonderings to your chart.
20. If time allows, remove Room A from the box model.

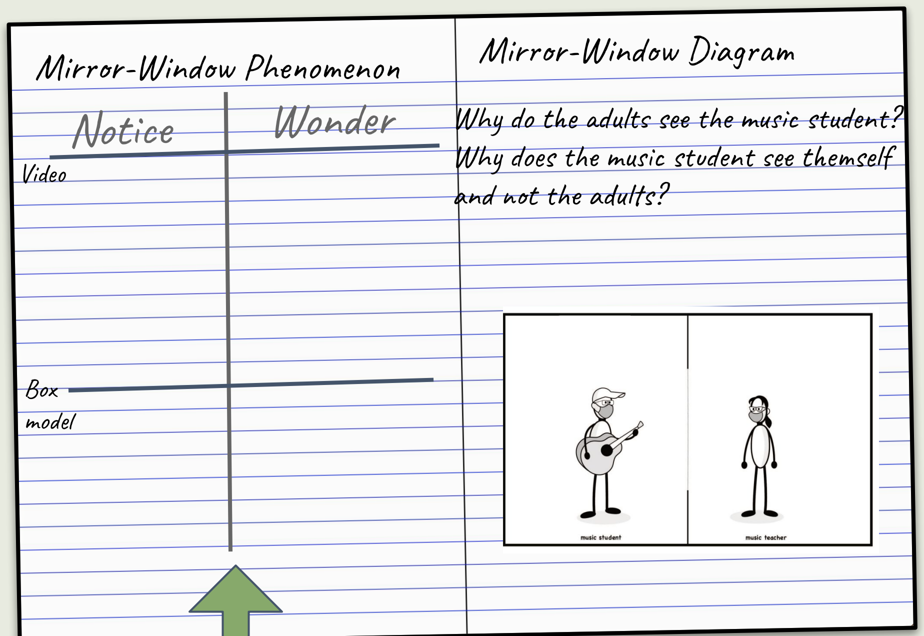
- Purpose is to use questions around a phenomenon that lead the class to engage in science practices to make sense of the phenomenon, and then develop the science ideas as part of the explanation.
- The basic structure of the work of three-dimensional learning.

OpenSciEd CERTIFIED

Activate Learning VERSION

Investigate Using the Box Model

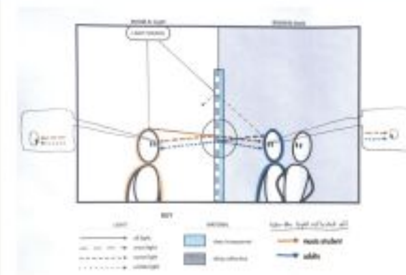
Locate your Notice and Wonder chart. Draw a line below your last noticing from the video. Add noticings from the *Box Model Investigation* to your chart.



1. Turn on the flashlight for Room A.
2. Peek through the viewing hole for Room A. Record noticings to your Notice and Wonder chart.
3. Peek through the viewing hole for Room B. Record noticings.
4. Turn off the flashlight.
5. Add wonderings to your chart.
6. If time allows, remove Room A from the box model.

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 5 1 day **How do light and the one-way mirror interact to cause the one-way mirror phenomenon?** Putting Pieces Together, Problematizing	 *The one-way mirror acts as a mirror on the lit side and as a window on the dark side.*	In this lesson, we revisit the anchoring phenomenon and model interactions between light, the people, and the one-way mirror to explain why the music student and the adults all see the music student. We realize that a little light reflects off the adults and enters the student's eyes, which makes us wonder why the student doesn't see the adults. We figure out these things: • When light reflects off the music student and travels to the one-way mirror, about half of the light reflects off the silver structures back to the student's eyes and the other half transmits through the transparent parts to the adult's eyes. • The light that transmits through the one-way mirror reflects off the adults and travels to the one-way mirror. About half of that light reflects off the silver structures back to the adult's eyes and the other half transmits through the transparent parts to the student's eyes.	

⇓ **Navigation to Next Lesson:** We figure out that there are two light inputs into the student's eyes: light that has reflected off the student and light that has reflected off the adults. We wonder why the student doesn't see the adults, and we share initial ideas.

- Students take the pieces of ideas they have developed across multiple lessons and figure out how they can be connected to account for the phenomenon the class is working on.
- Serves to help students take stock of their learning and engage with the class to develop a consensus representation, explanation, or model to account for the target phenomenon.

Problematizing Routine

PROBLEMATIZING ROUTINE

LESSON 8

3 days

Why do we sometimes see different things when looking at the same object?

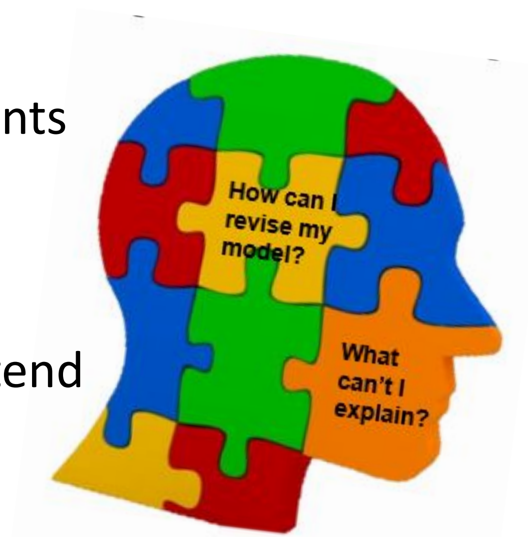
Investigation, Putting Pieces Together

Materials like glass can act like one-way mirrors when there is a differential in light on both sides of the glass.

We investigate the best light conditions for the one-way mirror phenomenon to occur and decide the effect is greatest when there is a large difference in light on both sides of the material. We use this idea to investigate related phenomena. We conclude that other materials, like glass, can act like one-way mirrors in situations in which there is a similar light differential on either side of the material. We use our model and science ideas to demonstrate what we have learned on an assessment. We revisit the DQB to document the questions we have answered in the unit and to reflect on our learning. We figure out these ideas:

- Differences in light on either side of an object or material can cause us to see different things when looking at the same object or material.
- The brighter or more prominent an object appears, the more light that reaches our eyes from the object.

- Reveal a potential problem with the current model, explanation, or design solution in order to motivate students to extend or revise their models.
- Teacher seeds, cultivates, and capitalizes on an emerging disagreement that reveals the potential problem and gets students to focus on an important question that could extend their models.



3

Discourse in OpenSciEd

OpenSciEd CERTIFIED

Activate Learning VERSION

OpenSciEd Discussion Types

Initial Ideas Discussion	Get ideas out on the table and have students hear and work with those ideas
Building Understanding Discussion	Make sense of what we have done and draw on evidence we have collected
Consensus Discussion	Create a class-level explanation or model highlighting where we agree and where we still disagree or have questions.

Teacher Handbook pgs. 38-39

Initial Ideas Discussion

Purpose

- To share students' initial ideas and experiences
- To help students make connections between what they are figuring out in the classroom and what they have seen or experienced outside of school
- To provide a chance to share and make sense of ideas-even if those ideas are tentative or still being formed

When This Type of Discussion Is Useful

- During the Anchoring Phenomenon routine
- During the Investigation routine
- During the Problematizing routine
- Any time students are beginning the process of making sense of a phenomenon

Strategies for This Type of Discussion

1. Provide a way for all students to surface their ideas (think-pair-share is one strategy).
2. Encourage students to use multimodal communication to express their thinking (such as gestures, graphical representations, etc.) and allow them to use all of their linguistic resources (this could include multiple languages).
3. Give students a chance to clarify one another's ideas and to ask about students to expand on what they have said and explain their thinking.
4. Ask a student to summarize the class's initial ideas.
5. Ask students how they might test or further explore their ideas.

LESSON 1

4 days

How can something act like a mirror and a window at the same time?

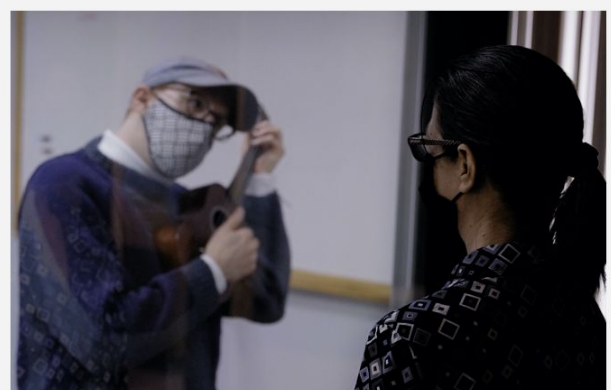
Anchoring Phenomenon

Slide C

What do we think is happening?

Turn and Talk

- Why do the adults see the music student?
- Why does the music student see themself and not the adult?



OpenSciEd CERTIFIED
Activate Learning VERSION

OpenSciEd CERTIFIED
Activate Learning VERSION

Building Understanding Discussion

Purpose

- To share, connect, critique, and build on others' findings, claims, evidence, and explanations
- To provide the teacher and students with an opportunity to clarify which aspects of the questions and problems the class has identified have been addressed and developed and which need further investigation

When This Type of Discussion Is Useful

- During the Navigation routine
- During the Investigation routine
- During the Putting the Pieces Together routine
- Any time students have been exploring new ideas

Strategies for This Type of Discussion

1. Invite a student or group to share their current explanatory model or design solution with the class.
2. Invite others to ask questions about the model or solution, suggest additions to it, and critique the model or solution.
3. Invite a second student or group of students to share their model or solution, and then invite response and critique.
4. Ask students how the proposed models or solutions are similar and different.
5. Invite the class to consider what might need to be revised in the models or solutions, based on the models seen and the evidence which has thus far been gathered and made sense of.

Slide P

Building Understandings Discussion: Dark in Both Rooms

What would happen if it was dark in both rooms?

- What did you observe when you made this change?
- What do you think is happening?
- How did you represent what was happening?

LESSON 2

3 days

What happens if we change the light?

Investigation

LESSON 1

4 days

How can something act like a mirror and a window at the same time?

Anchoring Phenomenon

Slide D

Initial Explanations

What "parts" or "components" from the scene in the video do we think are important for explaining the phenomenon?

What's not important?

What are we not certain about?

OpenSciEd
CERTIFIED
Activate Learning
VERSION

Consensus Discussion

Purpose

- To collectively work towards a common (class-level) explanation or model. This includes capturing the areas of agreement for which the class has evidence as well as areas where the class still disagrees and might need further evidence
- Take stock of where the class is in its figuring out and support the public revision of earlier ideas

When This Type of Discussion Is Useful

- During the Putting Pieces Together routine
- Any time students have had the opportunity to construct new understandings

Strategies for This Type of Discussion

1. Ask students to take stock of where the class has been and what it has figured out, offering conjectures or pieces of a model, explanation, or solution.
2. Ask students to offer proposals for a consensus model, explanation, or solution.
3. Ask the class who agrees, disagrees, has alternatives, or questions about each proposed idea.
4. Ask students to support or challenge proposed models, explanations or solutions and to say what evidence is the basis for their support or critique.
5. Ask students to propose a modification to the model, explanation or solution based on input from the class.
6. Scribe what the class agrees on, and track where the class has open questions or disagreements.

Slide G

Why doesn't the student see the adults?

The adults are in a dark room, but it's not completely dark. They are lit up a little. Why doesn't the student see them?

Turn and Talk

- Where is the light coming from that lights up the adults?

LESSON 5

1 day

How do light and the one-way mirror interact to cause the one-way mirror phenomenon?

Putting Pieces Together, Problematizing

Scientists Circles

Using a Scientists Circle for Equitable Discussions

A Scientists Circle reconfigures the learning space so students sit in a circle and can see and speak directly to each other.

While it can be convened at any point in a lesson, it is most often used at moments in which the class needs to work toward consensus on ideas they have figured out.

SCIENTISTS CIRCLE

You will form a Scientists Circle in many future lessons as well. Setting up the norms and logistics for forming, equitably participating in, and breaking down that space is important to do if this is your first time forming such a space. Having students sit in a circle so they can see and face one another can help build a sense of shared mission and a community of learners working together. Returning to this Scientists Circle throughout the course of the unit to take stock of what the class has figured out and where they need to go next will be an important tool in helping the class take on greater agency in steering the direction of their learning. This circle will also help build a sense of pride in their work. You may want to inform students that professional scientists collaborate with one another to brainstorm, discuss, and review their work also.

OpenSciEd CERTIFIED

Activate Learning VERSION

4

Questioning Tools

OpenSciEd CERTIFIED

Activate Learning VERSION

What is a success and a challenge you have encountered during class dicussions?

Elicit Questions

Probe or Clarify Questions

Challenge Questions

Questions to Support Science Discourse

Elicit Questions

Goal: To learn about students' prior knowledge and experiences, current understandings, and ways of making sense—whether their ideas are scientifically accurate or not.

- What are your ideas about (phenomenon)?
- What are your ideas about how to solve (this design challenge)?
- What experiences do you have that might help you think about (this phenomenon)?
- What are some ways we could test our initial thinking?
- What questions do we need to answer to solve the design challenge / explain the phenomenon?
- What are some of the key components of your model/solution?
- Could someone restate our question (or our charge)? What are we building consensus about?

Probe or Clarify Questions

- Can you say more about that?
- Where does that idea come from? Is that something you've heard, observed, or experienced before?
- What do you mean when you say the word "X"?
- Could you tell us more about that component of your model/solution?
- Can you clarify ___________ aspect of your model/solution?
- Could you clarify the link you are making between your explanation and the evidence?

Purpose: Get more information about a student's thinking and understanding. It is not designed to teach new ideas or to "lead" students to a correct answer.

Goal: Designed to push students to think further, to reconsider their thinking, to make a new connection, and/or to use new science vocabulary.

Challenge Questions

- How does this model explain the evidence we have so far about this phenomenon?
- How does this solution fit the criteria we identified for a possible solution?
- Is there any evidence you know of that's not accounted for in your model/solution?
- How could we modify what we have, so that we account for the evidence we agree is important to consider?
- Is there more evidence or clarification needed before we can come to an agreement? What might that be?

- Did anyone have a similar question to that?
- Does anyone have a different question that we haven’t talked about yet?
- Can anyone add onto this idea?
- Who has a different way of thinking about this topic?
- Who can summarize some of the ideas we’ve heard today?
- Is this a complete summary? Can someone add what they think is missing?
- What questions do you have for this group about their model/solution?
- What do the rest of you think of that idea?
- Who feels like their idea is not quite represented here?
- Would anyone have put this point a different way?

Purpose: To explicitly support students in communicating in scientific ways with one another.

Questions to Support Science Discourse

OpenSciEd CERTIFIED

Activate Learning VERSION

What helps you differentiate between the four types of questioning strategies?

Communicating in Scientific Ways

OpenSciEd

How we figure things out	Symbol	How we communicate
1. Ask why and how questions		How come ...? I wonder ... Why ...? How do they know that ...?
2. Observe		I see .... I noticed ... I recorded .... I measured ...
3. Organize data and observations		I see a pattern ... I think we could make a graph ... Let's make a chart ...
4. Think of an idea, claim, prediction, or model to explain your data and observations		My idea is ... I think that ... We could draw a picture to show ... I think it looks like this ...
5. Give evidence for your idea or claim		My evidence is ... The reason I think that is ... I think it's true because ...
6. Reason from evidence or models to explain your data and observations		The reason I think my evidence supports my claim is because .... The model shows that ...

How we figure things out	Symbol	How we communicate
7. Listen to others' ideas and ask clarifying questions		Are you saying that ...? What do you mean when you say ...? What is your evidence? Can you say more about ...?
8. Agree or disagree with others' ideas		I agree with _____ because... I agree with you, but I also think... I disagree with ______ because... I know where you are coming from, but I have a different idea... I am thinking about it differently...
9. Add onto someone else's idea		I want to piggyback on April's idea. I want to add to what Jeremiah said.
10. Search for new ideas from other sources		We could get some new ideas from ...
11. Consider if new ideas make sense		That idea makes sense to me because ... That idea doesn't make sense because ... What's their evidence?
12. Suggest an experiment or activity to get more evidence or to answer a new question		What if we ...? We could get better evidence if we ...?
13. Let your ideas change and grow		I think I'm changing my idea. I have something to add to my idea.

Scaffolding supports for students

OpenSciEd CERTIFIED

Activate Learning VERSION