Unit 1

Light and Matter:

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

Student Work Pages

GRADE 6 Core Knowledge Science®

Core Knowledge®

Light and Matter:

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

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Light and Matter:

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

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Science Classroom Norms

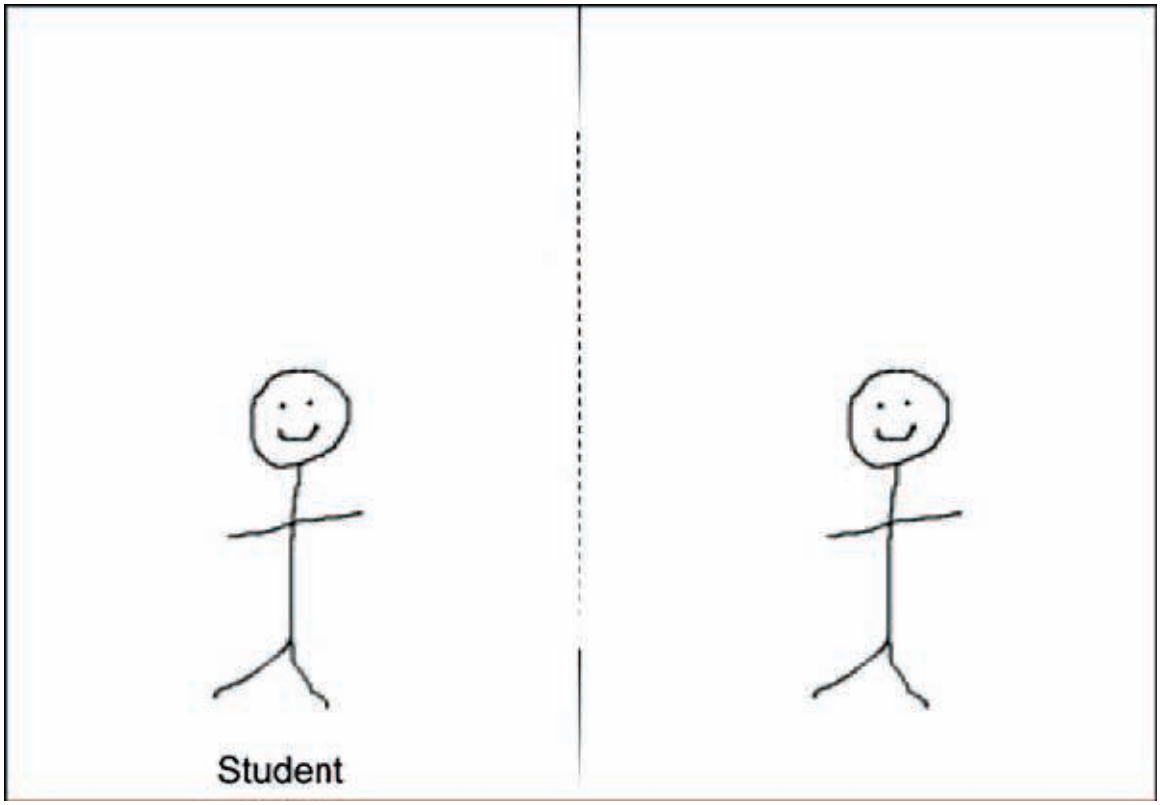
Classroom Norms	
Respectful Our classroom is a safe space to share.	• We provide each other with support and encouragement. • We share our time to talk. We do this by giving others time to think and share. • We critique the *ideas* we are working with but not the *people* we are working with.
Equitable Everyone's participation and ideas are valuable.	• We monitor our own time spent talking. • We encourage others' voices who we have not heard from yet. • We recognize and value that people think, share, and represent their ideas in different ways.
Committed to our community We learn together.	• We come prepared to work toward a common goal. • We share our own thinking to help us all learn. • We listen carefully and ask questions to help us understand everyone's ideas. • We speak clearly and loud enough so everyone can hear.
Moving our science thinking forward We work together to figure things out.	• We use and build on others' ideas. • We use evidence to support our ideas, ask for evidence from others, and suggest ways to get additional evidence. • We are open to changing our minds. • We challenge ourselves to think in new ways.

Name: _____ Date: _____

Initial Diagram to Explain the Phenomenon

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

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

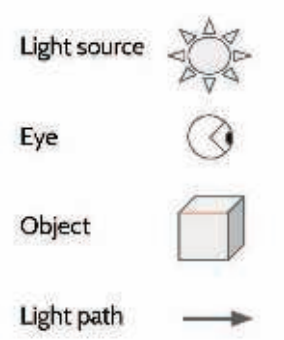


Name: _____ Date: _____

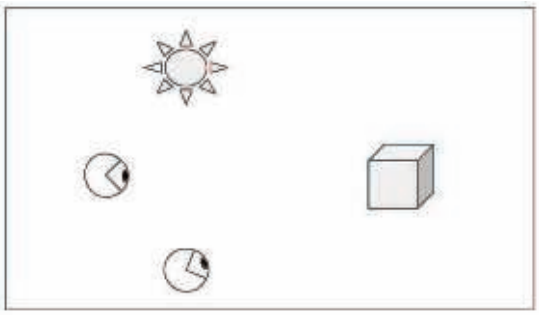
Representing the Path of Light in Different Scenarios

Use arrows to draw the path that light travels.

Then below, describe what the person or people in each scenario see.

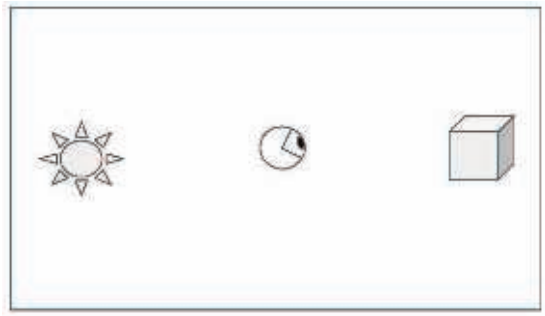


Scenario 1



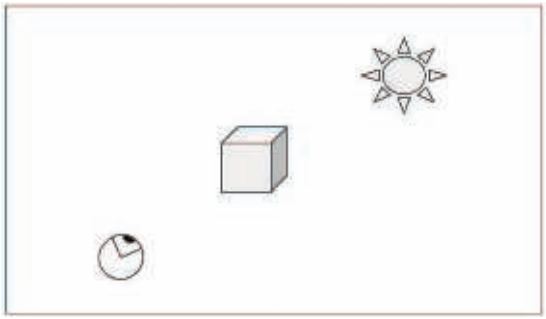
What do these people see and why?

Scenario 2



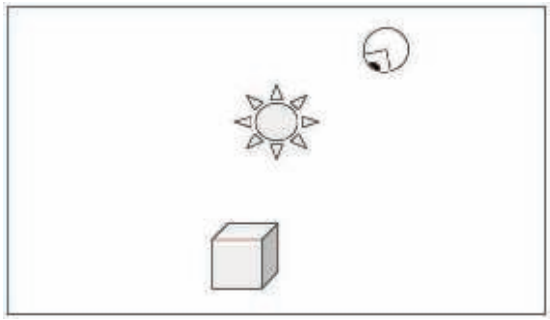
What does this person see and why?

Scenario 3



What does this person see and why?

Scenario 4



What does this person see and why?

Name: _____ Date: _____

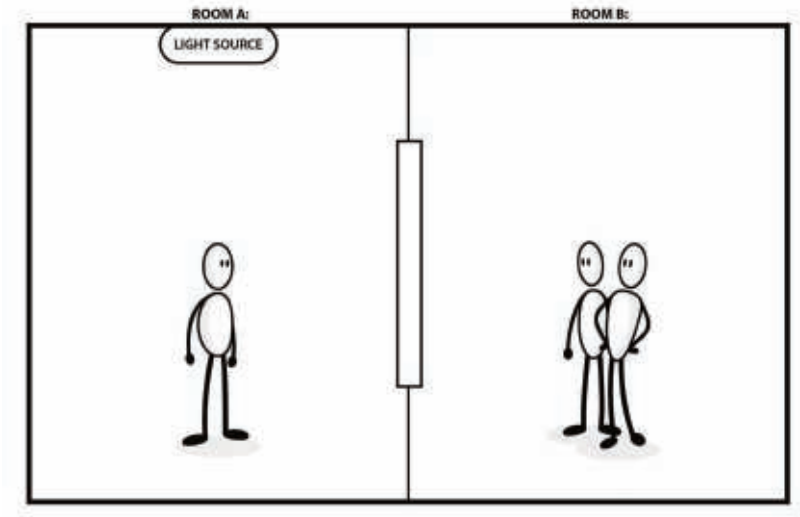
Testing Light Scenarios

Part A: What happens if we change the light in the box model?

The diagram below shows the original Music Lesson setup.

1. Highlight and record what you're changing from the original setup in the diagram below.
2. What do you predict you will observe when you make that change? Why?
3. Record your observations from both sides of the box model on the diagram below.

Observations from Room A Observations from Room B



Part B: Sensemaking questions

1. Why does changing the light affect what we see?
   a. Draw on the diagram what you think is happening.
   b. Record your ideas in words below.

Name: _____ Date: _____

Asking Questions Tool – Experimental Questions

Part A

1. What is the original question you want to investigate?

Scientists develop experimental questions to identify what they want to test or change in an experiment (independent variable). They also include what they are going to observe or measure (dependent variable).

For example:

How does the amount of light a plant gets in a day affect how tall the plant grows?

(independent variable) (dependent variable)

Example question frames for experimental questions:

How does _____ affect _____?

(independent variable) (dependent variable)

What is the effect of _____ on _____?

(independent variable) (dependent variable)

2. Look at your original question. What do you think will cause an effect? This is the variable you will change in your experiment (independent variable). _____

3. What will you measure to see if the change you made has an effect? This is the variable you will observe or measure (dependent variable). _____

4. Revise your question to include the variable you are changing (independent variable) and the variable you are measuring (dependent variable). Use the question frames shown above to help you revise your question.

5. If you collect this evidence in an experiment, what new thing about the phenomenon will it help you explain?

Part B

Peer or Teacher Feedback

Name: _____

Name of person giving feedback: _____

Provide feedback using the table below.

Criteria	Yes or no?	Feedback and/or suggested revision
Does the question include an independent and dependent variable?		
Is the question specific enough that you can design an investigation to answer it?		
Does the question help you figure out something new about the phenomenon?		

Name: _____ Date: _____

Measuring Light Investigation Procedures

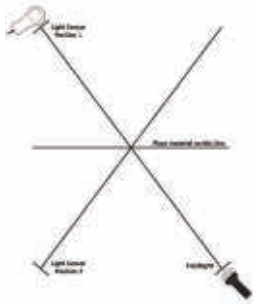
For each material listed in the table that follows, make a prediction about what the light will do when you shine it on the material. Will it transmit (go through)? Will it reflect (bounce off)? Will it do both? Will it do something else? Circle your predictions in the second column of the data table. Choose a role for each member of your group. Who will hold the flashlight? Who will hold the light meter? Who will hold the material? Who will read the light meter and record the data?

Tape the cardboard tube to the light meter so the tube surrounds the sensor.

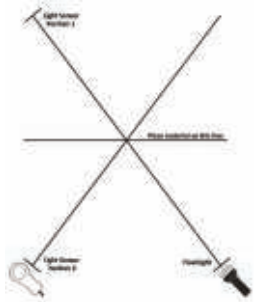
Place the flashlight on top of a wooden block or a set of books so it is elevated about 3-4 inches above the table top. This will ensure that the light is not blocked by the picture mat that holds the one-way mirror material.

Wait for your teacher to darken the room. Make sure your light meter is set to medium sensitivity (x10 lux) and the flashlight and the light meter are pointed in the right directions. Use the template to keep the flashlight and the light meter the correct distance apart. Then measure how much light is coming from the flashlight when nothing is in the way. Record that value in the box at the top of the data table.

For each material listed in the data table, measure the light that transmits through the material (position 1). Record each observation in the data table.



Measure the light that reflects off the material (position 2). Record each observation in the data table. Circle the option (or options) in the last column that best describes what happened to the light when shined on the material.



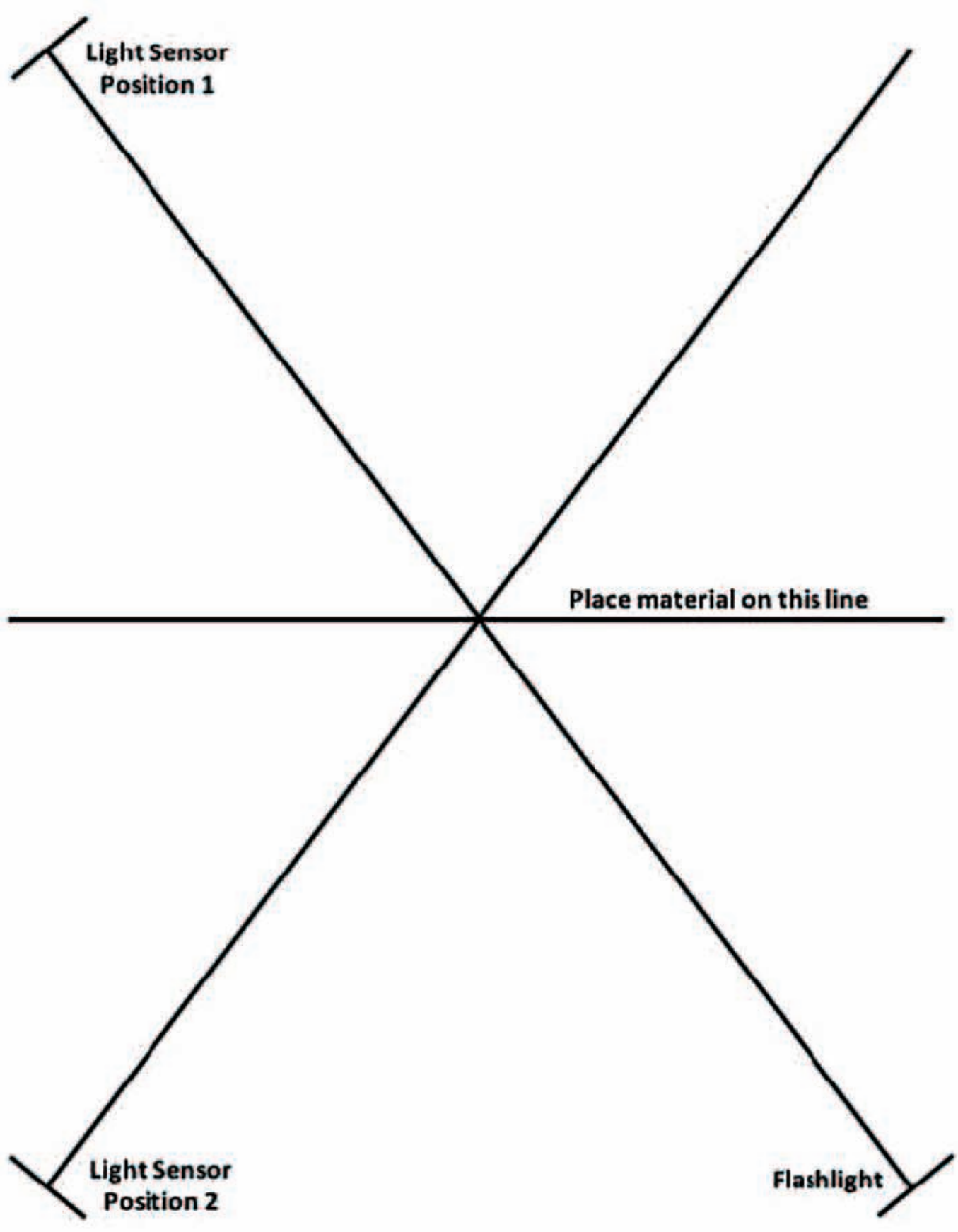
Title a new page in your notebook: "Measuring Light Investigation". Turn the handout over and attach the data table to your notebook. On the opposite page in your notebook, answer the following questions: How does the 1-way mirror compare to the glass? How does the 1-way mirror compare to the regular mirror? Did your predictions match your observations? What surprised you?

Data Table

Light coming from flashlight (x10 lux): _____

Material	What will the light do? (circle your prediction)	Light transmitted (x10 lux) Position 1	Light reflected (x10 lux) Position 2	What did the light do? (circle your conclusion from the data)
One-way mirror	Transmit Reflect Other			Transmit Reflect Other
Glass	Transmit Reflect Other			Transmit Reflect Other
Regular mirror	Transmit Reflect Other			Transmit Reflect Other
	Transmit Reflect Other			Transmit Reflect Other

Light Sensor Position Template



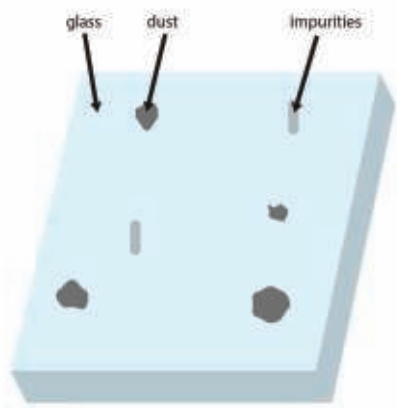
Name: _____ Date: _____

Reading: How is a one-way mirror made?

To understand how a one-way mirror is made, first we need to understand how a regular mirror is made.

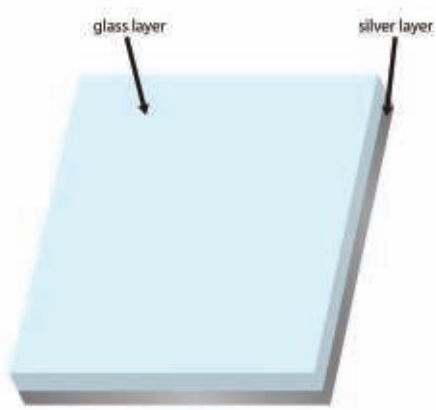
How is a regular mirror made?

Making a regular mirror starts with a piece of glass or plastic. A piece of glass is transparent because it transmits most of the light that shines on it. It cannot transmit all the light because there are impurities in the glass as well as dust and other things on its surface. Light reflects off the dust and impurities to our eyes, which is how we see the glass.



Glass with dust and impurities

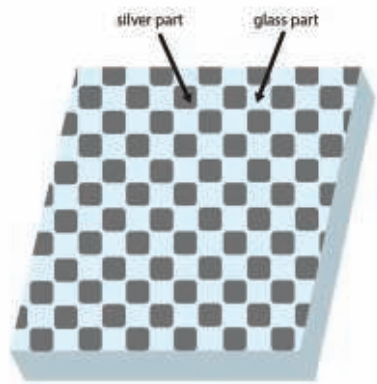
To make a mirror, a thick layer of smooth metal, such as silver, is added to the back of the glass. This process is called "silvering." Behind the silver layer is a layer of paint to protect the back of the mirror. With the silver layer and paint layer, the mirror is opaque, meaning that no light can transmit through it. All the light reflects off it.



Mirror with thick silver layer

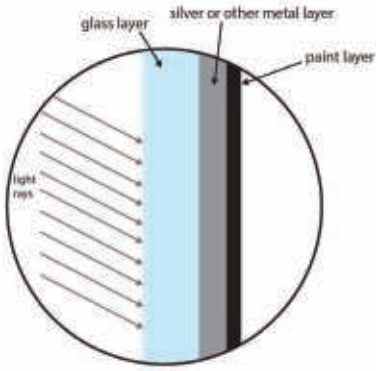
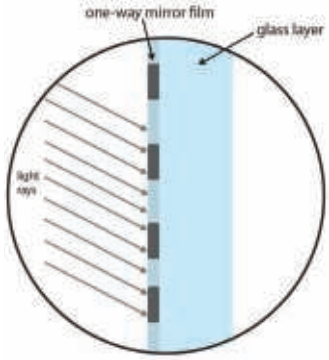
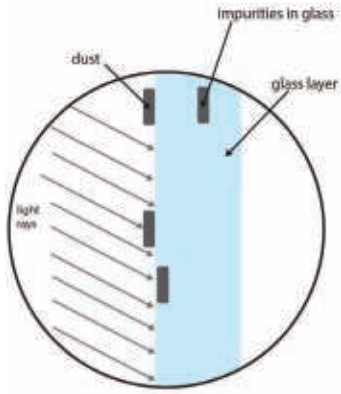
How is a one-way mirror made?

A one-way mirror is made by combining a thin layer of one-way mirror film and a piece of glass or plastic. The one-way mirror film has special structures that we can only see when we zoom into a scale we cannot see with our naked eyes. The film is made of a very thin layer of silver, aluminum, tin, or nickel that is mixed into a clear piece of plastic. This creates a "half-silvered" plastic film. The half-silvered film is added to the front side of a piece of glass. Because the silver layer is so thin, this leaves some parts of the glass fully transparent, while other parts are covered by silver. The result is a material that has some transparent surface and some reflective surface.



One-way mirror with thin silver layer

If 10 light rays shined on a mirror, a one-way mirror, and a pane of glass, what would happen to the 10 light rays? Draw your ideas on the diagrams below.

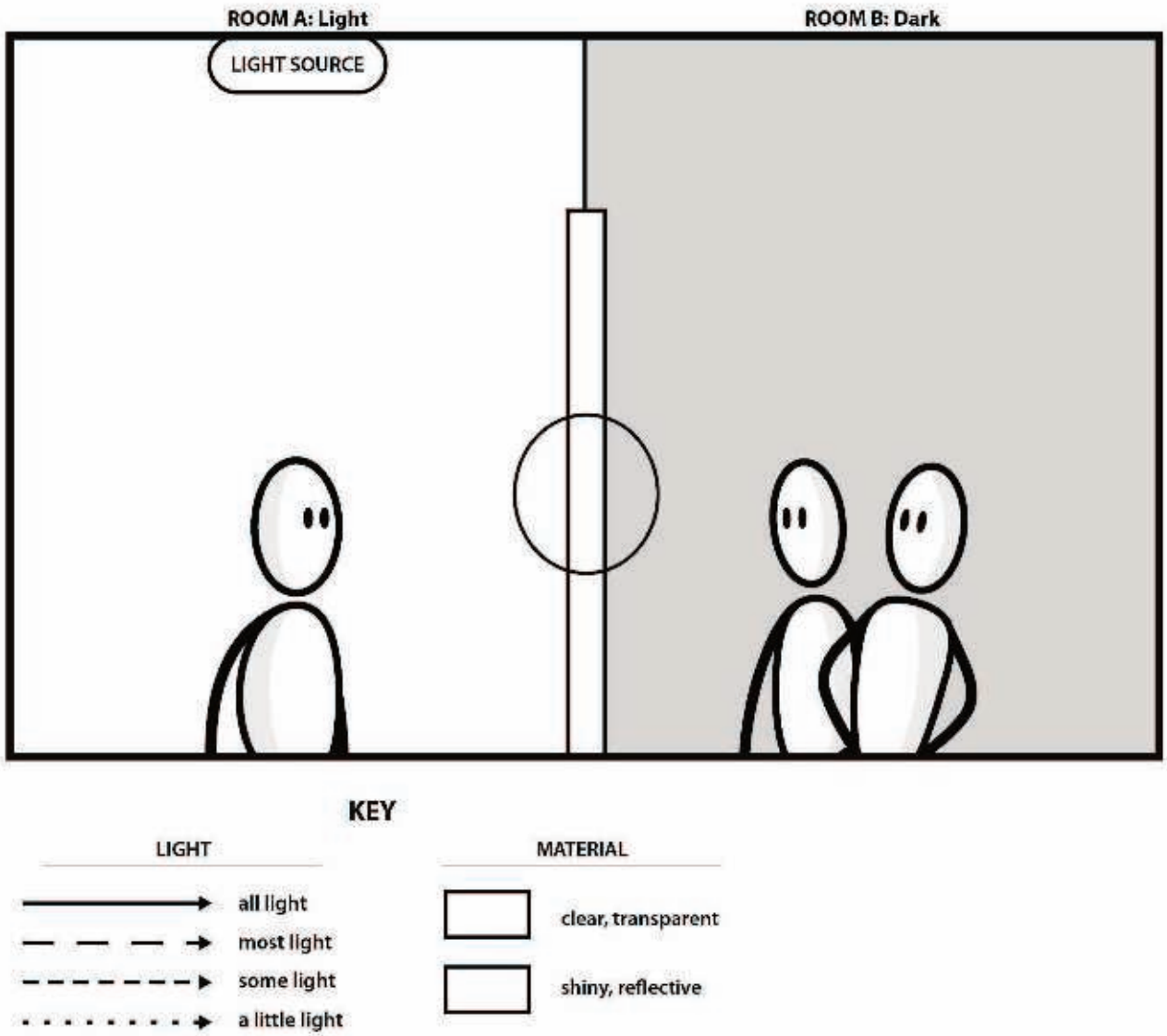
Mirror	One-way mirror	Glass
		

What new ideas do you have to answer the question, "How do similar amounts of light transmit through and reflect off the one-way mirror?"

Name: _____ Date: _____

Develop a Model

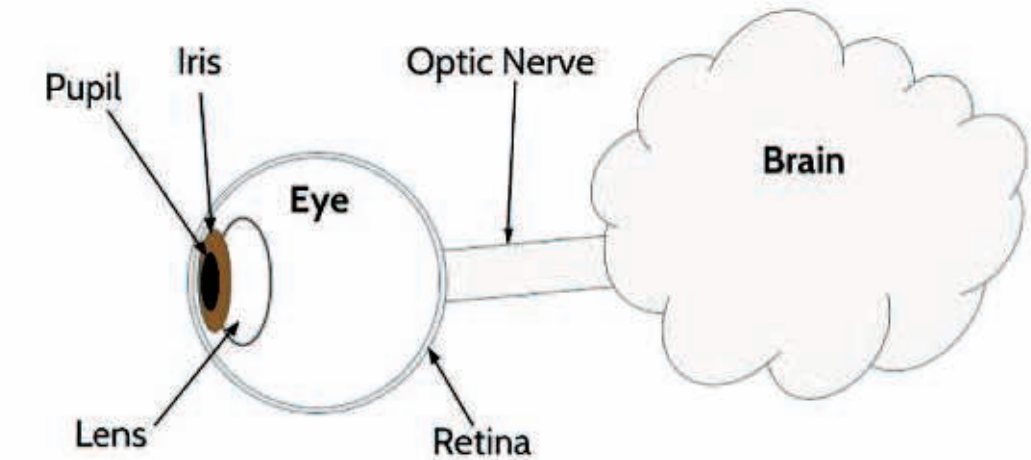
Develop a model to explain why the music student sees themself and the adults also see the music student.



Name: _____ Date: _____

Why does the student see themself and not the adults?: Model Template

Revise the model and the key to explain why the music student sees themself but doesn't see the adults.



Who the light reflected off

☐ The music student

☐ The adults

Name: _____ Date: _____

Explaining the One-Way Mirror Phenomenon

1. Why do the adults see the music student?

2. Why does the music student see themself but not the adults?

Self Assessment and Peer Feedback

Does the explanation include the important elements?

Important elements of scientific explanations	Self-assessment	Peer feedback: Use a colored pencil
1. Does the explanation explain how or why the phenomenon works: a. Why does the music student see themself? b. Why does the music student not see the adults? **Tips** • Did you include all the important parts in the system? • Did you include how the parts interact?	Underline places where you explain how or why. Make notes of where you can improve your how or why explanation. Think about the science ideas you may want to add.	Are the underlined parts where they explain how or why? If so, add a check mark. Are there additional places where they explain how or why but did not underline them? If so, underline them. Could their explanation be improved by using more science ideas? If so, which ones and where would you add them?
2. Does the explanation include evidence from classroom investigations (labs, readings, videos) to support the science ideas?	Circle evidence that you used. Make notes about where you could add more evidence to support your explanation.	Are the circled ideas examples of evidence? If so, add a check mark. Is there additional evidence that is not circled? If so, circle it. Could the explanation use more evidence to support it? If so, add suggestions of what evidence could be used and where to use it.

Based on self-assessment and peer feedback, consider how to revise the explanation: What should be added? What should change?

- Does the explanation include both why the music student sees themself AND why they do not see the adults?
- Does the explanation include the important parts of the system and how they interact? Are there additional interactions to include?
- What evidence from investigations does the explanation use? Is there additional evidence to include?

Record notes about what to revise directly on *Explaining the one-way mirror phenomenon*.

Name: _____ Date: _____

Explaining New Phenomena

Option A: The same lake on a calm or windy day

On a day that is very calm, you can see a full and clear reflection of the mountains in the lake.

On a day with a lot of wind, you cannot see a very good reflection of the mountains in the lake.

Option B: A wood floor before and after waxing the floor

Before waxing a wood floor, workers sand the floor and you cannot see any reflection.

After adding a new wax coat, you can see the reflection of the windows and lights.

Select **one** of the two options and explain: **Why do we see different things when looking at the same object?**

Choose how you want to explain the phenomenon. You can use words or pictures or a combination. In your explanation, include:

- What happens to light when it reaches the surface of the lake or the gym floor?
- Why do we see or not see a clear reflection in each scenario?

Name: _____ Date: _____

Let's Answer Questions from Our Driving Question Board!

Look through the list of questions from our DQB. Mark questions that you think the class has answered by putting a symbol next to it:

- We did not answer this question or any parts of it yet: **?**
- Our class answered some parts of this question, or the ideas we developed help me see how I could now answer some parts of this question: ✓
- Our class answered this question, or the ideas we developed help me see how I could now answer this question: ✓✓

Then pick three of the questions you have marked and write what you think that answer would be.

Question and Symbol	Answer and supporting evidence (select 3)

Question and Symbol	Answer and supporting evidence (select 3)

Name: _____ Date: _____

Science Literacy Exercise Page 1 Use with Reading Collection 1

Roadmap for Reading

This week's reading collection focuses on models of light and how they are useful in understanding the behavior of light. The selections include explanations of the wave model, a visual and numerical scale called the *electromagnetic spectrum*, and the particle model. The collection then looks at some ways organisms detect and interact with light.

"Collection 1: Light and Color" consists of 5 selections.

1 Why Are We Talking about Waves?
2 Electromagnetic Radiation
3 Science Interviews Podcast
4 Light and Sight in Nature
5 Color

As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Preview the headings to understand how each reading is organized.
- Consider how graphics support the text and how text clarifies the graphics.
- Think about how each reading supports or adds to knowledge you already have about light and waves.

Written Response

Your writing exercise is to draw and label a graphic organizer that summarizes some important science ideas in the reading collection.

- Draw your graphic organizer on a separate sheet of paper; attach this page to the front of it when you turn it in.
- Choose a light source to draw at the center of the page. Write a sentence to identify it as a light source.
- Draw a ray of light coming from the source for each of the reading selections. Write one big idea from each selection along a ray. Add up to three more rays if some selections have more than one big idea.
- Use color to make the organizer attractive and easier to understand.
- Set off science vocabulary you want to learn or remember by using uppercase letters.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Evaluation Guidelines

Element	1	2	3	Feedback
Choice of light source	The object drawn is not a light source, or the label is missing. Rays are missing or do not point away from the source.	An appropriate light source is drawn, but it is not in the center of the page or not labeled; light rays point away from it.	An appropriate light source is drawn in the center of the page and labeled; light rays point away from it.	
Related big ideas	Fewer than five big ideas; two or more selections are not represented; more than two science errors; science vocabulary is not highlighted using uppercase.	At least five big ideas, but not all reading selections are represented; one or two science errors; uppercase is used, but one or two are not science vocabulary.	One big idea from each of the five selections with two to three additional big ideas; all statements are scientifically accurate; uppercase is used to emphasize science vocabulary.	
Design and graphic elements	Messy drawing; text is difficult to read in several places; color is absent or detracts from the overall design.	Mostly neat and legible design; somewhat easy to read; color is used but contributes little to the overall design.	Neat, legible design; easy to read; color is used effectively.	
Grammar and mechanics	Six or more errors in punctuation, capitalization, and spelling	Three to five errors in punctuation, capitalization, and spelling	Fewer than three errors in punctuation, capitalization, and spelling	

Additional Feedback Notes:

Name: _____ Date: _____

Science Literacy Exercise Page 2 Use with Reading Collection 2

Roadmap for Reading

This week's reading collection focuses on how light interacts with matter. The selections include a report of a science investigation done by high school students. The data reveal patterns that the students used to hypothesize a cause-and-effect relationship.

"Collection 2: Reflection and Absorption" consists of four selections.

1 Light Cooking
2 Light in the Atmosphere
3 Photography and Light Metering
4 Clarity of Water

As you read:

- Consider the general purpose of each selection: is it a description, an explanation, a procedure, or an attempt to persuade?
- Think about how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each reading in the collection relates to knowledge you gained from the previous readings.

Written Response

Your writing exercise is to complete a well-designed infographic that informs viewers about three ways light interacts with Earth systems.

- Compose your infographic on a separate sheet of paper; attach this page to the front of it when you turn it in.
- Plan a layout that will have a text block for your title and a text block for each of the three ways matter interacts with light—by reflecting, absorbing, or transmitting.
- Provide an interesting piece of numerical or quantitative data from one of the readings for each interaction.
- Use the vocabulary terms in ways that show you understand their meaning.
- Add color to each text box to make the infographic attractive and readable.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	One or no terms related to interactions between light and Earth materials are used accurately.	At least two terms related to interactions between light and Earth materials are used accurately.	Shows mastery of the three terms related to interactions between light and Earth materials by using them in context accurately.	
Supporting details	There are three pieces of information, but not all are numerical or quantitative, and they do not clearly come from the readings.	There are three acceptable pieces of numerical or quantitative data from at least two readings.	There is at least one well-chosen piece of numerical or quantitative data from three or more readings.	
Design	The infographic used less than half of the page. The title is missing. Color was not used.	The infographic fills most of the page. The title is present but not clearly displayed. Color is used but not effectively.	The infographic fills the page. The title is prominently displayed, and three supporting text boxes use color effectively.	
Grammar and mechanics	Six or more errors in punctuation, capitalization, and spelling	Three to five errors in punctuation, capitalization, and spelling	Fewer than three errors in punctuation, capitalization, and spelling	

Additional Feedback Notes:

Name: _____ Date: _____

Science Literacy Exercise Page 3 Use with Reading Collection 3

Roadmap for Reading

This week's reading collection focuses on how the eyes and brain interact with light and what people see as a result. The selections include information on how the brain is sometimes tricked into seeing things that aren't really there.

"Collection 3: Human Vision" consists of four selections.

1 Human Eyes
2 The Brian, Visual Decoder
3 Illusions and Mirages
4 Factoring in Refraction

As you read:

- Consider the author's purpose: is it a description, an explanation, an instruction, or an attempt to persuade?
- Think about how the graphics support the narrative text and how narrative text clarifies the graphics.
- Slow down and compare what you are reading to what you knew about the topic before reading.

Written Response

Your writing exercise is to create a meme that that uses vocabulary and big ideas from the readings in this collection and would be enjoyed by other students.

- Compose your meme on a separate sheet of paper; attach this page to the front of it when you turn it in.
- Think about what struck you as funny, odd, amazing, or inspiring in these readings.
- Draw or print a rectangle-shaped picture.
- Write some amusing or inspiring text about vision and light in bold lettering—no more than a line or two.
- Try to use science vocabulary and at least one big idea from this collection.
- Make sure your meme meets your school rules and is not offensive.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	The meme has an image and text, but the point is not clear. The science idea seems inaccurate or unclear. The image and text seem unconnected.	The meme's point is not particularly funny, clever, or inspiring, but the science idea is accurate. The image and text work together fairly well.	The meme is funny, clever, or inspiring. The image and text refer to scientific ideas about vision and light. The two work together effectively.	
Design	The image is not a rectangle. The text is too light, unreadable, or not present.	The image is a rectangle. The text is bold and fairly readable but could be better positioned.	The image fills a rectangle. The text is bold, easy to read, and well positioned related to the image.	
Grammar and mechanics	Two or more errors that were not intentional for comedy's sake or space reasons	At least one error that is not intentional for comedy's sake or space reasons	Any errors are intentional text language for comedy's sake or space reasons.	

Additional Feedback Notes:

Name: _____ Date: _____

Roadmap for Reading

This reading collection revisits the topic of blue light and eye health and introduces three light phenomena that photographers need to consider.

"Collection 4: A Closer Look at Light" consists of four selections.

1 Blue Light and Eye Health
2 Color Temperature
3 Scattered Light
4 Polarization

As you read:

- Preview the headings and boxed notes—including Consider the Source, Vocabulary, and Connection.
- Consider the general purpose of each reading: is it a description, an explanation, a procedure, or an attempt to persuade?
- Think about how each reading relates to knowledge you gained from previous reading collections.

Written Response

Your writing exercise is to complete a well-constructed paragraph that describes some cause-and-effect relationships related to light and matter.

- Compose your paragraph on a separate sheet of paper; attach this page to the front of it when you turn it in.
- Choose one of the following topic sentences.
  - *The colors that things appear depends on several factors.*
  - *The intensity, or brightness, of light depends on several factors.*
  - *Photographers should know about factors that affect how their pictures will ultimately turn out.*
- Build on the topic sentence to complete a well-constructed paragraph that is formal in style. Use details from the text or graphics in the reading selections in your paragraph's supporting sentences.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	Inadequate summary of cause-and-effect relationships involving light as set up by the chosen topic sentence	Adequate completion of a structured paragraph about cause and effect, but weak in alignment with the chosen topic sentence	Thorough support of the chosen topic sentence, citing specific, relevant details from the reading selections and summarizing, using wording to identify cause and effect, key points from data tables and/or graphics	
Supporting sentences (details)	Incomplete sentences; details relate to only one or none of the readings; details irrelevant to the paragraph topic	Complete sentences, but too few; supports come from only one or two readings or have unclear relationships with the topic sentence	At least six complete sentences, encompassing three major points from three or more readings that support the topic sentence	
Conclusion	Abrupt end	Adequate end, but with weak or no reference to the overarching paragraph topic	Closing sentence that echoes the topic sentence	
Organization, transitions, and style	Statements with little clear relationship to the topic sentence or each other; style too informal	Key supporting details present, but absent or choppy transitions; style is partly formal and partly informal	Ideas in an order that helps the topic make increasingly more sense; a formal style is maintained throughout	
Grammar and mechanics	Six or more errors in punctuation, capitalization, and spelling	Three to five errors in punctuation, capitalization, and spelling	Fewer than three errors in punctuation, capitalization, and spelling	

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