LESSON 8: How does the brightness of light on either side of the one-way mirror affect what we see?

PREVIOUS LESSON

We compared one-way mirrors and other transparent materials, and wondered why one-way mirrors transmit less and reflect more light. We learned that regular mirrors have thick reflective coatings on glass, while one-way mirrors have thin reflective coatings. We explain what happens when light shines on these different materials. We wonder about how light causes one-way mirrors and glass to act like mirrors and/or windows.

THIS LESSON

INVESTIGATION

1 day

We revisit questions from the DQB about what happens when we change the brightness of light in each room in the box system. We design and test different box system setups with different amounts of light, adding light to both rooms and dimming the light in one room. We notice patterns that a smaller difference in light between rooms causes a weaker one-way mirror effect. We develop a model to explain why. Using a demonstration, we figure out that when different strength light signals reach our eyes, it is harder to sense the weaker signal. We are ready to explain the anchoring phenomena.

NEXT LESSON

In this lesson, we will use all the ideas from the unit to finalize our explanation of what is happening in Room A and Room B in the Mr. Bean video and the box system. We will add to our shared key to represent our ideas and updated our model to include Room B, zooming into specific places where light interacts with objects. We will develop explanations for everyday phenomena using these same ideas. We will return to our Driving Question Board (DQB) and will check off the questions we can now answer.

BUILDING TOWARD NGSS

MS-PS4-2

WHAT STUDENTS WILL DO

Modify a model, based on evidence, to explain why adding a second light source to Room B (a small change to the system) causes our eye to see more or less reflection and transmission through the one-way mirror (large change).

WHAT STUDENTS WILL FIGURE OUT

- A large difference in light in each room causes a stronger one-way mirror effect.
- A small or no difference in the brightness of light in each room causes a weaker one-way mirror effect.
- The eye has difficulty detecting a weak signal (light from one source) when the weak signal happens at the same time as a stronger signal (light from a second source).

Lesson 8 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	5 min	**NAVIGATION** Revisit what we know about when one-way mirrors and glass are reflective like a mirror and transparent like a window.	A	
2	7 min	**SELECT QUESTIONS FROM THE DQB TO INVESTIGATE** Gather students around the DQB to identify questions about the effects of changing light levels. Work together to develop the lesson question to investigate.	B	Driving Question Board,
3	10 min	**PLAN AN INVESTIGATION** Plan an investigation to add bright and dim lights to Room B in the box system and make predictions about what we will see.	C-D	Different Lighting Investigation
4	15 min	**CONDUCT THE DIFFERENT LIGHTING INVESTIGATION** Monitor students as they carry out the investigation to add bright and dim lights to Room B, record their observations, and discuss observed patterns.	E-F	Different Lighting Investigation
5	7 min	**NAVIGATION** Prompt students to share initial ideas about why the difference in the brightness of lights in Room A and Room B affects what we see.	G	
6	3 min	**NAVIGATION** Revisit and share initial explanations about why the difference in the brightness of lights in Room A and Room B affects what we see.	H	
7	12 min	**DEVELOP A MODEL TO EXPLAIN SETUP 1** Individually develop a model to explain why we see a weak one-way mirror effect when there is bright light in both Room A and B. Then share with a partner, or small group and revise.	I-J	*Setup 1 Model*, 2 different colored pencils or markers,
8	18 min	**DEVELOP CONSENSUS MODEL TO EXPLAIN BOX SYSTEM SETUP 1 AND 2** Facilitate a Consensus Discussion about how to represent the path light travels to the eye in the Room A viewing hole for Setup 1. Then develop a consensus model to explain what we see through the Room A viewing hole for Setup 2.	K-L	chart paper, 2 different color thick markers, 1 thin marker,
9	5 min	**FLASHLIGHT DEMONSTRATION** Demonstrate how our eyes will sense the stronger light signal using a flashlight in a well lit and dark classroom.	M-N	1 flashlight,
10	5 min	**EXPLAIN WHAT WE SEE IN SETUP 1 AND 2** Use the class models and new understandings about how our eyes sense strong and weak signals to develop verbal explanations for what we observed through the Room A viewing hole in Setups 1 and 2.	O	Setup 1 and Setup 2 models on chart paper,
11	5 min	**NAVIGATION** Assign home learning to take photographs of windows from inside the home at night and in the morning.	P	

End of day 1

Lesson 8 • Materials List

	per student	per group	per class
Different Lighting Investigation materials	• *Different Lighting Investigation* • page 3 optional	• 1 box system with 1 toy in Room A and 3 toys in Room B • 2 flashlights with high and low modes • 1 one-way mirror • 1 frame • 2 binder clips	• tape
Lesson materials	• science notebook • *Setup 1 Model* • 2 different colored pencils or markers	• *Setup 1 Model*	• Driving Question Board • chart paper • 2 different color thick markers • 1 thin marker • 1 flashlight • Setup 1 and Setup 2 models on chart paper

Materials preparation (30 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.

Print copies of Page 3 of the *Different Lighting Investigation* if you think your students would like to test more than the two box system setups and will need a place to record additional observations.

Print enough copies for *Setup 1 Model* for each student, plus extra copies, one per group.

Day 1: Different Lighting Investigation
Group size: 4-5 students
Setup:

- Slide the one-way mirror inside the frame of each box system.
- Check each flashlight to make sure it doesn't need new batteries.
- Storage: Find a location where you can stack the box systems to the side of the classroom. You won't revisit the box systems for the remainder of the unit.

Lesson 8 • Where We Are Going and NOT Going

Where We Are Going

In this lesson, students deepen their understanding of the one-way mirror phenomenon. They know that the one-way mirror phenomenon is caused by light in one room and darkness in the other. They discover that the phenomenon changes when you turn the light on in both Room A and Room B: you can see the toys in both rooms. The one-way mirror effect becomes weaker; it is both a weak mirror and a weak window. They discover that the one-way mirror effect becomes stronger (more mirror/ window like on either side) as the difference in brightness of light between rooms becomes greater. We will explain why we see a weaker one-way mirror effect in two scenarios: when there are bright lights on in both rooms, and when Room A has a bright light and Room B has a dim light. The big idea in this lesson is that our eye can detect weaker light signals, but when there is a second light source with a stronger signal, it is more difficult for our eye to detect that weaker signal.

Where We Are NOT Going

We do not yet explain why we see the strongest one-way mirror effect when one room has bright light and the other has no light (the anchoring phenomenon). We will leave this lesson with some productive ideas about the anchoring phenomenon, but we will develop a full explanation in Lesson 9. We will also not examine this phenomenon using the plexiglass.

LEARNING PLAN for LESSON 8

1 · NAVIGATION

5 min

MATERIALS: science notebook

Revisit student ideas about what causes a one-way mirror to act like a window and mirror. Remind students, *We know a regular mirror only reflects light because it is opaque, but the one-way mirror and glass windows sometimes are reflective like a regular mirror and sometimes are transparent like a window. We have not figured out yet when they will look like a mirror or window.*

Project **slide A**. Have students Turn and Talk about when glass windows and one-way mirrors act more reflective, or more transparent and why. Then, have a few students share their ideas.

ADDITIONAL GUIDANCE

If students struggle to remember when the one-way mirror looks transparent like a window, reflective like a mirror, or both, have them review their systems diagrams in their science notebooks from Lesson 2.

Suggested prompt	Sample student response
Why is a mirror always reflective like a mirror and never transparent like a window?	*Because it's completely opaque. Only clear transparent things can act like a window.*
When did the one-way mirror act more reflective like a mirror?	*From the light side of the box, when it's light on one side and dark on the other.* *From in the classroom, when there's only Room B and it's dark inside.*
When did the one-way mirror act more transparent like a window?	*From the dark side of the box, when it's light on one side and dark on the others.*
When was the one-way mirror both reflective like a mirror and transparent like a window?	*In the classroom, when it's light all around.*
What were our ideas about what caused one-way mirrors and windows to be reflective from one direction and transparent from another?	*When one room is light and one room is dark.* *It has to do with the difference in light.*

2 · SELECT QUESTIONS FROM THE DQB TO INVESTIGATE

7 min

MATERIALS: Driving Question Board

Identify questions from the DQB to investigate the effects of changing light levels. Have students revisit the DQB, focusing on questions they had about the effects of different lighting within the box system. Use **slide B** to prompt students to remember questions they had from Lesson 1.

- What questions did we want to investigate about the effects of different lighting within the box system?
- What is the most important question to investigate and why?

✱ SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS

Share proposed investigation questions about a difference in lighting. Have students share their proposed questions to investigate with the whole class.✱ Anticipate questions including:

- What happens if we turn lights on in both rooms?
- What happens if we turn lights off in both rooms? Will they both be see-through (like a window)?
- What happens if one room has slightly less light than the other?

ADDITIONAL GUIDANCE

Your DQB will likely have questions about turning on lights in both rooms and turning off lights in both rooms. If students do not bring up a question about changing the brightness of the lights in each room (e.g. bright light and dim light) in each room, that is okay. You can introduce that question later when you introduce the different settings on the flashlight.

Agree on a first question to investigate. Summarize by saying, *It sounds like we're interested in exploring what we'll see when we change the lighting in different ways.*

Have students summarize a broader question for investigation, or share your own summary of the broader question for investigation: ***How*** *does changing the brightness of light on either side of the one-way mirror affect what we see*?

Returning to the DQB and determining which of these questions we should investigate promotes meaningful investigations for students because they understand the reason for their investigations. Students have been wanting to investigate adding light to both rooms. In this lesson, we are concerned with first investigating ***how*** changing the brightness of light in both rooms will affect what we see. We spend the rest of the first day of this lesson identifying the following pattern:

- When there is little difference in the brightness of the light source between the two rooms, the material appears both partially reflective and partially transparent from both sides.
- When there's a large difference in the brightness of the light source between the two rooms, the material appears mostly reflective from the light side and mostly transparent from the dark side.

On Day 2, we will start explaining ***why*** changing the brightness of light in Room B changes the one-way mirror effect, due to the strength of the light signals entering our eye. We will fully answer this explanatory question in Lesson 9.

3 · PLAN AN INVESTIGATION

10 min

MATERIALS: Different Lighting Investigation

Introduce materials for the investigation. Review the materials students can use for investigation, including: the box system, two flashlights, the frame with binder clips, and the one-way mirror material.

Introduce the high and low modes on the flashlight. Model how students can manipulate the brightness of light coming out of the flashlight.

Discuss ways to manipulate the lighting in the box system. Project **slide C.** Have students work in small groups to discuss the different lighting setups they would like to try.✱

Discuss as a class the setups that everyone will test. Encourage students to plan investigations to find out what we see with:

- Bright light in both rooms with the one-way mirror (Setup 1).
- Bright light in one room and dim light in the other room with the one-way mirror (Setup 2).

Have all students agree to test the following two setups:

✱ SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS

Use this opportunity to connect *Asking Questions* to *Planning and Carrying Out Investigations.* As students discuss the different setups they want to test, help them make the connection to questions from the DQB. Students may need to revise the questions from the DQB into testable questions. For example, if they want to figure out what happens if we turn the light on in both rooms, they would ask the question, "How does the one-way mirror effect change when both lights are turned on?" They would then setup the box system with flashlights in both rooms and

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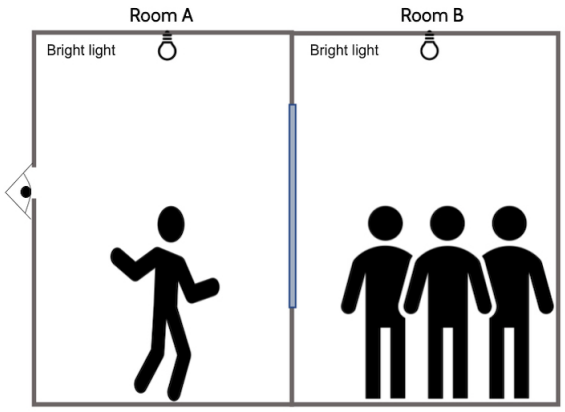
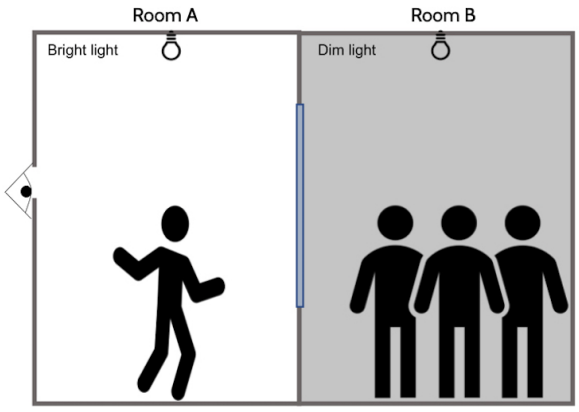
	

Tell students that if they have additional time, they can test other lighting setups they may have been curious about (e.g. both rooms dark, one room with dim light and the other with no light).

Make predictions. Project **slide D**. Pass out pages 1 and 2 of *Different Lighting Investigation*. Have students tape the handout into their science notebook and record predictions for these two lighting setups. If you anticipate having additional time, you can pass out page 3 of *Different Lighting Investigation* for students to add their own additional setups.

make observations when only one light is turned on, then make observations with both lights on for comparison.

4 · CONDUCT THE DIFFERENT LIGHTING INVESTIGATION

15 min

MATERIALS: Different Lighting Investigation

Work in groups to investigate the different lighting setups. Project **slide E** and review the investigation steps. Then, dim the lights in the classroom and give students time to conduct their investigations.✱

ADDITIONAL GUIDANCE

While students investigate, new questions may arise, such as "Does the angle of the light matter?" The angle of the light can make a difference, because shining a light directly toward the one-way mirror causes more light to transmit to the other room and reflect off objects in that room. You may not want to encourage students to test angle yet. If you do let students to test the angle of the light, they will not be able to explain their observations until after Lesson 9, when they figure out that the light from one room can transmit to the other room, reflect off toys in the other room, and then transmit back.

Discuss patterns as a whole class. Bring the class together to discuss patterns they observed about the differences in lighting, guided by the following questions (**slide F**).

✱ ATTENDING TO EQUITY

While students carry out their investigation, emphasize the importance of equitable talk and discussion as you circulate the room by prompting students to make sense of what they are observing with their groups. Example prompts include:

- What patterns are you noticing about how the brightness of light in each room affects what we see in each room?
- Does everyone agree? Why or why not?
- Do you have ideas about why we see those patterns?

Suggested prompt	Sample student response
When is the one-way mirror effect the strongest? The most reflective from one side and most transparent on the other?	*When the difference between the light in both rooms is very large (e.g. bright light in one room and no light in the other), we see the strongest one-way mirror effect. This is neither Setup 1 nor Setup 2, but the original phenomenon we saw with bright light in one room and no light in the other.*
When is the one-way mirror effect weaker? Less reflective and transparent?	*When the difference between the light in both rooms is very small (e.g. Setup 1, bright light in both rooms), we see the weakest one-way mirror effect. Setup 2 also had a weaker one-way mirror effect, but it was stronger than Setup 1.*
What can we say about how a difference in the brightness of the light sources in each room affects what we see?	*When there is a large difference in the brightness of the light sources in each room, the one-way mirror effect is stronger. When there is no difference in the brightness of each room's light source, the one-way mirror effect is weakest. When there is a moderate difference in the brightness of each room's light source, the one-way mirror effect is moderate.*

5 · NAVIGATION

7 min

MATERIALS: None

Share initial ideas about why the difference in the brightness of each room's light source changes what we see. Project **slide G**. Have students turn and talk, discussing their initial ideas about why the differences in the brightness of each light source changes what we see. At this point, accept all explanations. Listen for student ideas about the strength of the light signals entering the eye.

6 · NAVIGATION

3 min

MATERIALS: None

Summarize our observations and our questions. Say, *We've now collected additional evidence that the difference in lighting causes us to see different things from each side of the box. Let's focus on why we see different things.*

Share initial ideas. Project **slide H**. Have a few students share their initial ideas to the questions they discussed previously.

- When light is bright in both rooms, we see both a reflection and can see to the other side. Why?
- When the light is dimmer, we see more reflection from the brightly lit side and it's harder to see the other dimly lit side. Why?

Listen for students ideas such as:

- When both sides have a bright light, that means both sides are lit up. That's why we see objects from both sides. Light can bounce off objects on both sides and go through the one-way mirror.
- When Room B gets a light, the light from that side can go through the glass, which is why we can see objects in Room B.
- When one side is brighter than the other, light from that side will pass through the one-way mirror and is stronger than the light coming from the other room.
- If there is a dim light on one side, less light from that room can go through the one-way mirror. So we will see the objects from the side with more light.

7 · DEVELOP A MODEL TO EXPLAIN SETUP 1

12 min

MATERIALS: *Setup 1 Model*, 2 different colored pencils or markers

Review how we see things. Project **slide I**. Orient students to the image. This is what we see through the viewing hole in Room A. Scooby, the brown dog is the one toy Room A. The green, red, and blue toys are all in Room B. The lights in both rooms are on bright.

Have students quickly review in small groups how we see things, either reflected off a mirror, one way mirror, or through transparent materials. Then share out as a class. The purpose of this review is to ensure that all students understand that when we see an object, this means light reflected off that object and entered our eye. Students should have built this understanding in fourth grade and revisited it again in Lesson 3, and they will need it to explain what they see in Setup 1 (bright light in both rooms) and Setup 2 (bright light in one room and dim light in the other).

Suggested prompt	Sample student response
What is happening with light that allows us to see the reflection of the one toy (Scooby, the brown dog)?	*Light is reflecting off the one toy, reaching the one-way mirror (which has a partial reflective coating), and going back into our eye.*
What is happening with light that allows us to see the three toys on the other side of the one-way mirror?	*Light is reflecting off the three toys, then passing through the one-way mirror (which is partially transparent) and entering into our eye.*

Individually, model light entering the eye from the Room A viewing hole in Setup 1. Say, *Let's think about the light that enters our eye when we look into the box system with bright lights in both rooms in Setup 1. Where is it coming from? How does that cause us to see both a reflection of one toy and see the three toys on the other side? Let's start by focusing just on what we see from the Room A viewing hole.*

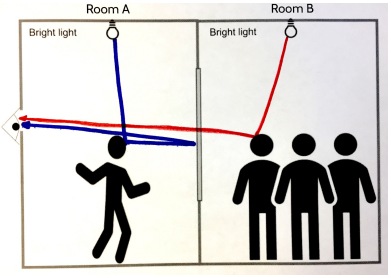
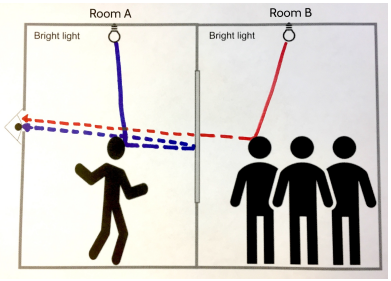
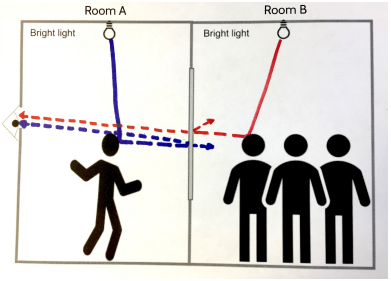
Project **slide J** and pass out *Setup 1 Model*. Have students record their model on their own handout and tape into their notebook. Have students add light arrows to indicate where light is coming from that enters the eye through the Room A viewing hole. Encourage students to use a pencil to sketch out what's happening with light and color if it helps them identify which light source the light is coming from.✱

ASSESSMENT OPPORTUNITY

Collect students' individual models as an artifact to use for formative assessment. Use the models to identify where students need to be pushed in terms of representing and communicating their thinking visually, so that other students can interpret what the models are trying to explain.

Prompt each group to make one version of the model. Have students share their individual models and create a small group consensus model on a new *Setup 1 Model* to share with the class.

Students may need to do several iterations of their model, first mapping the path light travels to enter the eye, then modifying the arrows represent how much light enters the eye, and finally adding arrows to represent that light also reflects off/ transmits through the one-way mirror into Room B. Circulate the room and use the following prompts to push students' thinking.

Help students map the path light travels to enter our eyes. • When you look through the viewing hole in Room A, what do you see? • What does that tell you about what light is reflecting off of before it enters your eye? • Where is the original source of light that reflects off the one toy in Room A? • Where is the original source of light that reflects off the three toys in Room B?	**Help students map how much light enters the eye.** • Does all the light reflect off the toys? How can we represent that? (use our dashed arrows) • What happens when light reaches the one-way mirror? • Does all the light reflect off/transmit through the one-way mirror? How can we represent that? (use our short dashed arrows)	**Help students represent that not all of the light that shines on the one-way mirror passes through or reflects off.** • Does all the light that shines on the one-way mirror transmit from Room B to Room A? How can we represent that? (add a small arrow reflecting light back to Room B) • Does all the light that shines on the one-way mirror reflect from Room A back to Room A? (add a small arrow transmitting light into Room B)
		

8 · DEVELOP CONSENSUS MODEL TO EXPLAIN BOX SYSTEM SETUP 1 AND 2

18 min

MATERIALS: chart paper, 2 different color thick markers, 1 thin marker

Develop a consensus model to explain what we see through the Room A viewing hole in Setup 1. Display **slide K**. Draw box system Setup 1 with a viewing hole for Room A on a piece of chart paper. As a whole class, map out on the chart paper the path that light travels from both light sources to toys, to the one-way mirror, to the eye.

- Start with the aspects of the model that most of the class agrees on.
- As you encounter differences between the models, ask representatives from groups to explain their thinking and argue for their representation.
- Use two different color markers to represent light coming from the light sources in Rooms A and B, so it is easy to trace the light from each light source into the eye.

ADDITIONAL GUIDANCE

The Room A side of this model should be similar to the consensus model students developed in Lesson 6. If students struggle to come to consensus, reference the Lesson 6 class consensus model and use it as an example. The new additions should be 1) adding their eye to the box, and 2) adding light to Room B. It is important that students to represent most, some, and "a little" light, particularly as it relates to the light entering the eye reflecting off the one toy in Room A and three toys in Room B. Those arrows should be about the same (e.g. some light), which is why you see the toys on both sides about the same.

✱ SUPPORTING STUDENTS IN ENGAGING IN DEVELOPING AND USING MODELS

Through a collaborative process -- starting with individual, then a group, and finally whole class conversation -- students develop and revise shared models that represent a class consensus. Emphasize productive and respectful discourse during group and class discussions to support collaboration by asking questions like:

- Does anyone disagree with the idea presented?
- Is there anything about the phenomenon that we haven't explained yet? Are there any gaps that need filling?

Develop a consensus model to explain what we see through the Room A viewing hole in Setup 2. Say, *Now that we have a model to help us explain what we saw in Setup 1, let's try to develop a model for Setup 2 that answered our question: When one light source is dimmer, why do we see more reflection from the brightly lit side and it's harder to see the dimly lit side?*

Project **slide L**. Draw box system Setup 2 with a viewing hole for Room A on another piece of chart paper. Ask students to start with what is happening to light coming from the source in Room A. Have students discuss first in small groups, then have a few students share out with the class. Draw that on the chart paper. This should look very similar to what you drew for Room A Setup 1, because it is the same bright light.

Develop a shared representation for brighter and dimmer lights. Now, problematize that Room B now has a dimmer light. Ask students:

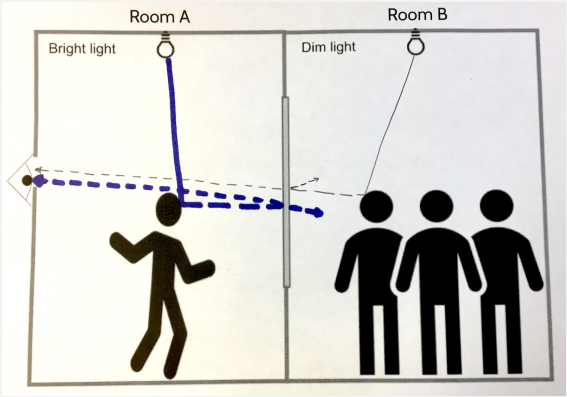
- How should we represent that less light is coming out of the light source?✱

Give students time to discuss, first in pairs and then share their ideas with the class. Decide on a group representation for this. Students may suggest:

- Thick = brighter light, thin = dimmer light

Example representation with a thinner line coming out of the Room B light source.

Take suggestions from the class about how to represent what happens with the light coming from the Room B light source, as it reflects off the 3 toys, transmits through the one-way mirror, and then enters the eye. This should be very similar to what you agreed on for Setup 1, just all of the thin lines should indicate less light, including the brightness of light entering the eye from the toys in Room B. Use the thin marker for the light coming out of the Room B light source.



9 · FLASHLIGHT DEMONSTRATION

5 min

MATERIALS: 1 flashlight

Problematize what we saw in Box Setup 2. Say, *In Setup 2, there were two different light signals entering our eye. One stronger signal came from the bright Room A light source and reflected off the one toy in Room A, and then back from the one-way mirror and into our eye. Another weaker signal from the dim Room B light source reflected off the three toys in Room B and then transmitted through the one-way mirror and into our eye. If there are two light signals entering our eye, one that is stronger and one that is weaker, let's think about why we see a dimmer image with the weaker signal.*

Introduce the flashlight demonstration. Project **slide M.** Say, *Let's think about related scenarios where the strength of the light signals differs. Consider a flashlight in a well-lit classroom and a dark classroom.*

- **Demonstrate turning on a flashlight in a well-lit classroom.** Keep the overhead lights on and point the flashlight around the room so students can see the brightness of light coming from the flashlight. Ask students:
    - Can you see this light signal right now? How strong does it appear?
- **Demonstrate turning on a flashlight in a dark classroom.** Turn off the overhead lights and point the flashlight around the room so students can look directly at it. Ask students:
    - Can you see this light signal right now? How strong does it appear?

Flashlight in a well-lit classroom	Flashlight in a dark classroom
	

Discuss the flashlight demonstration. Project **slide N**. Discuss the demonstration, working toward the idea that if there is a weak signal entering the eye, our eyes will be able to sense it (flashlight in a dark classroom). But, when there is a weak signal entering the eye and we add a second strong signal entering the eye, our eye will sense the stronger signal and it will be more difficult to sense the weaker signal.

Suggested prompts	Sample student responses	Follow-up questions
Did the strength of the light signal coming out of the flashlight and entering your eye change?	*No.*	*What changed?*
With both light sources, which signal is stronger: the classroom light or the flashlight?	*Classroom light.*	
If the strength of the light signal leaving the flashlight didn't change, why does the flashlight signal look weaker when it's in a brightly lit classroom?	*The classroom light is bigger, so it overpowers the flashlight.*	*What do we mean by "overpowers?"*
If we have two light signals and one is stronger than the other, which one will we see better?	*Our eye will see the stronger signal more.*	

ALTERNATE ACTIVITY

If time allows, share a related scenario with people talking. Invite two students to the front of the room. Have one speak very loudly and the other whisper. Discuss the demonstration, working to reinforce the idea that if two signals enter our body (eyes, ears) we will sense the stronger signal (brightness of light, loudest sound).

10 · EXPLAIN WHAT WE SEE IN SETUP 1 AND 2

5 min

MATERIALS: Setup 1 and Setup 2 models on chart paper

Prepare to explain. Have students return to their seats. Summarize, *We've figured out that if there are multiple light signals entering our eye, we will sense the stronger signal more than the weaker signal.*

Use the models to develop an explanation. Place the two pieces of chart paper with the class models representing Setup 1 and 2 at the front of the room side by side. Project **slide O**. Then, have students work in pairs and use the model to develop verbal explanations to answer these two questions:✱

- Why do we see both a reflection of the one toy in Room A *and* the 3 toys in Room B when there is bright light in both rooms?
- When light in Room B is dim, why do we more reflection of the one toy in Room A and it is harder to see the 3 toys on the other dimly-lit side?

Have a few students share out their model-based explanations with the class.

✱ SUPPORTING STUDENTS IN ENGAGING IN CONSTRUCTING EXPLAINING AND DESIGNING SOLUTIONS

At the start of Lesson 8, new phenomena are introduced to drive model building: the addition of bright and dim lights to Room B cause the one-way mirror effect to appear different. The purpose of developing the Setup 1 and 2 models is to explain these new observed phenomena. Students use their models to construct verbal explanations to explain the causal mechanisms and the unseen causes of the phenomenon. This links the practices of developing and using models with constructing explanations.

11 · NAVIGATION

5 min

MATERIALS: None

Foreshadow explaining the anchoring phenomenon and related phenomena of glass windows during the day and night. Say, *We've figured out so much about how the difference in the brightness of light in each room leads to stronger and weaker light signals entering our eyes. Tomorrow, we will use what we've figured out to revise our explanation of the Mr. Bean video. Hopefully, we'll also be able to explain other related phenomena.*

Assign home learning. Project **slide P**. Assign students to observe and document the related phenomena of seeing different things when looking at glass windows by taking photographs looking out the same window at home, when the light is on inside and it's dark (nighttime) and light (morning) outside.✱ Now that they have some new understandings, encourage them to attend to how much of their own reflection they can see and how much they can see outside, and how big of a difference there is in lighting, inside and outside. If students have access to cameras, have them take photographs and send them to you, or bring them in, so that the class can explain them.

✱ ATTENDING TO EQUITY

Having students self-document the related phenomenon of what we see in our windows at home during the day and night, can help students see how the focal science ideas they just learned relate to everyday phenomena in their lives. In Lesson 9, students will have an opportunity to transfer their understandings of the one-way mirror in the box system to explain why what we see in windows at home changes, dependent on the brightness of light inside and outside. If students live in the city where it's not completely dark or light, they can still sense differential lighting and how that affects what they see in the window.