LESSON 3: What is light doing when it shines on the one-way mirror from only one side?

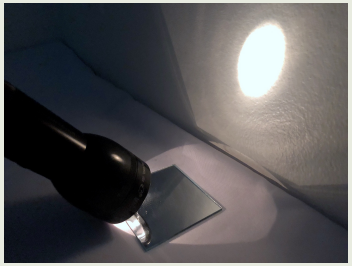
PREVIOUS LESSON

We moved the flashlight to Room B and the phenomenon reversed. We observed the one-way mirror in the classroom and saw that it was partially reflective and partially see-through. We thought light was causing us to see different things in each system. We wondered what would happen if we shined a light directly on the one-way mirror.

THIS LESSON

INVESTIGATION

2 days



We wonder how the one-way mirror is like a regular mirror when light shines on it from only one side. We investigate the one-way mirror by shining a flashlight directly onto the one-way mirror from one side and we compare our observations to what we observe with a regular mirror. Our observations motivate us to compare the one-way mirror to a transparent piece of glass. We model the different things that happen to light when it shines on one side of different materials. We agree to use straight arrows to show the path light travels and the direction that it is moving.

NEXT LESSON

We will investigate how much light is transmitted or reflected through various kinds of materials using a light meter. We will use our observations to make a prediction about what makes some materials very reflective and some materials less reflective.

BUILDING TOWARD NGSS

MS-PS4-2

WHAT STUDENTS WILL DO

Develop and use a ray model for light to show the path light travels in different systems when it bounces off some objects in the system and goes through others.

WHAT STUDENTS WILL FIGURE OUT

- Light travels in straight lines.
- Light moves so quickly that its speed cannot be measured without special equipment.

Lesson 3 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	12 min	**ADD QUESTIONS TO THE DQB** Have students share new questions that have arisen from investigations and post these questions to the DQB.	A	notecards, markers, Driving Question Board,
2	8 min	**BRAINSTORM WHAT TO TEST IN THE FLASHLIGHT INVESTIGATION** Tell students they will test the one-way mirror with a flashlight. Allow students to brainstorm different conditions they would like to try in the investigation.	B	
3	12 min	**CONDUCT THE FLASHLIGHT INVESTIGATION** Have students work in small groups to make observations of shining a flashlight on the one-way mirror and mirror in different ways.	C-D	Flashlight Investigation
4	13 min	**MAKING SENSE OF THE FLASHLIGHT INVESTIGATION** Gather students in a whole group discussion of their results. Facilitate a Building Understandings discussion and motivate the need to compare to transparent materials.	E	
				End of day 1
5	3 min	**NAVIGATION** Introduce the lesson question and ask students to summarize their observations of light shining on the three materials: one-way mirror, mirror, and glass.	F	
6	8 min	**MODEL ONE MATERIAL IN SMALL GROUPS** Have students work in groups to model one of the three materials they tested in the Flashlight Investigation. They should draw their models on a white sheet of paper to post around the classroom.	G	1 - 8 x 11.5 piece of white copy paper, colored pencils,
7	12 min	**GALLERY WALK TO VIEW OTHER MODELS** Preview with students the norms and purpose for the gallery walk. Then give students time to make observations from other groups' models.	H-J	
8	18 min	**FACILITATE A CONSENSUS DISCUSSION ON HOW TO MODEL LIGHT** Facilitate a whole group sharing from the gallery walk and then transition to a consensus discussion about how to represent the path light travels.	K	1 flashlight, 1 laser pointer, 1 sheet of paper,
9	3 min	**NAVIGATION** Pose the question to students about whether the one-way mirror seems more like a window or a mirror and brainstorm how we could test this.	L	
				End of day 2

Lesson 3 • Materials List

	per student	per group	per class
Flashlight Investigation materials		• 1 flashlight • 1 - 8 x 10 one-way mirror film in picture mats • 1 - 8 x 8 mirror	
Lesson materials	• science notebook	• notecards • markers • 1 - 8 x 11.5 piece of white copy paper • colored pencils	• Driving Question Board • 1 flashlight • 1 laser pointer • 1 sheet of paper

Materials preparation (15 minutes)

Review teacher guide, slides, and teacher references or keys (if applicable).

Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

Have white copy paper, chart paper, markers, and colored pencils ready for day 2 modeling.

Day 1: Flashlight Investigation

- **Group size:** 3
- **Setup:** Prepare a lab bin for each group containing 1 flashlight, 1 - 8 x 10 one-way mirror film in picture mats, 1 - 8 x 8 mirror, and 1 - 8 x 8 plexiglass.
- **Notes for during the lab:** Remind students to handle materials with caution, especially the mirrors. Students should not shine flashlights directly into another student's eyes or bounce light from a mirror into another student's eye.
- **Safety:** Do not use mirrors that have exposed sharp edges. If the edges of your mirrors are sharp, wrap the edge with thick tape, like duct tape. Plexiglass will likely not shatter when dropped, but glass mirrors will. Remind students to be careful when handling materials and if a material is dropped and shatters, to follow your safety protocols to have you handle the sharp objects.
- **Disposal:** Most single-use batteries can be disposed of in your regular classroom waste. Batteries can also be recycled at special locations and recycling events. Rechargeable batteries contain hazardous material and must be recycled at a special location and cannot be discarded with regular waste.
- **Storage:** All materials can be safely stored in a regular classroom cabinet or closet. For long-term storage, remove batteries from the flashlights and store in a cool, dry location.

Lesson 3 • Where We Are Going and NOT Going

Where We Are Going

In this lesson, students review and add to their understanding of a ray model of light. In fourth grade, students develop ray models to explain how light reflects from objects to our eyes in order for us to see the object. In this lesson, students apply the ray model of light to explain the different paths light travels when it shines on a mirror, a piece of glass, and on the one-way mirror. The lesson ends with students agreeing to use straight arrows to show the path and direction of light and discussing how light travels across a space. Depending on your students' familiarity with a fourth grade ray model for light, make adjustments to either move quickly through the development of this model or spend time as needed. This lesson is intended to reinforce fourth grade science because students will move beyond fourth grade science after this point in the unit.

Where We Are NOT Going

This lesson cycles back to content from earlier grades, in terms of how we see objects through reflection, but the lesson does not repeat how light enters the eye for us to see, or how shadows form. Rather, there are brief reminders that allude to these ideas but an assumption students already know this content. The focus of this lesson should remain on establishing a shared way to represent light using straight lines in the context of reflection off of and transmission through materials and that light is traveling at a speed we cannot detect without special equipment. While students are thinking about angles of light changing, they are *not* working toward an explanation that includes the angle of incidence (the angle at which light shines on the material) and angle of reflection (the angle at which light reflects back from the material).

LEARNING PLAN for LESSON 3

1 · ADD QUESTIONS TO THE DQB

12 min

MATERIALS: science notebook, notecards, markers, Driving Question Board

Ask students to share ideas they developed in the previous lesson. Prompt 3-4 students to share some important ideas they think the class figured out together in the last lesson. Listen for ideas, such as:

- When there is light on one side, it can be a mirror. From the dark side, it can be a window.
- When there is light all around it, it's the same from either side.
- It can only be a one-way mirror if there is a difference in light.

Say, *These are some really important things we've already figured out. We know more about the conditions that are needed for these materials to act like a mirror and window. We need light at one side, but probably not the other side. Now that we know more, let's take another look at our Driving Question Board to see if we want to add to or change some of our questions.*

Brainstorm new questions for the Driving Question Board (DQB).✱ Arrange students in small groups of 3-4 students to brainstorm questions. Display **slide A** for guidance if necessary. Have students share questions that may have emerged for them in the previous lesson. Students can also revise existing question on the board. Prompt each group to write at least 2 new questions or to revise 1 question as a group. Give groups about 3-4 minutes to complete this work. As students work, encourage them to work on writing open-ended questions that cannot be answered with yes or no.

Share new questions and add to the DQB. Bring groups back together, and give each group 1 minute to present their new questions and post to the DQB. As each group shares, ask if any other group had a similar question. To facilitate the sharing of questions, use the following prompts:

- What new questions do you have that connect to questions already on our DQB?
- Did anyone else have a similar question?
- Did anyone have questions that are not represented on our DQB yet?

Don't linger too long on this activity. Use the time to allow students to add new questions to the DQB and also to motivate the need to learn more about how light is interacting with the one-way mirror in different conditions. To wrap up the second pass at the DQB say, *We all seem to think that where you place the light affects how the one-way mirror works. Let's continue some more investigations about this.*

✱ SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS

The second pass at adding to the DQB is an opportunity for students to:

- use evidence they have collected from investigations to answer their initial questions, revise those questions, or generate new questions.
- brainstorm new questions that they can pursue through investigations.
- to ask questions that arise from their experiences and will continue to focus and motivate their learning.

2 · BRAINSTORM WHAT TO TEST IN THE FLASHLIGHT INVESTIGATION

8 min

MATERIALS: None

Remind students of where they ended in the previous class. Say, *Last time we observed that the one-way mirror becomes either fully or partially reflective like a mirror or fully or partially see through like a window. We thought it might be because the lighting was different. But why would having light on one side and dark on the other side matter? Let's try to figure this out.*

Plan the one-way mirror and flashlight investigation as a class.✱ Display **slide B**. Tell students that we are going to investigate the one-way mirror with a flashlight in a darkened room. Ask the following two questions.

- What things do we want to try to investigate by shining a light on one side of a one-way mirror?
- What do we hope to figure out from doing it?

Ask students to turn and talk with a partner to share their ideas to these questions. After one minute of partner sharing, return to a whole group and ask one student to share what their partner came up with. Ask the first student who shared to call on another student to share next. Continue until all major ideas are shared. As students share, consider recording students' ideas on chart paper or a

✱ SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS

Day 1 of this lesson focuses on allowing students to investigate "what happens if" questions generated in lesson 1 (e.g., what if we change the angle of the light). In day 2, the focus of the lesson will transition to an open-ended question that prompts students to model what happens to light when it shines on materials. You should make explicit the transition from 'what if'

whiteboard for all class members to see.

Listen for students to share suggestions, such as:

- Observe it from both sides to see if it works like a one-way mirror when the room is darker on both sides.
- Shine a flashlight on the one-way mirror on one side – kind of like the box system with it dark everywhere else.
- Look closely at the one-way mirror with the light shining on it to see if it has any special features.
- Shine the flashlight on the one-way mirror at different angles.

Motivate the need to compare the one-way mirror to glass and a regular mirror. Ask students, *What do you imagine we'll see when we shine the light on the one-way mirror with is dark everywhere else?* Listen for students to say:

- It should be like a mirror.
- It should reflect light like a mirror because it's dark on the other side.
- We'll see ourselves in it because it's dark on the other side.

Students may not mention wanting to make comparisons to a mirror, but suggest to students that they should repeat all these same tests with a mirror as a comparison to the one-way mirror to see if it truly becomes a mirror when it's dark on the other side.

questions to the open-ended questions so that students see how the two kinds of questions can work together in an investigation.

3 · CONDUCT THE FLASHLIGHT INVESTIGATION

12 min

MATERIALS: Flashlight Investigation, science notebook

Set up the science notebook for the Flashlight Investigation. Project **slide C.** Before students begin investigating, have them find a new page in their science notebook. They should title the page "Flashlight Investigation." Below the title they should draw an observation table to record their findings. Label one column "directly overhead" and the other "at an angle" so they can record findings shining the light in different ways on the one-way mirror and mirror.

Conduct the Flashlight Investigation in small groups. Display **slide D**. Organize students into small groups of 3 with a flashlight and the one-way mirror and mirror. Give students 6-8 minutes to carry out the investigation and to record responses in their observation table.

Example observations:

	Flashlight	
Material	directly overhead	at an angle
one-way mirror	*Light shines through the one-way mirror onto the floor. Light is reflected back onto the ceiling. There is a shadow where we are holding the light.*	*Light shines through the one-way mirror onto the wall instead of the floor. The light no longer reflects on the ceiling but higher on the wall. The lower the angle, the closer the two reflections get.*
mirror	*Light doesn't shine through the mirror but some shines around it. There is a shadow. We see that light reflects to the ceiling.*	*There is still a shadow from the mirror and no light shines through on the lower wall. There is more light shining around the mirror onto the wall. The circle of light reflecting onto the ceiling moved lower onto the upper wall.*

ADDITIONAL GUIDANCE

If students use the words reflect or transmit, probe students about what those words mean to them. If students have yet to bring those words into the discussion, continue to use the language they are comfortable using (e.g., words such as bounces off, goes through, and shines). Throughout this lesson and the next, consider where it makes sense to introduce students to those terms if they have yet to come up through discussion and to develop their understanding of what the words mean.

4 · MAKING SENSE OF THE FLASHLIGHT INVESTIGATION

13 min

MATERIALS: science notebook

Share results as a class through a Building Understandings Discussion. ✱ Gather students back into a whole group discussion to share findings. Display **slide E**. Ask each group of students to share one thing that they recorded in their observation table. Check to see if others found the same results by having students show a thumbs up to agree or thumbs down to disagree with what each group shares. If students disagree, have a set of materials nearby to complete the test again as a whole group to resolve disagreements. This should not take more than 5 minutes.

KEY IDEAS

Purpose of this discussion: Use evidence from the Flashlight Investigation and related experiences to motivate wanting to compare the one-way mirror to glass too. Come to tentative agreements that the one-way mirror does really similar things with light as compared to glass and some similar things to a mirror.

Listen for:

- With glass, light shines through and reflects off of it. Changing the angle changes the direction it goes through and bounces off.
- With a mirror, light reflects off, but does not go through.
- With the one-way mirror, light goes through and bounces off somewhat like the glass.

Problematize what they observed. Say, *It's surprising that we actually found the one-way mirror was kind of the same, but also very different from the mirror in the dark. Even when it was dark all around, the one-way mirror let light pass through it but the mirror didn't. What other types of materials might be similar to the one-way mirror because it lets light through and reflects it at the same time?* Student ideas might include:

✱ STRATEGIES FOR THIS BUILDING UNDERSTANDINGS DISCUSSION

A Building Understandings Discussion is a useful kind of discussion following an investigation because the purpose is to focus students on drawing conclusions based on evidence. Your role during the discussion is to invite students to share their conclusions and claims and to push them to support their conclusions and claims with evidence. Students can disagree with each other and the class does not need to reach consensus on all ideas shared, but instead areas of disagreement can motivate future investigations. Helpful prompts during these kind of discussions include:

- What can we conclude?

- Window can let light through them and reflect at the same time.
- You can see a reflection in car windows, but they also let light through them.
- A piece of glass lets light through it, but you can blind someone if you shine the light in their eye.

Say, *It sounds like you are thinking the one-way mirror might actually be doing similar things as windows and glass. Should we try that also?*

Demonstrate the plexiglass. Obtain a piece of plexiglass and a flashlight. Ask a student to darken the classroom. Demonstrate the plexiglass for students. They will immediately see if does very similar things to the one-way mirror.

If time permits, ask students to add a third row to their observation table and then demonstrate the plexiglass again to allow students to write observations.

plexiglass	*Light shines through the glass onto the floor and there is a bright reflection of light on the ceiling.*	*The light shines through the glass and lights up a larger area which is now on the wall. There is a reflection of light on the upper wall too and as you lower the angle the reflections of light come together.*

If time does not permit students to write their observations in the third row, ask students to share observations aloud as you demonstrate.

Transition to tentative conclusions to wrap up the class. Ask students to think about the Flashlight Investigation and their related experiences and summarize the ideas they figured out. As students share, prompt students for evidence, either from the investigation or personal experiences, to support their conclusions.

Suggested prompt	Sample student response
What conclusions can we draw for the one-way mirror?	*It let light through it like the glass.* *It bounced light off like the glass and the mirror.* *The mirror was the only thing that didn't let light through it.*
Why do you think the mirror couldn't let any light through it?	*Because its solid and not clear. Light can't go through a solid.*
So what happens to light when it shines on a solid thing and can't go through?	*We saw that the mirror bounced it off.*
So even when it was dark all around the one-way mirror it still let light through it more like a window. Are you thinking the one-way mirror is more like windows or more like mirrors?	*Seems like the one-way mirror is more similar to a window or glass that can just act like a mirror sometimes.*

To close out the class, say, *It sounds like we figured out a few things that light can do when it shines on these materials. We have seen how it behaves when light shines from both sides when we examined it with the classroom lights on. It wasn't much like a mirror until we put it in a system where light shined from only one side and it was dark on the other side. Then it acted like a mirror. We have confirmed that when light shines from one side, it can reflect light like a mirror, but it can also transmit light, like a piece of glass. Let's revisit this in the next class and see if we can explain what's happening to light when it shines on the one-way mirror from one side.*

If time remains, ask students to update the Table of Contents in their science notebook.

- How did you arrive at that conclusion?
- What's your evidence?
- Does any group have evidence to support Group A's claim?
- What data do we have that challenges Group B's claim?

End of day 1

5 · NAVIGATION

3 min

MATERIALS: science notebook

Share learning about the lesson question so far. Display **slide F**. Now that students have completed some investigation, introduce the lesson question to students, *What is light doing when it shines on the one-way mirror from only one side?* Make a point to share with students how their "what happens if" questions from lesson 2 and yesterday led to this new question for them to explain.

Have students Turn and Talk for 2 minutes about what they figured out so far in their investigations that could help them answer this question.

Say, *Let's use what we know about light to explain what its doing when it shines on the one-way mirror from one side while the other side is dark.*

ADDITIONAL GUIDANCE	Reflection and transmission are two science terms that should be introduced in today's lesson if they have not emerged already. An ideal place to pause and talk about the two terms is during the consensus discussion at the end of this lesson. However, if students use those words earlier in the lesson, take the opportunity to start developing their understanding of those words in that moment. Ideally, facilitating a discussion of words and how we use them, happens best in moments in which they are already being used by some students and it becomes clear that we need to pause and develop a shared understanding of the words.

6 · MODEL ONE MATERIAL IN SMALL GROUPS

8 min

MATERIALS: science notebook, 1 - 8 x 11.5 piece of white copy paper, colored pencils

Arrange students in small groups to develop one model. Assign each group one of the three materials to model: the mirror, glass, or one-way mirror. Provide groups with a flashlight and the material that they are assigned, as well as one piece of white copy paper and colored pencils. Give groups about 2 minutes with the classroom lights off to make observations of their material again. Then turn on the lights and transition the groups to developing a model for their assigned material on the white paper provided.

To give instructions, display **slide G.** Tell students the goal of their model is to answer the question, *What is light doing when it shines on _____ material from only one side?* Remind students of what it means to model their thinking. If necessary, brainstorm the parts of the system they might need to include in their models. For example:

- the flashlight
- the material
- What light does between the flashlight and material.
- What light does once it reaches the material.
- What light does after it shines on the material (between the floor, wall, ceiling).
- Where its light and where its dark.

After 5 minutes of small group work, ask one member from each group to post their model in a location around the room that you designate. Consider posting models for the same material near each other in preparation for the gallery walk.

ASSESSMENT OPPORTUNITY	Collect students' group constructed models as an artifact to use for formative assessment. Do not grade these models as they will not provide clear measurement of students' progress and also represent early modeling work in which students are just delving into the practice of modeling. Instead, use the models to identify where students need to be pushed in terms of representing and communicating their thinking visually on models so that other students can interpret what the models are trying to explain.

7 · GALLERY WALK TO VIEW OTHER MODELS

12 min

MATERIALS: science notebook

Discuss the purpose for the Gallery Walk. Display **slide H.** Tell students that now they will have an opportunity to walk around the classroom to view other groups' models. Set up norms and expectations for the Gallery Walk, focusing on the following questions.

- Why would we want to look at other people's work?
- What's the purpose of doing that?
- When we look at a model of the material similar to our own model, what should we pay attention to?
- When we look at a model of a material different from our own model, what should we pay attention to?

Introduce 'idea pirating' and discuss which community norms to focus on. Reinforce that students can get new ideas from looking at other groups' models that they can bring back and incorporate into their own models. Introduce this concept of 'idea pirating.' Have students review the community norms and consider which norms to focus on during the gallery walk.

Then display **slide I.** Have students set up a new page in their notebook to make observations from the Gallery Walk. Students can title the page, "Gallery Walk of Models." Have students draw an observation table to organize their observations from the Gallery Walk, something like the example shown below.

	What I notice is similar	What I notice is different
one-way mirror models		
plexiglass models		
mirrors models		

Gallery walk of the different models. Display **slide J.** Remind students to look for:

- Ways they represented light.
- Ways they represented light moving between things.
- Ways they represented light reflecting and transmitting (or going through/bouncing off).
- Where it was light and where it was dark.

If you want to avoid having all students move at once, ask one group member to stand near their model to answer questions while the other two group members circulate. Have group members rotate every 2-3 minutes so that each member has 5-6 minutes to observe models and 2-3 minutes to host their group's model.

8 · FACILITATE A CONSENSUS DISCUSSION ON HOW TO MODEL LIGHT

18 min

MATERIALS: 1 flashlight, 1 laser pointer, 1 sheet of paper

Share observations of similarities and differences between the models. Ask students to return to the seats. Display **slide K**. Ask students to share their noticings from models with respect to the:

- Way each model represented light.
- Way each model represented light moving between things.
- Way they represented light reflecting and transmitting (or going through/bouncing off).
- Where it was light and where it was dark.

Ask students to share what they noticed. Record on chart paper or the whiteboard some key similarities and differences between the models.

Summarize a key idea for students that motivates a need for consistency, *A lot of us have lines or arrows coming from the flashlight, but what do those lines and arrows actually mean? Seems like we need to agree on how we are going to use lines or arrows in our models so that we don't get confused about what the arrows mean.*

ADDITIONAL GUIDANCE	Emphasize here that the lines and arrows can be used for line of sight (what we can see) or for the path of light (how light traveled from one thing to the next thing). Using an arrow for the path of light is useful because it helps trace the direction light is moving and how it interacts with different materials.

Demonstrate light traveling from flashlight and laser pointer. Suggest that in order to figure out what the line/arrows represent, we should look at the light coming from a light source. Turn off the classroom lights and turn on a flashlight. Shine the light on a wall viewable by all students. Discuss what is happening by asking:

- *Where is the light coming from?*
- *Where is the light going?*
- *How did it get there?*

Block the light coming from the flashlight with a piece of cardboard (or paper). Ask students:

- *What changes do you notice?*
- *Can the light curve around the cardboard?*
- *Which material that we investigate is this most alike?*

Change out the flashlight for a laser pointer. Ask:

- *Can you see the light traveling?*
- *How do you know it's moving from the pointer to the wall?*
- *When the laser pointer is blocked by cardboard, can the light curve around it?*

Transition to a Consensus Discussion about how to represent light.✱ Come to consensus about how we're going to use arrows in our models to represent the path the light traveled from 1) the source to the material and 2) the material to where it goes next.

✱ STRATEGIES FOR THIS CONSENSUS DISCUSSION

A Consensus Discussion is different from other kinds of discussions because the purpose of the discussion is to converge on one idea or a couple of ideas that the whole class agrees upon. In this discussion, your classroom community is pressing toward a common (class-level) explanation, model, or model representation. During this work, the class resolves disagreements where possible. Your role is to help students see where they agree and where they still disagree. Prompts that are helpful in these kinds of discussions include:

- What ideas are we in agreement about?
- Would anyone have put this point a different way?
- Who feels like their idea is not quite represented here?
- Are there still places where we disagree? Can we clarify these?

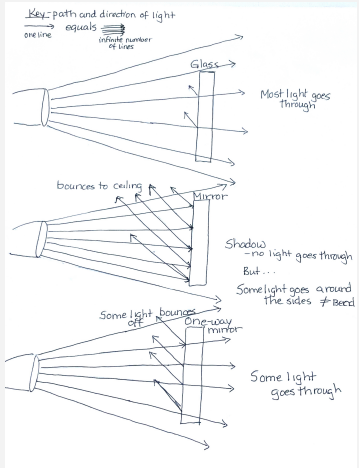
KEY IDEAS

Purpose of the discussion: The purpose of this discussion is to come to agreement about using straight lines and arrows to represent the path and direction that light traveled from the source to an object and from an object to where it went next.

Listen for:

- Areas of agreement between the light source and material:
  - Light travels in straight lines, so our lines need to be straight.
  - Light cannot bend around a solid object.
  - An arrow can show the direction light moved.
  - A shadow is made when light can't go through a solid object.
  - Light travels so fast we can't see it.
  - You can draw a lot of lines to show light, but we will just include a few lines to keep our models simple and easy to read.
- Areas of agreement between the material and where light goes next:
  - All of the above apply, plus:
  - Light can go through transparent materials in straight lines, which is why the angle changes when you change the angle of the flashlight.
  - Some light can go through partially transparent materials.
  - Light bounces/reflects off materials like mirrors and glass, but it travels in a straight line.
  - The angle that it reflects depends on the angle that the light reaches the material.

Say to students, *We can't actually see light moving because it's really fast. So fast that we would need special equipment to see it move. So how could we represent how it moved from the flashlight or laser to the wall? What are some things we need to show?*



As you facilitate this discussion, sketch a model of each material on chart paper or your whiteboard, and use arrows to show all the agreed upon ideas. Once light reaches a material, continue in a straight path (no refraction) through the material to show transmission. Show light reflecting back at different angles depending on how the light reaches the material, but do not dwell on angular dependency here.

Emphasize the words reflection and transmission during the discussion. As this discussion unfolds, take time to discuss both words and what they mean. Say, *When light goes through and bounces off materials, we use scientific words to describe the process. When light bounces, it is called reflection. When light goes through, it is called transmission. We are going to practice using these words in this lesson.*

Suggested prompts	Sample student responses	Follow-up questions
How does the light travel from the flashlight to the wall?	*It travels in a straight line.*	*How could we represent that on a drawing?* *How can we show which direction it is traveling?*
When the light shines on something solid, can it bend?	*No. Some light shines past the edges, but there is a shadow behind the object.*	*How can we show what light moves past the solid object and what light can't move past it?*

Suggested prompts	Sample student responses	Follow-up questions
When light shines on something clear like glass, how could we show what it does?	*A lot of light goes through.* *Some light bounces off too.*	*How should we draw these arrows on a model to stay in straight lines?*
Did we see that light still traveled in a straight line when we changed the angle of our flashlight on the material.	*When we tilted the flashlight, the light going through stayed in a straight path, which is why the light on the wall changed places.*	*If we change where the light is angled in the room, would this change how the light shined on the one-way mirror?*
When light shines on something like a mirror, how could we show what it does?	*All of it reflects.*	*How should we draw these arrows on a model?* *How did it change when we changed the angle of the light?*

9 · NAVIGATION

3 min

MATERIALS: None

Brainstorm how to measure what light is doing with each material. Display **slide L**. Hold up a piece of one-way mirror. Say, *We suspect the one-way mirror could be more like glass because our observations seemed that way, but how we could know, with more certainty, whether it truly is more like a mirror or more like glass? Some of you said it's not as transparent as glass and the light wasn't as bright going through. What are some tests we could run to see how much light is reflected or transmitted with each material?*

Allow students 1 minute for a Turn and Talk, then elicit ideas from the group. Listen for:

- See if the one-way mirror is letting more light through it than bouncing off it.
- See if the one-way mirror does more similar things to the glass or more similar things to the mirror.
- See if you can see your reflection in it like a mirror.
- See if you can see something on the other side like a window.

Say, *OK, you've given me some good ideas to think about. Maybe we need to get a better measurement of the reflected and transmitted light. Let's try to do that in the next class.*

Additional Lesson 3 Teacher Guidance

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN ELA	**CCSS.ELA-Literacy.SL.6.1.c: Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.** When the class takes a second pass at the DQB, prompt students to practice listening to each other and linking their ideas and questions to those that are shared before them. If students can't figure out which question to connect their question to, encourage them to ask the class for help. After an idea is shared, ask the original presenter if there is agreement and why, and then post the question.