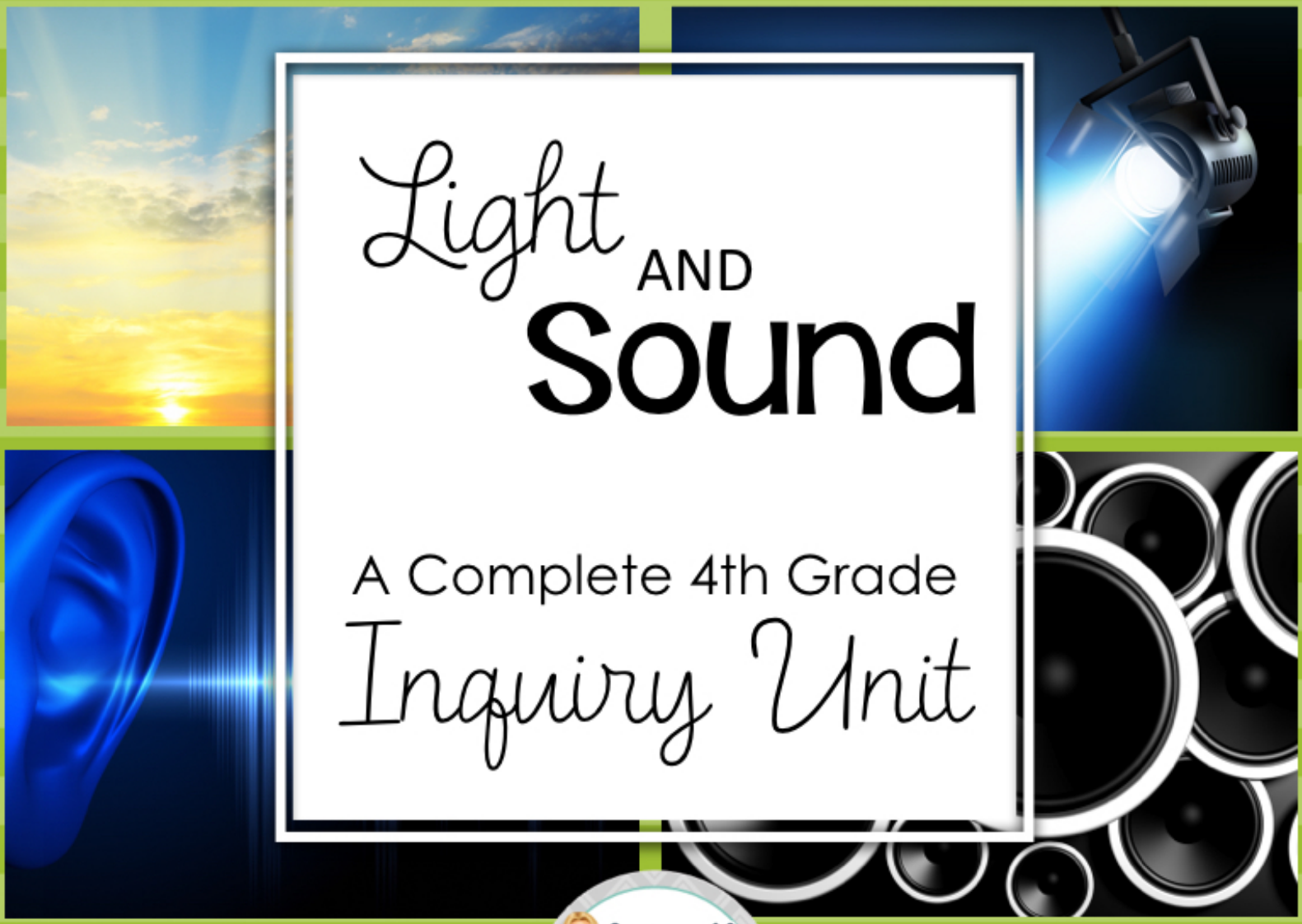
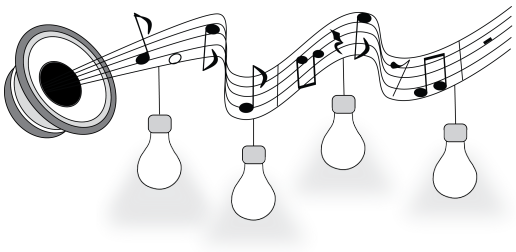
SCIENCE



Light AND Sound

A Complete 4th Grade Inquiry Unit

Madly LEARNING



Introduction
Light and Sound

Dear Teacher,

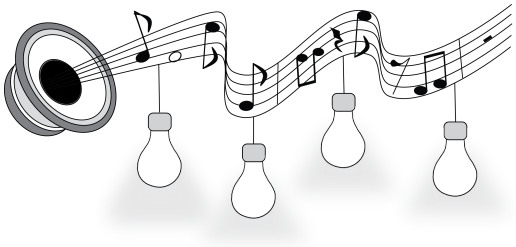
This unit has a lot of hands on experiments that will keep students excited and engaged while learning about light and sound. Wherever possible I have tried to ensure that all of the experiments use common and safe materials to accomplish the learning goals. However an important aspect of these experiments is the ability for students to reflect on their learning as some of the concepts are theoretical and some students may struggle with making these connections without your guidance. This is especially true with sound and understanding that sound travels through molecules and in waves two things which students cannot always see with their eyes.

I would also highly recommend that this is not your first unit of the year. There are many skills that students will require such as independent work skills, and a knowledge of inquiry and the inquiry process. These are skills that have to be explicitly taught, modelled, and rehearsed. It can be done in this unit but is much more easily done through other units that are more researched based and less hands on experiences.

This unit can be used by teachers at any stage of their inquiry journey. Learning how to use an inquiry approach in your classroom is a valuable and changing experience. As you begin I cannot promise you that it will all be smooth sailing as inquiry can be messy and uncomfortable as the teacher lets go of some control over student learning and the students begin to learn to take a more active role in their own learning. Understanding that this process is a journey and that this unit will help you to begin, continue or support you on that journey is paramount. If you are new to inquiry and would like more support please check out my video inquiry series on my website at http://bit.ly/ML-inquiry to learn about how I implement inquiry in my classroom with my split grade.

As always if you have any questions, concerns or comments you would like to share with me I am always available to support you. Send me an email and I will get back to you promptly. I appreciate when buyers contact me directly on any issue prior to leaving feedback.

Enjoy the unit!
Sincerely,
Patti
@MadlyLearning
EMAIL : info@MadlyLearning.com



Focus on Inquiry

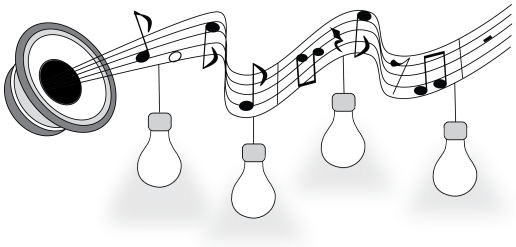
Inquiry is an approach to teaching that takes the teacher out of the role of lecturer and transitions the teacher into the guide on the side. By implementing an inquiry approach you are giving up some of the control in your classroom and over the learning.

Getting Started:

Start your unit getting to know how much your students know and what they are interested in. This is the goal of lesson one. Have them complete the arrow foldable then come and share what they know with the group. Get some of their questions and capture them on a chart paper. Have them share their ideas with the class. Students will ask questions but don't give them answers; just write them down and ask a question back that makes them think more deeply about the topic they are curious about. Get an idea on what they are interested in and what they know. Once you have captured their questions look at their list and group their questions into topics. These will serve as your lessons. Make a list of themes that students want to know. These will generally follow the lessons as they are planned out in this unit except now you have let them choose why they are learning about them.

The Lessons:

The lessons in this resource reflect the typical goals of an initial student inquiry. You will work through these lessons always referring to these as being a part of the student goals. They do not have to be done in exactly this order and you can add in other information based on student interest. You will notice that many of the pages included either activate prior knowledge or are a reflection on a hands on learning activity to ensure that students are learning from the activities what they are supposed to learn. This is where your guidance becomes and important part of the learning process.



Focus on Inquiry

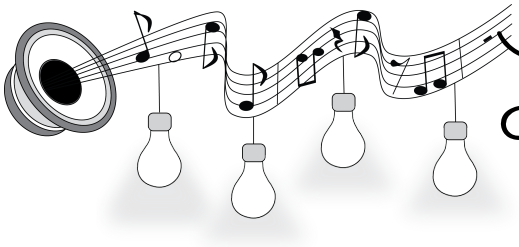
The Lessons continued:

You are no longer just giving information but you are leading discussions through questioning techniques that help students to draw conclusions. Conferencing and knowledge building circles will be important activities for this to occur. Assess who is doing most of the talking? It should be the students doing the talking about their learning and not just listening. This is the goal for learning. However this may be new to many of them as they learn to listen to each other instead of just you. So train them, train them, train them by gradually releasing the control of the conversation away from you and more to them.

Final Inquiry Project:

This is the application piece of all of their learning and should take up the most of your teaching and learning time. During this time you are not teaching and lecturing but supporting, questioning and conferencing with students. If this is one of your first inquiry units you can consider a guided inquiry approach where you walk them through each step and limit their choices, or you can allow students to work as a group based on interest and use a guided reading for science model to help them through their inquiry.

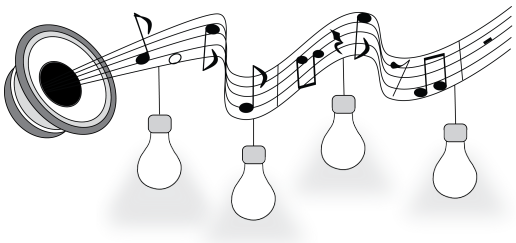
Inquiry is a journey and wherever you are on your inquiry journey as a teacher is an okay place to be. Start with one inquiry task and with every new experience release a bit more control to students letting them lead. This happens over time not over night.



Light and Sound

Lesson Overview

	Lesson
1	Light and Sound in our World.
2	Artificial and Natural Light.
3	How Light Travels - Experiments.
4	Light: Bend, Bounce, Absorb.
5	Light and Colour.
6	What is Sound?
7	How Sound Travels.
8	Detecting Sound.
9	Light and Sound Safety.
10	**Inquiry Project** - How light and sound inventions have changed the way we live.



ONTARIO Curriculum Links

Ontario Curriculum Expectations	1	2	3	4	5	6	7	8	9	10
Assess the Impact on society and the environment of technological innovations related to light and sound.										
1.1 Assess the impact on personal safety of light and sound devices.	X								X	X
1.2 Assess the impacts on society and the environment of light and sound energy produced by different technologies (from different perspectives).									X	X
Investigate the characteristics and properties of light and sound.										
2.1 Follow safety procedures.			X	X	X		X			
2.2 Investigate the basic properties of light: • Light travels in a straight path. • Light reflects of shiny surfaces. • Light refracts. • White light is made of many colours.			X	X	X					
2.3 Investigate the basic properties of sound: • Sound travels. • Sound is absorbed or reflected. • Sound can be modified. • Relationship between sound and vibrations.						X	X	X		
2.4 Use problem solving skills to design, build and test a device that makes use of the properties of light.			X							X
2.5 Investigate applications of the properties of light and sound.	X	X							X	
2.6 Use appropriate science vocabulary.	X	X	X	X	X	X	X	X	X	X
2.7 Use a variety of forms to communicate understanding.	X	X	X	X	X	X	X	X	X	X
Demonstrate an understanding of light and sound as forms of energy that have specific characteristics and properties.										
3.1 Identify a variety of natural light sources.	X	X								
3.2 Distinguish between objects that emit their own light and objects that reflect light.	X	X								
3.3 Describe the properties of light (travels in a straight line and can be absorbed, reflected or refracted).			X	X	X					
3.4 Describe the properties of sound (sound travels, sound can be absorbed, reflected or modified).						X	X	X		
3.5 Explain how vibrations cause sound.						X	X			
3.6 Describe how different objects and materials interact with light and sound (prisms, voice, echo, water, air).				X						
3.7 Distinguish between sources of light that give off both light and heat.					X					
3.8 Identify devices that make use of the properties of light and sound.		X							X	X

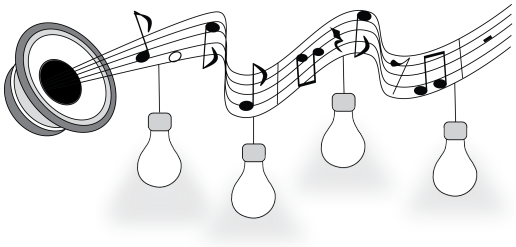
Links and Resources

Light and Sound

LINK TO LIVE BINDER RESEARCH FILES

http://bit.ly/ML-lightsound

ACCESS CODE: MLSS&S

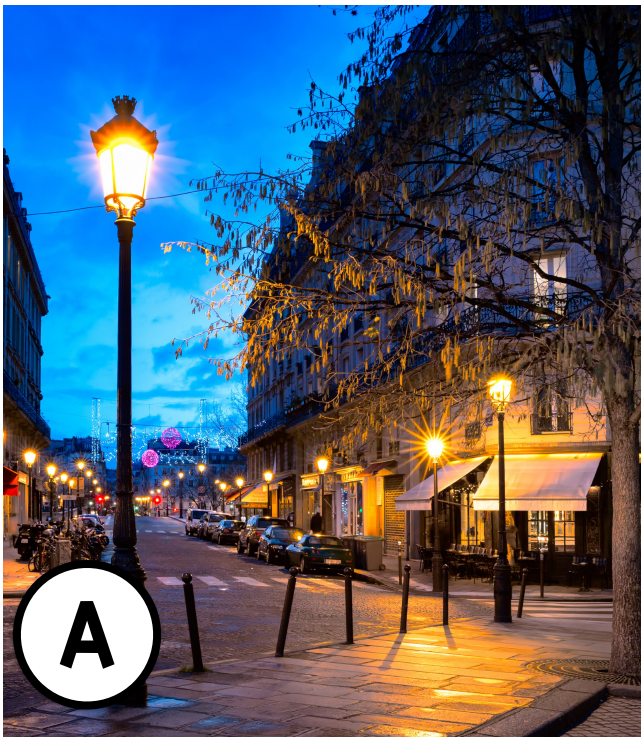


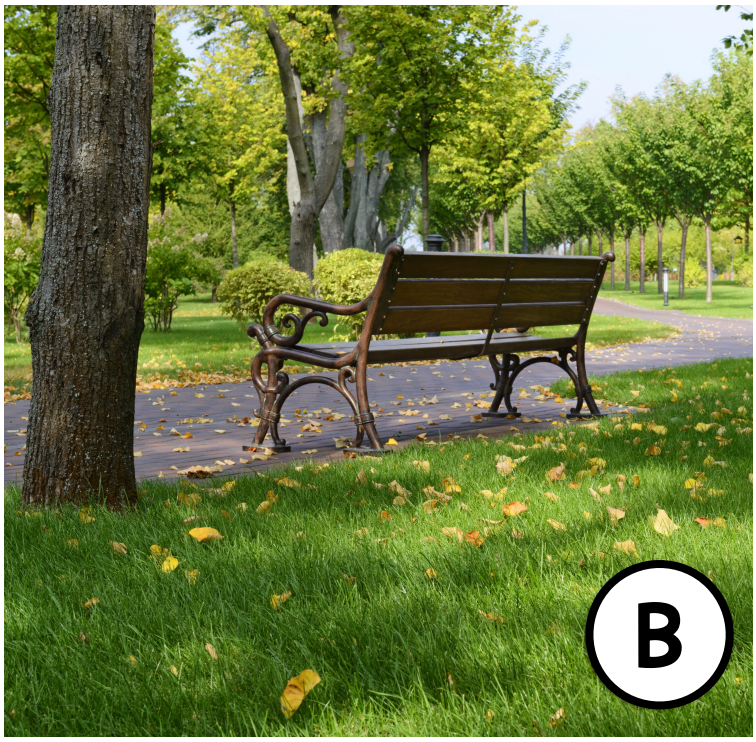
Lesson #1

LIGHT AND SOUND IN OUR WORLD

Lesson #1

	First Half	Second Half
Prep	Photocopy or colour print the grade 4 collage of pictures of light and sound, the interactive notebook for students note-taking. Prepare chart paper to record students questions and ideas to generate learning goals and success criteria.	
Gr. 4	Provide students with the photo collage of light and sound. **Student Activity:** Students will look at the photo and access their background knowledge to identify and sort the things in the pictures that emit light and things that make sounds. They will answer the questions on the foldable flap activity about light and sound prior to meeting with the teacher.	**With the Teacher:** Students will meet with teacher to discuss their pictures. Students will share what they saw and their answers to some of their questions. After this conversation invite the students to share their thoughts about the upcoming unit of light and sound. ○ What do they wonder about light and sound ○ What are they curious about ○ What would they like to learn more about Record students responses to create learning goals and success criteria. This will create a a focus for students for the remaining parts of the unit.
Notes	Grade 4: Not every student needs their own picture page. You may want to print a few pages or display this page on an interactive board or Apple TV.	





Instructions:

Complete the three pages of the foldable based on the pictures that you and locations that you see. Try to imagine yourself in the scene: what lights and sounds would you see. They do not necessarily need to be in the picture. When all of the pages are done then cut them out around the outside of the shape. These will be glued together and assembled after you meet with your teacher.

Answer the following questions about light and sound

Can you think of examples of natural light?

_____

_____

_____

Can you think of examples of artificial light?

_____

_____

_____

Which pictures or locations would you consider noisy? Why?

_____

_____

_____

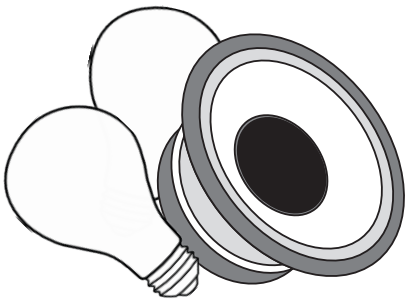
How do the lights and sounds in these locations keep us safe?_____

_____

_____

Think about it

Wondering
all about
Light AND Sound



<u>Look at Picture D&E</u>

Brainstorm a list of lights and sounds that you might see and hear in these locations.

BUSY STREET

FACTORY

pictures D&E

Look at Picture B&C

Brainstorm a list of lights and sounds that you might see and hear in these locations.

COMMUNITY PARK **AMUSEMENT PARK**

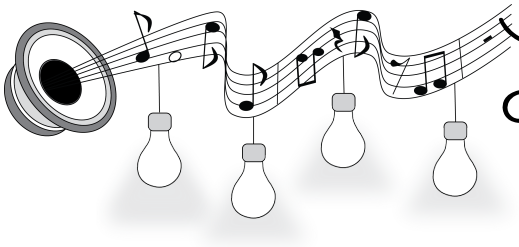
pictures B&C

Look at Picture A

Brainstorm a list of lights and sounds that you might see and hear in this location.

CITY STREET AT NIGHT

picture A

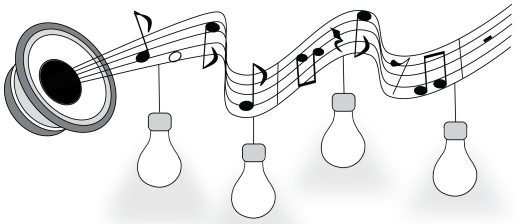


Light and Sounds All Around

After participating in the conversation with your teacher and classmates what are some of your questions about Light and Sound:

- I still wonder: _____
- What might happen if: _____
- How does? _____
- Why does? _____
- I'm curious about: _____
- I want to know more about: _____

What I Wonder

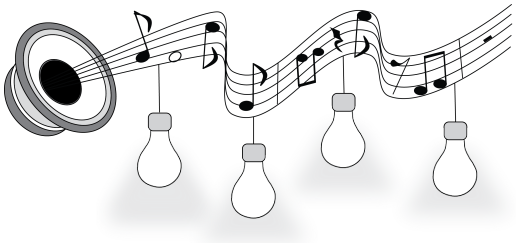


Lesson #2

ARTIFICIAL AND NATURAL LIGHT

Lesson #2

	First Half	Second Half
Prep	Students need both sets of pages their picture sort and their REFLECTION: How does light help.	
Gr. 4	**Student Activity:** Students will read the article on natural and artificial light sources. Students will then sort the light cards into two categories natural and artificial light sources.	**Work with Teacher:** Students will reflect on where light comes from. Look at the different sources of light and how they help people to live and benefit of the environment. • **Sun** - helps us see during the day. Helps us do work. Helps us grow plants. • **Lightbulb** - helps us see at night and indoors. • **Lightning -** • **Glowworm -** glow to find a mate so they can reproduce
Notes		



Types of Light

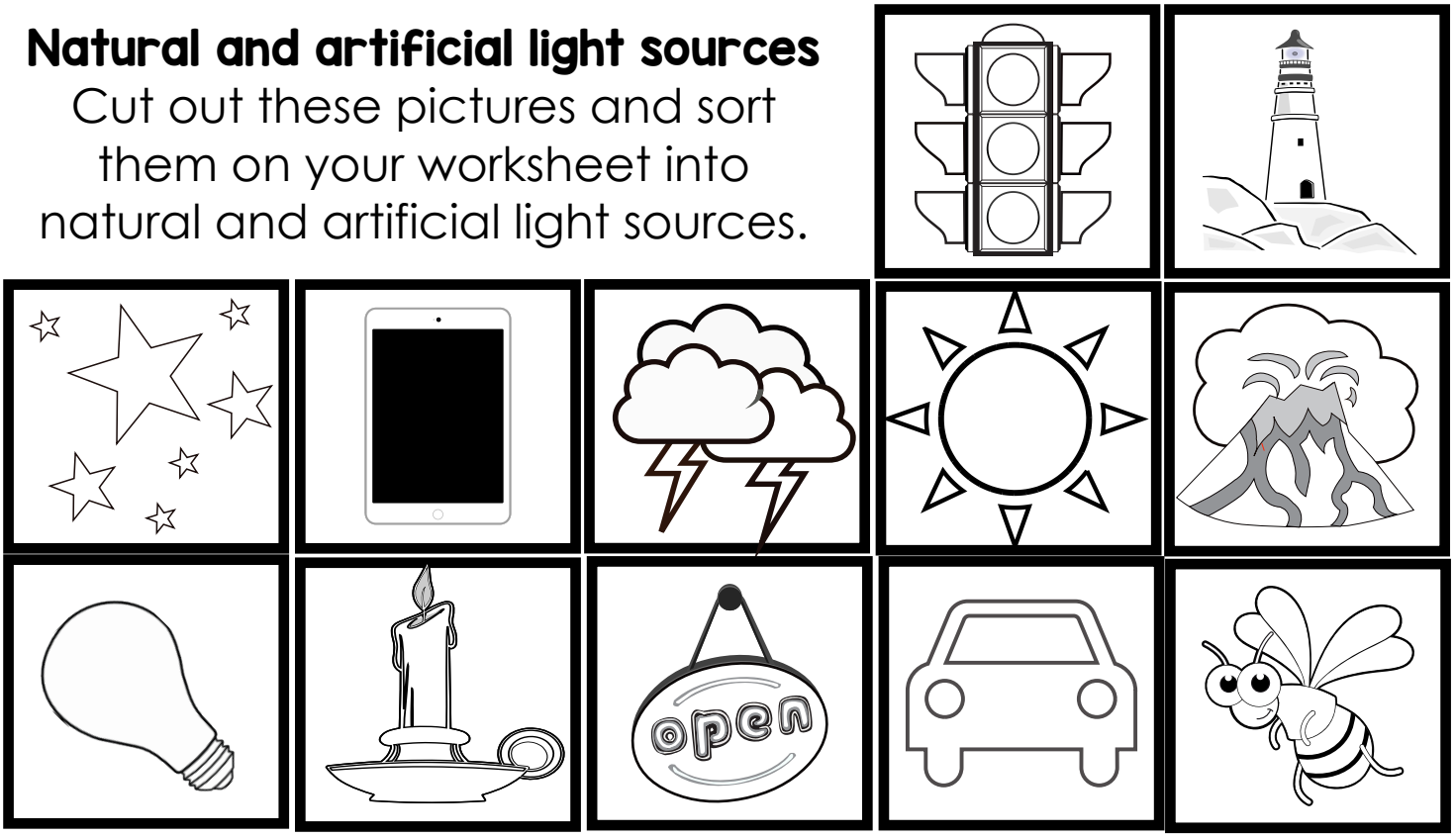
Natural and Artificial Sources of Light

We need light in our lives to do many things. There are two different types of light. Lights that occur in nature and lights that are made by or invented by people. Light invented by people is called artificial light. Can you think of and sort different sources of light?

Natural Light Source	Artificial Source of Light

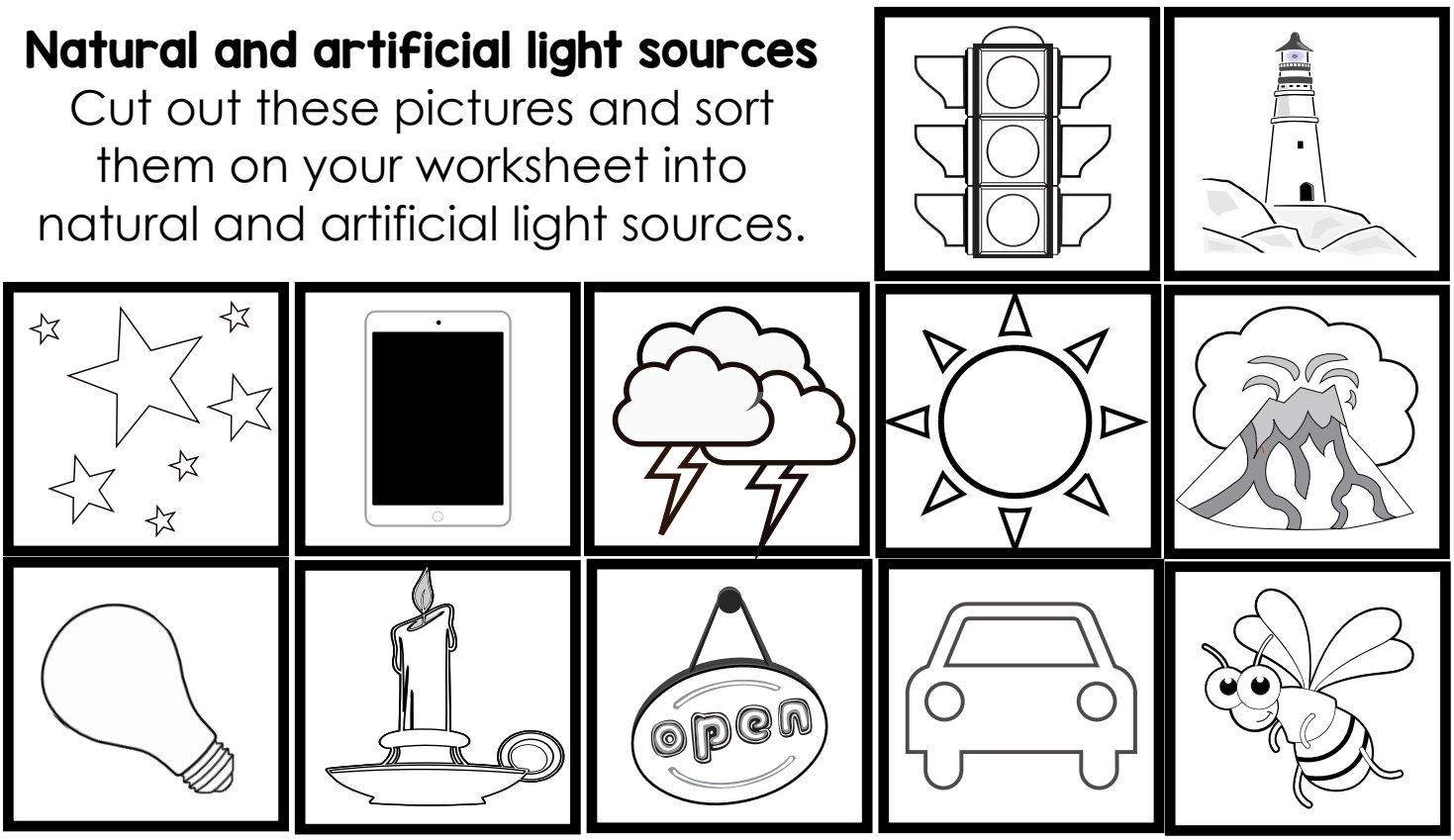
Natural and artificial light sources

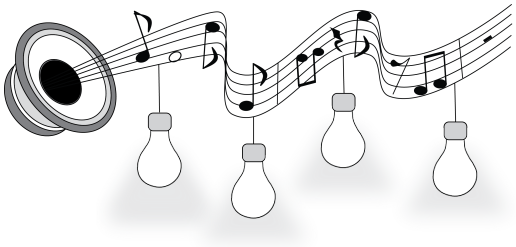
Cut out these pictures and sort them on your worksheet into natural and artificial light sources.



Natural and artificial light sources

Cut out these pictures and sort them on your worksheet into natural and artificial light sources.





Light Sources

Natural and artificial light sources

REFLECTION: How does light help?

1. Light source

_____

2. Natural or artificial?

3. How does this help?

_____

_____

_____

_____

_____

_____

1. Light source

_____

2. Natural or artificial?

3. How does this help?

_____

_____

_____

_____

_____

_____

1. Light source

_____

2. Natural or artificial?

3. How does this help?

_____

_____

_____

_____

1. Light source

_____

2. Natural or artificial?

3. How does this help?

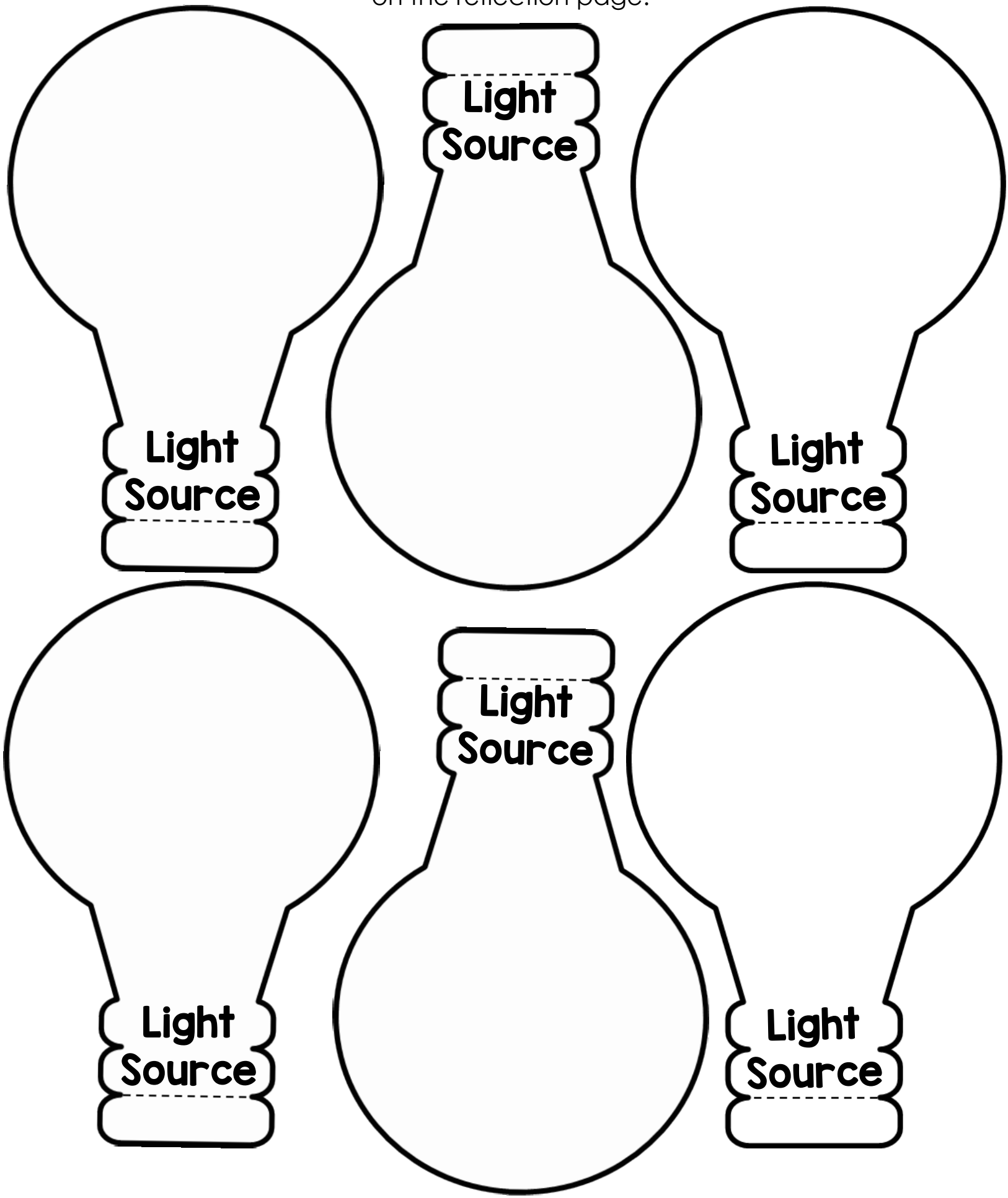
_____

_____

_____

_____

Cut out four light bulbs for yourself. Draw a picture of your chosen light source. Fold each light on the dotted line and glue the tab down over the questions on the reflection page.



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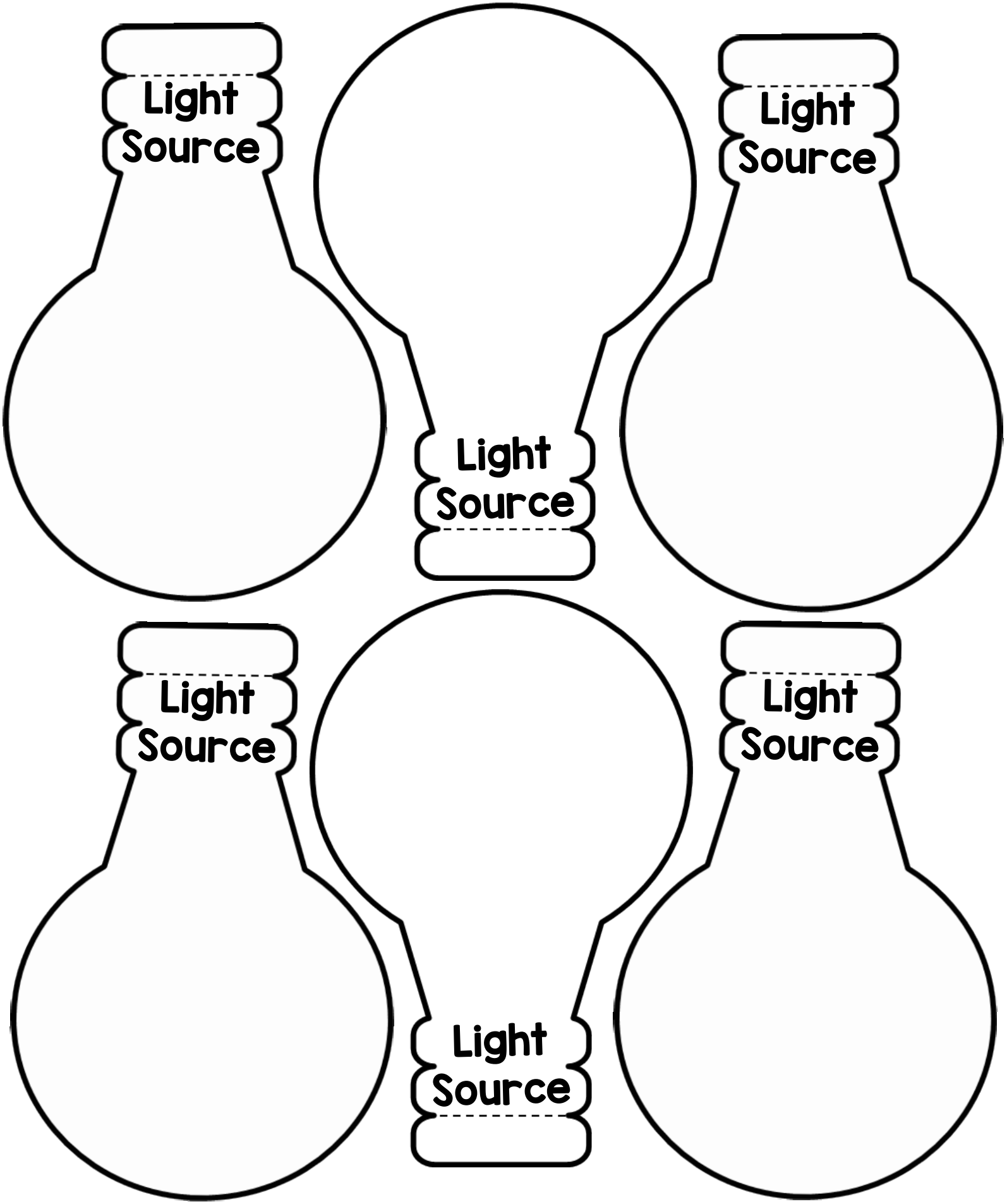
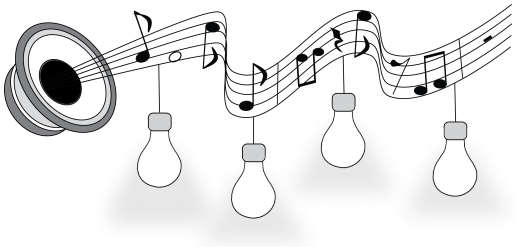


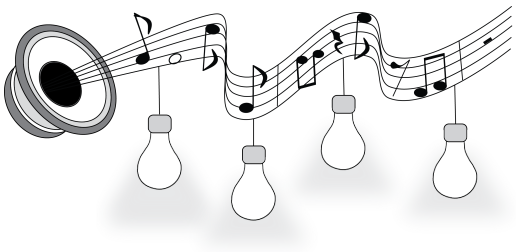


Lesson #3

HOW LIGHT TRAVELS - EXPERIMENTS

Lesson #3

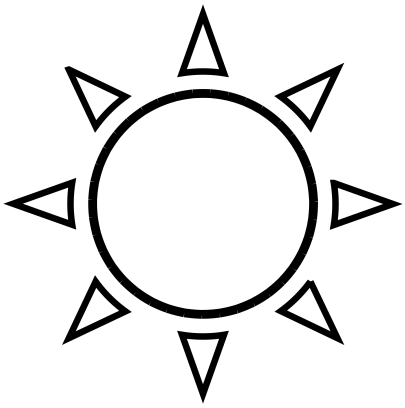
	First Half	Second Half
Prep	Gr.4: Students need both sets of pages their picture sort and their REFLECTION: How does light help?	
Gr. 4	**How light travels:** Students will begin to understand that light travels in a straight line. The experiments that are designed for this will help them to see this concept however they may need support to draw this conclusion. Reflection will be necessary. **Work with Teacher:** Talk with students about how light travels. Have them generate a hypothesis together. Ask the following questions to prompt them to draw a hypothesis. You may want to actually draw pictures to help students visualize what they are trying to convey. • How does light travel from the sun to the earth? • How does the light travel out of a flashlight? • What path does light take?	**Student Activity:** Students will participate in two experiments. (these can be done either as demonstrations, whole group, or small group centres depending on the needs of your class) There are two experiments: 1) Light through cards - Materials (index cards or card stock, single hole punch, modelling clay, straw) 2) Light around a corner (cardboard box- it is suggested that you use something like a cereal box or larger box, mirrors, flashlight)
Notes		



Traveling Light

How does light travel?

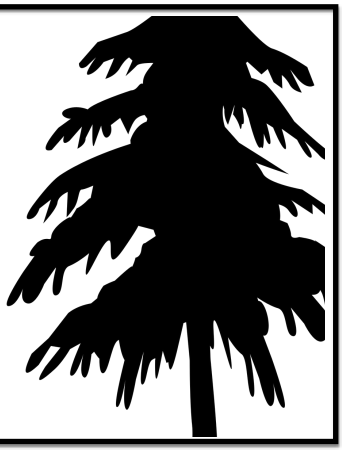
Have you ever thought about how light gets from the sun to the earth or how a flashlight is able to light your path in the dark? Think about what you know about light. Can you make a hypothesis (an educated guess) about the path that light travels to get from one point to another? Look at the pictures below and draw the path that light travels to help you make your hypothesis.



Hypothesis: Describe how the light travels:

_____

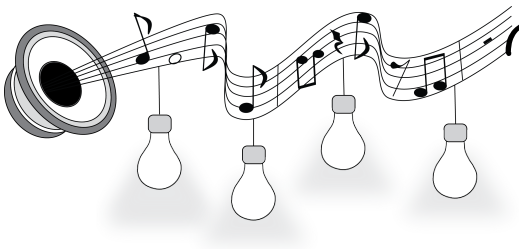
_____



Hypothesis: Describe how the light travels:

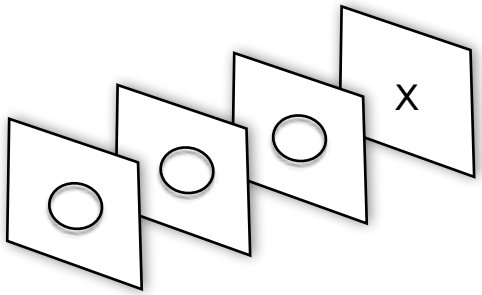
_____

_____

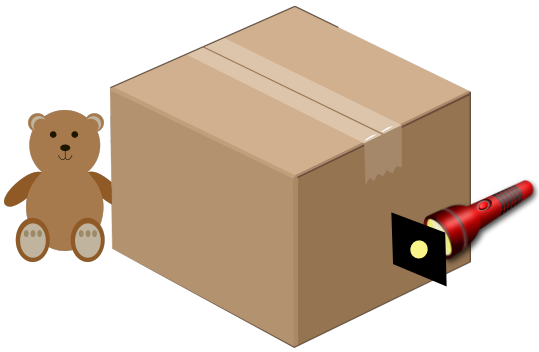


Traveling Light Experiments

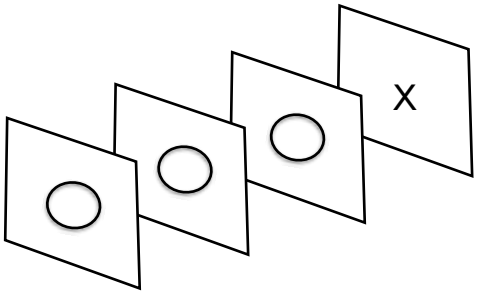
Light Through Cards



Light Around Corners



Light Travels
Experiment #1



1. Question

How does Light Travel?

2. Hypothesis:

I think _____

_____

_____

3. Experiment

Follow the instructions to test your hypothesis then draw a picture of your results.

Light Through Cards

You will need:

4 index cards
One Hole Punch, Modeling clay
Straw and Flashlight

Getting Ready:

Punch a hole in the middle of three of the cards in the same place. Using one of the punched card as a guide place it over the unpunched card and make a mark on the blank card in the middle of the hole.

Test It:

Using the flashlight try to get the light to pass through all three cards to hit the target spot on the last hole.

4. Results

Describe your results. How did you have to set up the cards to hit the target?

_____

_____

_____

_____

_____

What does this tell you about how light travels?

_____

_____

_____

5. Reflection

After meeting together and sharing the test results as a class what did this experiment teach you about how light travels?

_____

_____

_____

Light Travels
Experiment #2

1. Question

How does Light Travel?

2. Hypothesis:

I think _____

_____

_____

3. Experiment

Follow the instructions to test your hypothesis then draw a picture of your results.

Light around Corners

You will need:

Black Construction paper with a hole in the middle, Flashlight, cardboard box, mirrors (2-3)

Getting Ready:

Take the black construction paper about the size of the end of your flashlight and cut a hole in the middle of the paper. Place the black paper in front of the light. Place a target object at a different corner of the box

Test It:

Place your target at one corner of your cardboard box. Starting your flashlight at a different corner to light up your target. Try to get the light to move around all four corners of the box using the mirrors to help if needed.

4. Results

Describe your results. How did the light travel around the box?

_____

_____

_____

_____

_____

What does this tell you about how light travels?

_____

_____

_____

5. Reflection

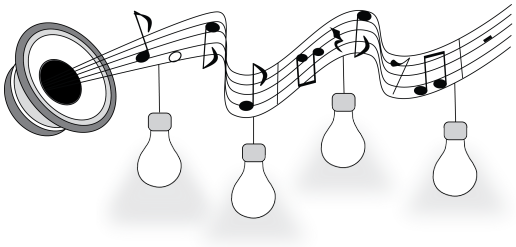
After meeting together and sharing the test results as a class what did this experiment teach you about how light travels?

_____

_____

_____

_____



Lesson #4

LIGHT: BEND, BOUNCE AND ABSORB

Lesson #4

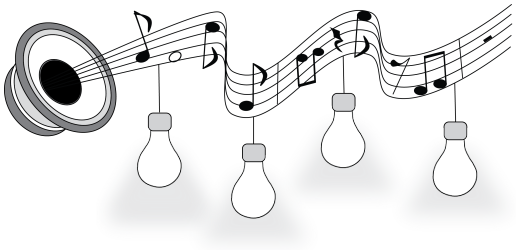
	First Half	Second Half
Prep	Ensure you have the materials for the experiments. Mirrors, flashlights, clear cups, straws, oil and water. Alternatively aluminium foil can also work instead of mirrors.	
Gr. 4	**Light: Bend Bounce Absorb:** **Student Activity:** <u>All students together:</u> Students will read the article about bending, bouncing and absorbing light. To learn more about how light reflects, refracts and absorbs light. Students begin to answer the questions on the foldable and will continue to consolidate their learning through the demonstration experiments.	*This activity allows you to model for students the scientific process. These quick experiments should be modelled for students as a large group. I would recommend blowing up the experiment guide pages to the largest size available on your school photocopier* **Experiments** **Light Bends:** mix two substances together to see how light bends. They must focus on that in order for us to see an object the light hits the object and bounces off to hit our eyes so we can see it. When that object passes through substances with different densities the light travelling to our eyes makes it look like the object is broken. That is the light bending because the image we see doesn't look continuous. **Bouncing Light** You will need at least one strong source of light (good flashlight would work) and mirrors for students. Follow the instructions to bounce the light around from person to person. **Absorbing Light**
Notes	**See teacher notes on light experiments**	

Teacher Notes

Light Bends:
Mix oil and water together to see how light bends. When you look at the straw or pencil in the cup straight on from the side it will look like the straw is cut into two. This is said to have a bent (or broken) appearance. This happens because in order for our eyes to see an object, light hits the object and bounces off of it then hits our eyes so we can see it. When the straw or pencil passes through substances with different densities like oil and water, the light travelling to our eyes makes it look like the object is broken. The light travels slower through substances like oil that are more dense than it does through water. That is the light bending because the image we see doesn't look continuous. It is altered due to the different speed in which the light bounces off the object to our eye.

Bouncing Light:
You will need at least one strong source of light (a good flashlight would work) and mirrors for students. Follow the instructions to bounce the light around from person to person. The reflectivity of light off a mirror will lose about 10% of its energy when bouncing off the mirror. If using aluminium foil you can expect a 12% loss of energy. This will affect the amount of students that are able to bounce the light off the objects. Therefore this game should have a maximum of about 8 people to work properly. Students should be able to notice that through this experiment there is energy loss as the beam of light is less bright as it bounces from person to person.

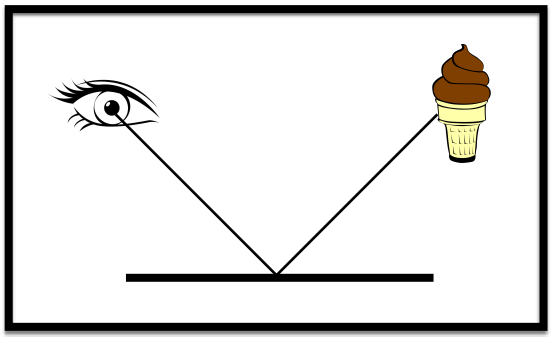
Absorbing Light:
White light is made up of all of the colours of the rainbow. When you see the colour white all the colours of light are reflected and nothing is absorbed. With black all the colours of the rainbow are absorbed and the energy from the light is converted into heat. This is why black objects are hotter in the sun.



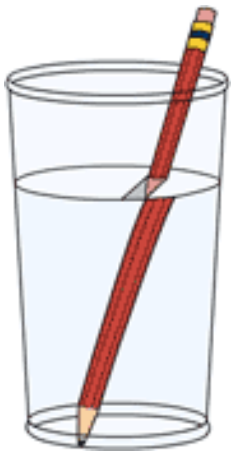
Altering Light

Bend, Bounce, and Absorb

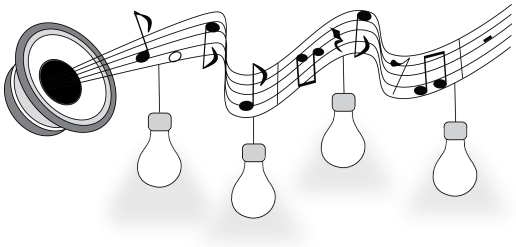
Light travels in a straight line. However, when rays of light bump into things or pass through things sometime the ray of light changes and can bend, bounce or be absorbed by the object it ran into.



When a light ray bounces off of an object that is called reflection. Reflection helps us to see things in our world. When light hits a smooth surface at an angle (the angle of incidence) the light is then reflected in the opposite direction at the same angle. When light hits surfaces that are not smooth the reflected angles may scatter all around. Objects that do not produce their own light like walls and desks need to reflect the light that bounces off of their surfaces into our eyes so that we can see the object.

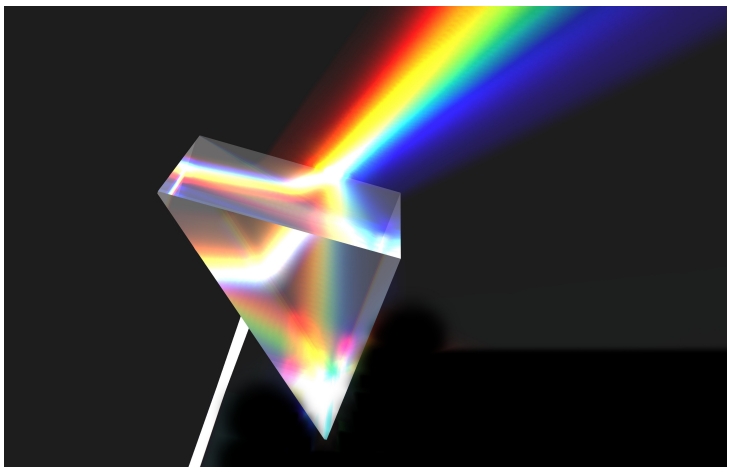


When a light ray passes through different materials with different densities it is bent or refracted. If you put a pencil into a glass of water it looks like the pencil is bent or distorted. This is because the light ray is travelling at one speed through the air but when it hits the denser water it slows down. Just like when you try to run through water in a pool you are much slower than running on land. As the light ray hits the water it slows down and bends altering the direction it was travelling.



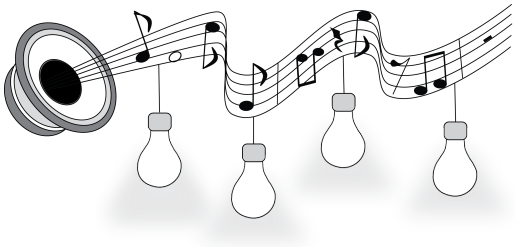
Altering Light

Bend, Bounce, and Absorb



If light bounces off of surfaces to help us see, why are things different colours? Light is made up of many different colours that when combined look like white light. When a light ray hits your red shirt It absorbs all of the colours in the light ray except the red colour. The red colour is bounced back and reflected back to our eye. Some colours are absorbed more than others. Black objects absorb all colours of light. When colour is absorbed by an object the energy from the light is changed into heat. This is why on a hot day the black asphalt road is too hot to walk on with your bare feet. It is also why white objects are not as hot because white absorbs less colours.

Reflection	Refraction	Absorbing
When light hits an object and the light bounces off in the opposite direction	When light bends as it passes through an object with a different density	Light is absorbed by an object to help us see colour. All colours of light are absorbed except the colour we see.



Altering Light Experiments

1. Question

How does light bend as it passes through substances with different densities?

2. Hypothesis:

I think _____

_____

_____

3. Experiment

Part 1: Rate the substances for density

Least dense:

_____

Somewhat dense:

_____

Most dense:

_____

Part 2:

Describe what the straw looked like in the cup:

_____

_____

_____

Light Bends

You will need:

Three clear cups, oil, water and a straw

Part #1:

Take three clear cups and fill one with 2/3 water, fill another clear cup with 1/3 of the oil and leave the third cup empty. Dip the straw in each cup and move it around. Notice the different densities of each substance. Which was thicker?

Part #2:

Mix the oil, and water into the empty cup and wait until is settles and separates. Put the straw into the cup. Look at the straw in the cup what do you notice?

4. Results

Draw the results of your experiment for part 2.

5. Reflection

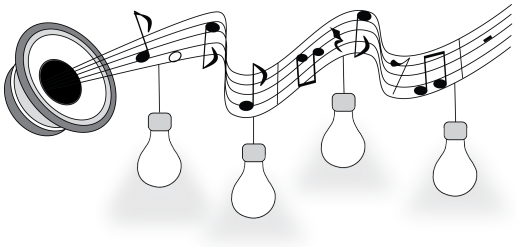
What did you learn about refraction from this experiment?

_____

_____

_____

_____



Altering Light Experiments

1. Question

How do mirrors help to move light?

2. Hypothesis:

I think _____

_____

_____

3. Experiment

Draw a picture of a successful round of your game.

Bouncing Light Game

You will need:

A mirror for each student and a light source.

Instructions:

Have students play a game where one student starts with a light source (flashlight) The light has to be passed around in a circle to eventually return to the person with the flashlight.

Rules:

You may not pass the light to the person next you. Everyone in the group must help to pass the light before it is returned to the sender. Start with a small group of 3 people and then increase the size of your group.

4. Results

Choose a round of your game and describe what happened

Number of people:____

What did you notice about how the light travelled in your group?

_____

_____

_____

_____

_____

5. Reflection

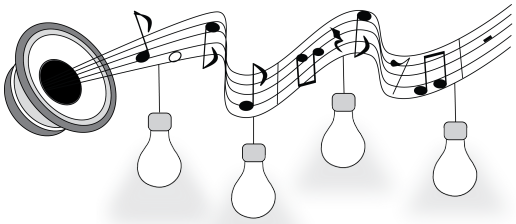
What did you learn about reflection from this experiment?

_____

_____

_____

_____



Altering Light Experiments

1. Question

How do we see colours?

2. Hypothesis:

I think _____

_____

_____

3. Experiment

You will need

Four pieces of paper (red, blue, green and white), 4 flashlights, cellophane paper in red, blue and green

Getting Started

Line up all four pieces of paper in a row. Shine each flashlight on each piece of paper. What do you notice? Record the colours you see in the chart to the right.

Absorbing Light

Record what colour you see when you shine each colour of light on different colours of paper.

	White Paper	Green Paper	Red Paper	Blue Paper
White Light				
Green Light				
Red Light				
Blue Light				

4. Results

Digging Deeper

Take two flashlights and shine both colours of light onto the white paper what do you notice.

What did you notice about combining the light rays?

_____

_____

_____

_____

_____

_____

5. Reflection

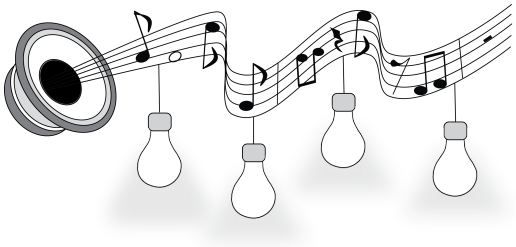
The colour you see is the light that is not absorbed by the object. How did this experiment show light being absorbed?

_____

_____

_____

_____



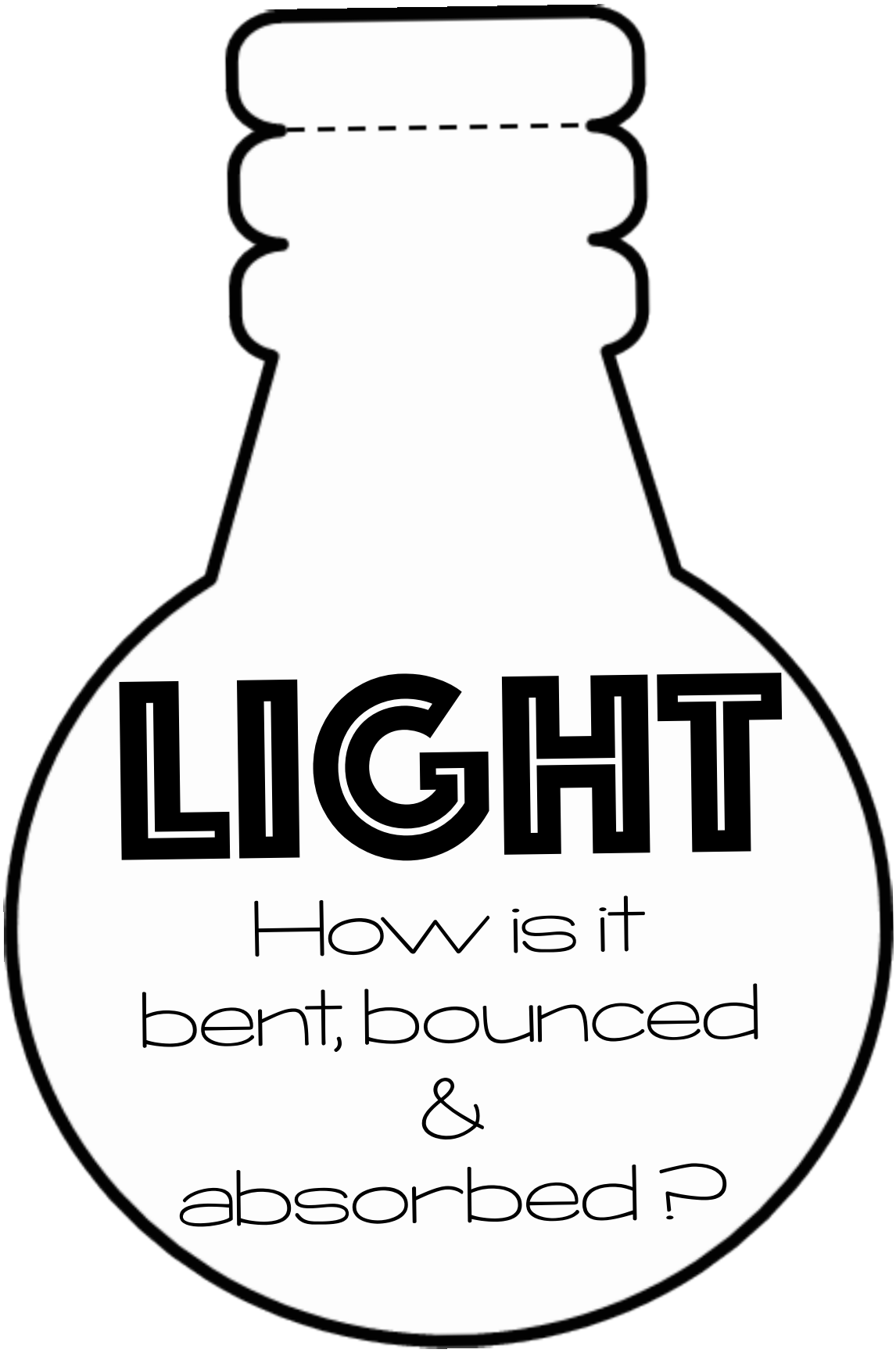
Altering Light

Bend, Bounce and Absorb

Create your light bulb foldable.
Complete the four question pages on bending light, bouncing light and absorbing light.

Cut them out around the outside of the shape and stack them together.
Place the title page on the top of the stack of question pages and fold the top tab back covering the top of the question pages. Staple the booklet together at the top.

Put glue on the back of the last page of the booklet and then glue on top of these instructions


LIGHT
How is it
bent, bounced
&
absorbed ?

How does light bend?

Another name for light that is bent is called:

What causes light to bend/refract?

Give an example of light refraction:

How does Light Bounce?

Another name for light that is bounced is called:

Reflection occurs when:

How does reflection help us see?

Give an example of light refraction:

Absorption

Refraction

Reflection

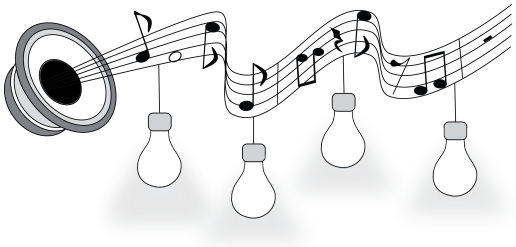
Draw It

How is light absorbed?

When light is absorbed how does it help us to see colour?

When more light is absorbed what happens to the surface of the object absorbing the light?

Give an example of how light being absorbed helps us to see colour:

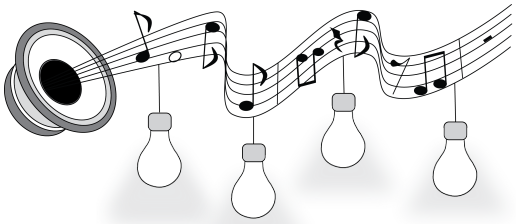


Lesson #5

LIGHT AND COLOUR

Lesson #5

	First Half	Second Half
Prep		
Gr. 4	**Light and Colour:** ***Big Idea:*** That the colour they see is not separate and distinct colours but a result of light either reflecting or being absorbed. **Experiment Activities:** These can be done as centres, demonstrations or you can pick and choose a few to do. This should take a few days. to complete. You may want to practice these prior to doing them with students You will need: • Food dye • Water • Glass jars/cups (x4) • Large glass bowl • Mirror • Coffee filter • Pencil • Black washable markers • Flashlight with a strong beam • Rubber bands • Black and white paper	***Making Black:*** *Using food dye, have students drop in one colour at a time into a clear glass jar to try to make black water. This can also be done with paint.* ***Seeing colours in black:*** Using coffee filters and a clear cup with some water in the bottom. Mark a coffee filter with washable markers just above the water line. As the filter is dropped in the water it will wick water up and as it hits the black spot the colours in the black marker will separate. ***Rainbow Making:*** Using a glass bowl, a mirror, water, and a flashlight. Place the mirror in the bottom of the bowl and cover with water. Shine the light at the mirror through the water and look for the rainbow reflected on the walls or ceiling. ***Light Colour & Heat:*** Wrap two glasses; one with black paper and the other with white paper and secure with rubber bands. Let them sit in the sun or under direct light and then measure the heat of each jar
Notes		



Making Black

1. Question

What colours make black?

2. Hypothesis:

I think _____

_____

_____

Instructions

You will need:

a glass jar, water, food colouring

Instructions:

Fill a glass jar just over half full. Add one drop of dye to the cup of water at a time. Tally the number and colour of drops in the chart. Try to make the water to turn black in colour.

Making Black
3. Experiment

Record your dye drops in the chart below

Colour	Tally of Dye Drops

4. Results

Were you able to make black? Explain how you did it.

_____

_____

_____

_____

_____

_____

_____

How could you make black in the least number of dye drops.

_____

_____

_____

5. Reflection

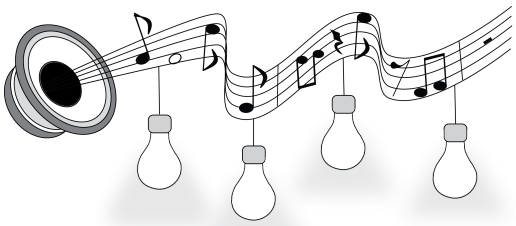
What did you learn about light and colour from this experiment?

_____

_____

_____

_____



Seeing Colours

1. Question

What colours make black?

2. Hypothesis

I think _____

_____

_____

Instructions

You will need:

a glass jar, water, washable black markers, coffee filter, pencil.

Instructions:

Cut the filter into strips and secure one around pencil with a tail hanging down to touch the bottom of the cup. Mark a solid circle on the strip 6cm from the bottom of the strip. Fill the cup with water 5cm deep.

Making Black
3. Experiment

Watch what happens to the coffee filter when you add the water.

BEFORE	DURING

4. Results

Draw what happened after.

AFTER

5. Reflection

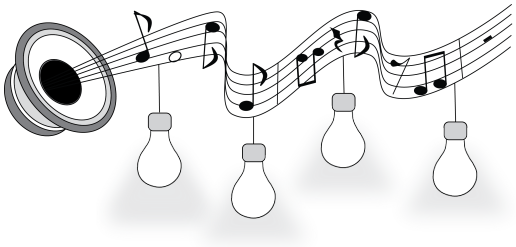
What did you learn about light and colour from this experiment?

_____

_____

_____

_____



Rainbow Making

1. Question

What colours make up white light?

2. Hypothesis:

I think _____

_____

_____

Instructions

You will need:

a glass bowl, water, mirror, flashlight.

Instructions:

Fill a glass bowl just over half full. Add the mirror to the bottom of the bowl. Shine the light through the water at the mirror and look for the reflection of light on the wall or ceiling.

Making Black
3. Experiment

Draw a picture of the experiment and what you observed.

4. Results

Describe what happened to the light that was reflected onto the wall or ceiling?

_____

_____

_____

_____

_____

_____

Why did this happen?

_____

_____

_____

_____

5. Reflection

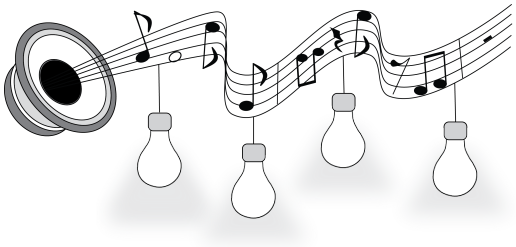
What did you learn about light and colour from this experiment?

_____

_____

_____

_____



Light, Colour and Heat

1. Question

How does colour affect heat?

2. Hypothesis:

I think _____

_____

_____

Instructions

You will need:

Two glass cups, black and white paper, elastics, thermometer.

Instructions:

Wrap one cup in white paper and the other in black paper. Secure the paper with elastics or tape. Fill the two cups 3/4 full of water. Put the cups in direct light (sunlight or artificial light) Record the temperature of each cup over time.

Making Black
3. Experiment

Record your dye drops in the chart below

Time Interval	White Cup Temperature	Black Cup Temperature
Start		
30 min		
1 hour		
Over 2 Hours		

4. Results

Describe how the temperatures change over time

_____

_____

_____

_____

_____

_____

_____

_____

Why do you think happened?

_____

_____

_____

_____

5. Reflection

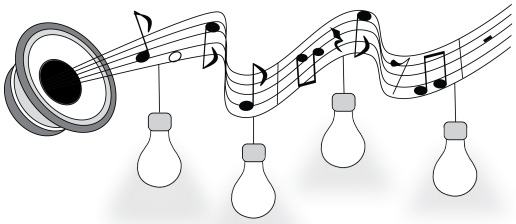
What did you learn about light and colour from this experiment?

_____

_____

_____

_____

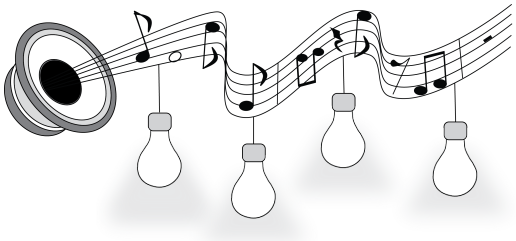


Lesson #6

WHAT IS SOUND?

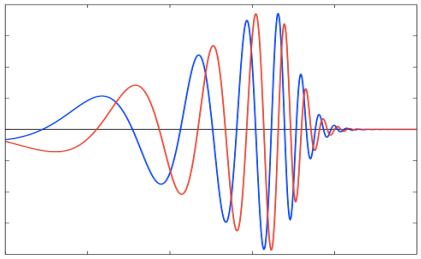
Lesson #6

	First Half	Second Half
Prep		
Gr. 4	**Sound: What is Sound?** Students will discover the answer to the question what is sound. They will read the article on sound then complete the activity based on what they read. This lesson will help to reinforce the concept 'how to research' helping students to understand how to extract information.	After students read the article there is an interactive notebook that will ask them to interpret the information that they read and answer the questions asked. Students cut out the flaps, fold on the dotted line then glue the back of the top tab down on top of the answer box on the first page. Answers have been provided.
Notes		



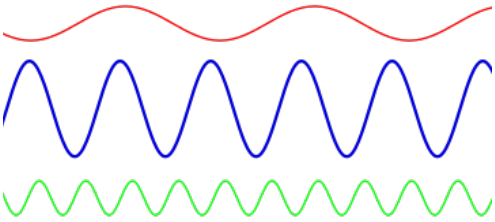
What is Sound

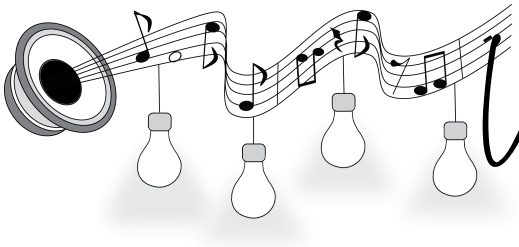
Close your eyes and listen to the world around you. What do you hear? Depending on where you are you may hear different things. Could you figure out where you are based only on the sounds that you hear? Sound helps people and animals everyday. To recognize their surroundings, keep them safe, and even to listen to others so that you can learn.



But what is sound? Sound is what you hear around you. Sound is caused by vibrations that travel through the air. When the waves reach your ear you can hear the sound. When something moves or vibrates it creates waves that travel though a gas (air), a liquid (water), or a solid (through walls or floors). Sound vibrations ripple though the molecules in solids, liquids, and gasses by pushing and pulling on the molecules as it travels past. Sometimes these sound waves travel in a regular pattern. This regular looking wave creates a note, like a musical note. An irregular looking wave creates noise.

The word frequency describes the number of waves that happen in a set time. If there are more waves then the sound that is made is a high pitch. If there are fewer waves in the same time then the sound you hear is a lower pitch. These sound wave keep moving until they run out of energy. This is why when someone is too far away from you, you struggle to hear them. These waves will also lose energy quicker if it has to travel though something that is more dense than air like water, or a brick wall.





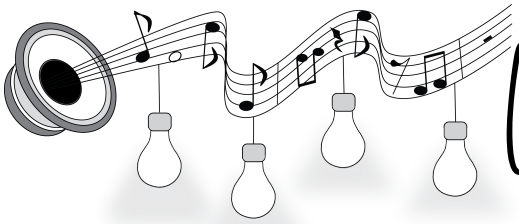
What is Sound?

Sound is important but it can also be dangerous to people. Since sound is a type of energy the force that a sound travels through the air can hurt us. Very loud sounds can damage our ears. Amplitude is the amount of force or pressure that a sound wave has as it moves through something. The more force and pressure that a sound uses to travel through the air the louder it is for our ears. To measure the amplitude of a sound wave we use decibels to compare sounds. Look at the chart to see some common sounds measured in decibels.

Sound	Decibels
Soft whisper	25dB
Soft talking	50dB
Normal talking	60dB
Shouting	100dB
Ear pain	140 dB

Sound	Decibels
Breathing	10dB
Toilet flush	70 dB
Ambulance siren	115dB
Fighter jet takeoff	140dB
Perforation of ear drum	160dB

As you can see from the chart some sounds have so much force and pressure as they travel that when they hit our ear they can damage our hearing, cause pain or even perforate our ear drum (make a hole). Sometimes, if you spend too much time in a loud environment (like loud music in your headphones or in a crowded sports arena) with sounds above 85 dB you will suffer tinnitus. Tinnitus is a ringing in the ears. If this happens too much you could permanently damage or lose your hearing.

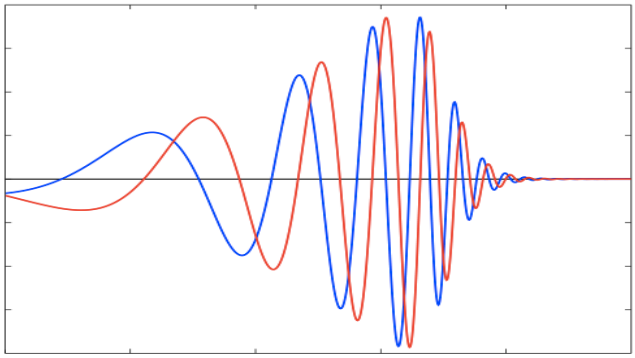


What is Sound?

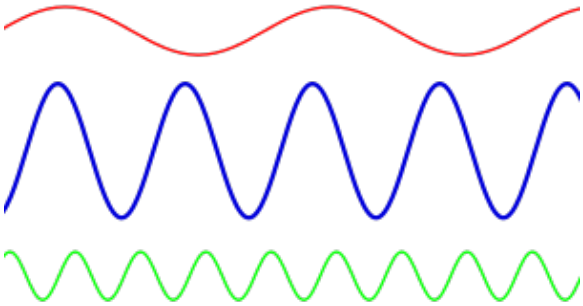
The Ear

Cut out around the shapes below. Fold on the dotted line and glue on the underside of the top tab. Glue this tab above the box on the notebook template base. Write your answer to the question on the lines below the tab.

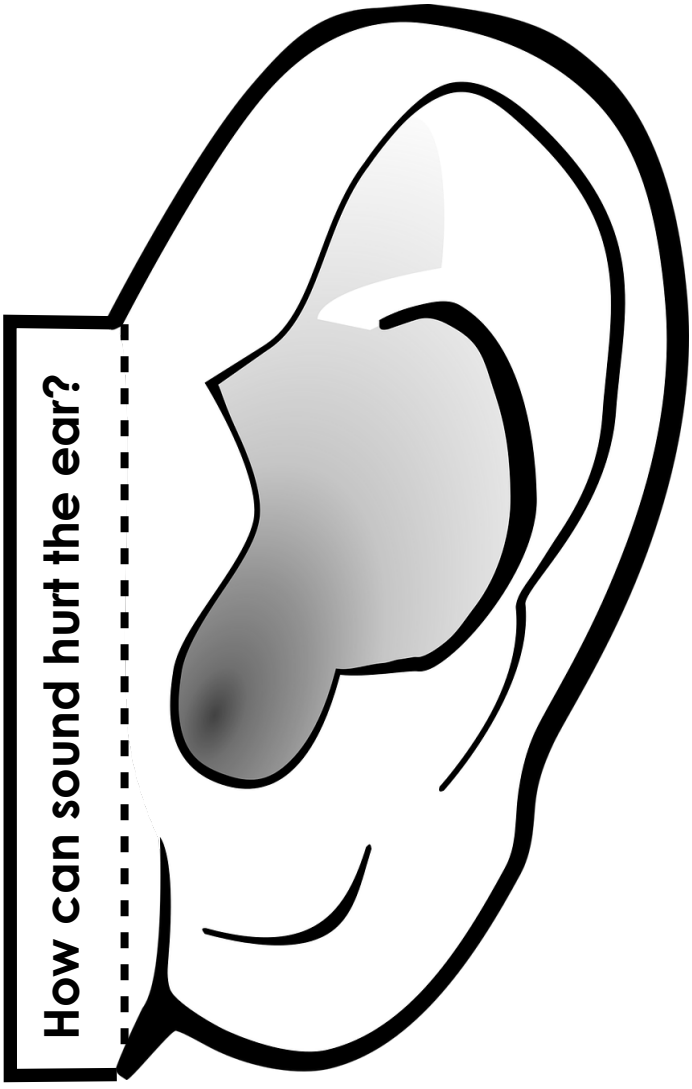
Describe how sound travels?



Describe what frequency means?

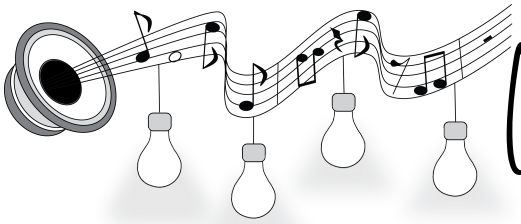


How can sound hurt the ear?



How does sound help people?

What is amplitude?



What is Sound?

ANSWER PAGE

Describe how sound travels?

Sound travels in waves. A regular wave pattern will make a consistent note and an irregular wave makes noise. When the sound reaches the ear we hear the sound.

Describe what frequency means?

The word frequency describes the number of waves that happen in a set time. The more waves there are the higher the pitch. The fewer waves the lower the pitch of the sound.

The Ear

How can sound hurt the ear?

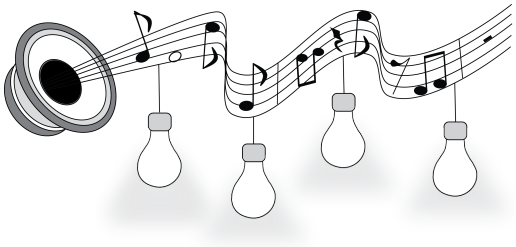
Loud sounds can hurt the ear by causing damage or breaking an ear drum. The force and pressure from the sound can hurt the ear. At 85dB the ear can have tinnitus and 120 dB will cause pain in the ear and 160dB will perforate the ear drum.

Describe how helps people?

We can use sounds to alert us We can use sound to figure out where we are and what is happening. We can use sound to learn - students can also use their own ideas and connections to expand on ideas here.

What is amplitude?

Amplitude is the amount of force or pressure that a sound wave has as it moves through something. Amplitude is measured in decibels. Loud sounds have more amplitude.

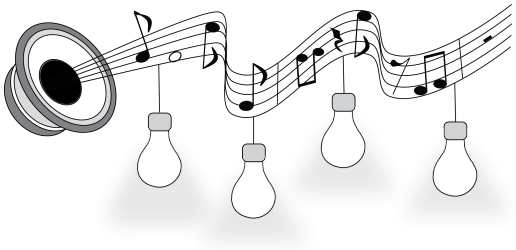


Lesson #7

HOW SOUND TRAVELS

Lesson #7

	First Half	Second Half
Prep		
Gr. 4	**Sound: Can sound travel through solids liquids and gases** Explain to students that they will be conducting a few simple experiments to see if sound can travel through solids liquids and gasses. Students will record their hypothesis prior to beginning their experiments with their partners. Depending on student readiness students can complete these activities with no teacher support, some teacher support or through teacher demonstrations. These experiments would also work well if done outside where students can spread out.	**Experiments** **Can sound travel through air?** Take two metal spoons and have students bang them together. Can they hear them? Ask students to walk further and further apart to hear the sound. What do they notice about the sound as it travels through the air? **Can sound travel through water?** Fill a large bucket with water. Cut the bottom off a jug to use a listening device. Take two metal spoons and submerge them in the water and bang them together. Students will listen to the banging of the spoons at various distances. Use the jug with the bottom removed to listen at the surface of the water. **Can sound travel through solids?** Using a barrier like a door, table or desk. Students bang a set of spoons on one side of the barrier where another student is on the other side.
Notes	**Grade 4 Experiments:** Students can do this experiment with a partner but it can be noisy. Larger groups of students will mean less sound being created by the spoons. This is a consideration if teaching a split grade. Students will need to reflect on their learning at the end of this. Questions include: What did you notices? Did the force you banged the spoons impact the volume of the sound? Why? What happened as you moved further away? What happened when the sound travelled through more dense material? How might this knowledge of how sound travels impact inventions that need to dampen or amplify sounds?	



Sound Experiments

Can you hear the sound?

Sound through AIR

Stand back to back with a partner at the distance specified. One person is the sound maker and the other person the listener. The sound maker will bang the spoons together. Record your results in the chart to the right and then write down your observations of the differences in sound at each distance.

Back to back:	2m apart:	5m apart:

_____

_____

_____

_____

_____

Sound through WATER

With a large bucket filled with water put your spoons near the bottom of the bucket under the water. Bang your spoons together underwater. The listening partner will try to hear the spoons banging together underwater with their ear at the distances listed (use the plastic jug provided by the teacher). Record your results in the chart to the right then write down your observations of the differences in sound at each distance.

Above the bucket:	Ear pressed to outside:	Jug on water surface:

_____

_____

_____

_____

_____

Sound through SOLIDS

With your spoons tap the bottom of a desk or table. The listener will listen at the distances specified. Record your results in the chart to the right and then write down your observations of the differences in sound at each distance. This experiment can also be done through a closed door to compare how the sound travels.

Ear to surface directly over top of spoon:	50cm-1m away ear to surface:	2m away from surface:

_____

_____

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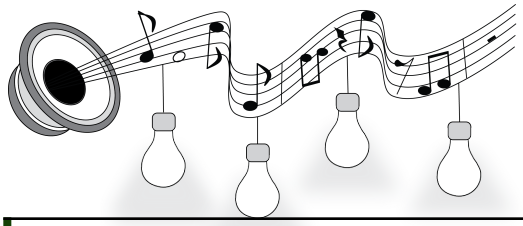
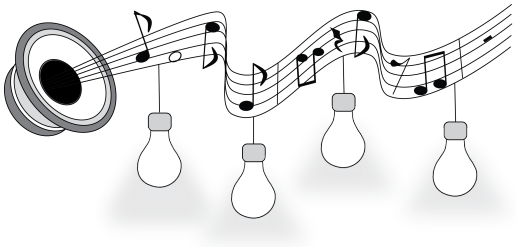


Teacher Notes

Experiment	Conclusions
Sound through AIR: Stand back to back with a partner at the distance specified. One person is the sound maker and the other person the listener. The sound maker will bang the spoons together. Record your results in the chart to the right and then write down your observations of the differences in sound at each distance.	*Students should conclude that the closer they are to the spoons the louder and more clear the sound. As they get further away it is harder to hear. In a noisy classroom it may be even harder to hear due to the volume of the noise surrounding them.* *Students could be asked to clarify what they could do to make the sound travel more clearly or to focus the sound so that it travels a longer distance.* *Why does sound get quieter the further away I am? - Sound waves lose their energy as they travel. The molecules in air are further apart so the sound wave travels slower through those molecules losing energy quicker.*
Sound through WATER: With a large bucket filled with water put your spoons near the bottom of the bucket under the water. Bang your spoons together underwater. The listening partner will try to hear the spoons banging together underwater with their ear at the distances listed (use the plastic jug provided by the teacher). Record your results in the chart to the right then write down you observations of the differences in sound at each distance.	*In water the molecules are closer together so the sound travels faster (4x faster than air) However the force needed to generate that sound is higher because of the density of the water.* *Students should have noticed that when the jug was in the water the sound was clear and louder than when they listened to it through the air. As well compared to the 'sound through air' test the sound in the water should have appeared louder. Students can discuss if sound travels in water better than air.* *Does sound travel better in water than air? - **YES*** *How could sound traveling in water impact the living things in the water particularly in the deep ocean? - Due to the darkness in much of the ocean animals depend on sound to navigate and find their prey. Many have specifically adapted to have a keen sense of hearing such as sharks.*
Sound through SOLIDS: With your spoons tap the bottom of a desk or table. The listener will listen at the distances specified. Record your results in the chart to the right and then write down your observations of the differences in sound at each distance. This experiment can also be done through a closed door to compare how the sound travels.	Students should notice that through this experiment when their ear is to the table the sound is louder than when they are 1m away. This is because sound travels faster through solids than it does through the air. This happens because the molecules in a solid are packed tightly together. It travels faster because there is less distance between molecules so it takes less time for the sound wave to cause them to bump into one another. This can lead to conversations about buildings and how walls are made especially in a classroom. If sound travels faster through solids than gases how should walls between classrooms be designed to keep the sound from one classroom out of another classroom. Why does it seem quieter in our classroom with the doors closed if people are making noise in the hallway? The architectural acoustics in a classroom or other environments make a difference in noise transmission. Acoustic ceiling tiles absorb sound from within a classroom. Doors often have an air gap/hollow. Walls have sound absorbing insulation or an air gap to reduce noise transfer.

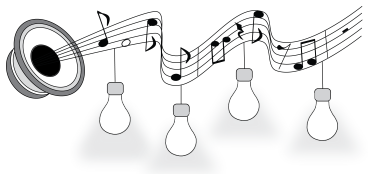


Lesson #8

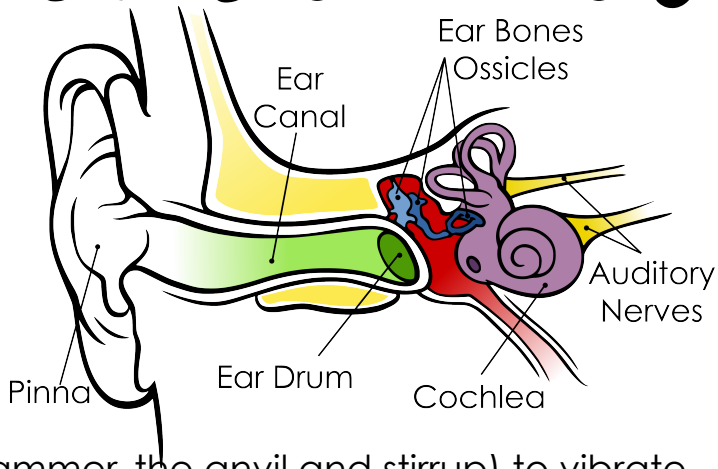
DETECTING SOUND

Lesson #8

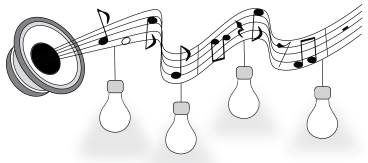
	First Half	Second Half
Prep		
Gr. 4	**Sound: Detecting Sound:** **Reflecting on Experiments** The previous experiment exposed students to a great deal of important learning about how sound is absorbed, reflected, transmitted and modified. It is an important task that they reflect on this learning. Conduct a knowledge building circle to reflect on their observations and learning have students share what they learned and what it all means. Create an anchor chart for students to develop conclusions about how sound travels. See the teacher notes as a guide to the conclusions students should come up with. After this discussion students can complete a quick reflection about what they learned.	**How Sounds are Heard:** Students will read about four different animals (human, sharks, bats and elephants), and discover how they hear. They will then compare similarities and differences in these animals. **Reflect on Learning** Students will discuss the similarities and differences of animals and how they hear. Complete the summary page that compares the four different animals.
Notes	Gr. 4 - This lesson is a great link with music on how sound is created and amplified. Looking at different musical instruments and the materials that they are made out of will help students to see how sound is amplified, transmitted, and reflected to create music.	



The Human Ear

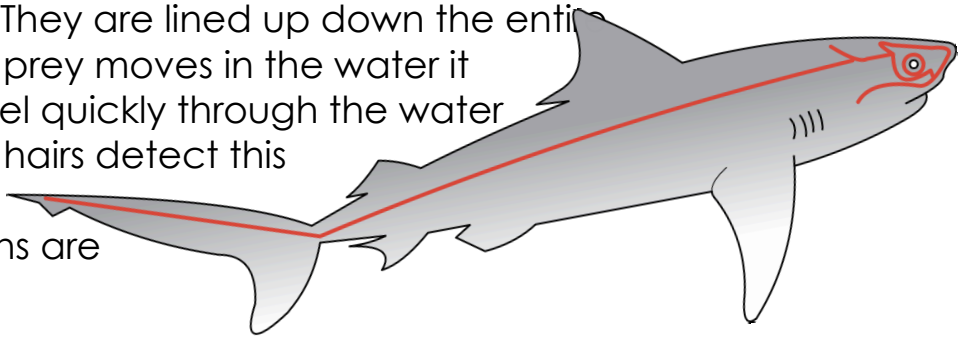


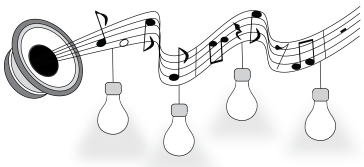
The human ear is made up of a system of parts that work together to get sounds into our brain so we can understand what we are hearing. First the sound hits our PINNA. This is the outside of our ear that we see on the side of our head. Next the sound travels down our EAR CANAL to our EAR DRUM. When the sound hits our ear drum it causes the three bones in our ear (the hammer, the anvil and stirrup) to vibrate. These vibrations reach the cochlea. The COCHLEA looks like a seashell and is filled with liquid and little hairs. When the 3 ear bones called the OSSICLES begin to vibrate, the liquid in the cochlea begins to move and swish past the little hairs. These hairs are called the stereocilia. These little hairs convert the vibrations and movement into electrical impulses that are sent along the auditory nerves to the brain. Our brain then understands what is is hearing.



Shark Senses

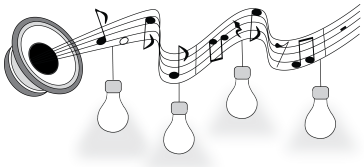
When you look at a shark you will probably not see ears sticking out on the side of their head like humans have. However sharks do have ears. Their inner ear has three different ear canals that allow them to stay balanced in the water and hear sounds. Sharks can hear low sounds in the water from over two football fields away. Their ears are lined with little hairs that help them to sense these vibrations to hear under water. However a shark hears with more that just its ears. They also have another way to detect the vibrations of very deep sounds that happen under water called the LATERAL LINE. The lateral line is a line of jelly filled tubes that are connected to vibration sensing hairs. These tubes are found just under the skin of the shark. They are lined up down the entire length of a sharks body. As prey moves in the water it makes vibrations which travel quickly through the water towards the shark. The little hairs detect this movement telling the shark which direction the vibrations are originating.





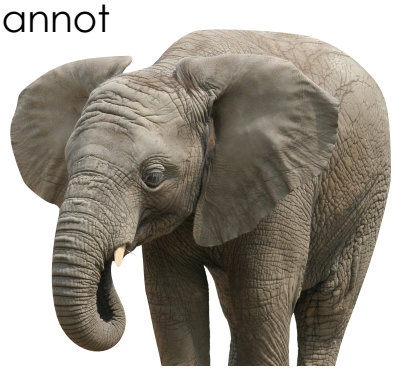
Bats in the Dark

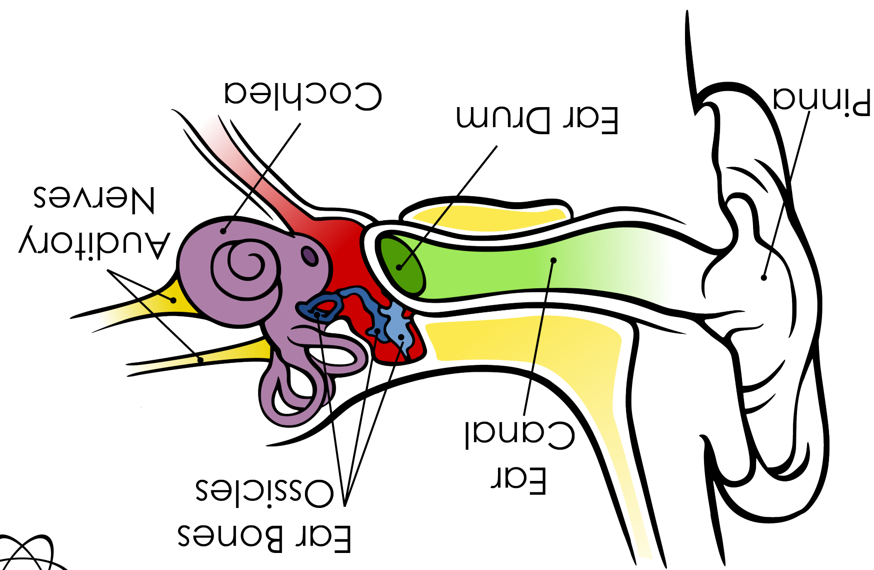
Bats have great hearing. They hunt for their food at night so they can't use their eyes to see their prey. They instead use their ears and their voice to find their prey. They make high pitched sounds that bounce off the cave walls like an echo. This is called echolocation. When a bat sends out a sound and it bounces back their ears can detect the slight changes in the sound wave as it is stopped by an insect the bat wants to eat. A bat's ears are specially designed to hear these echoes. When a bat screams out its call to find prey its ear temporarily goes deaf so that the call doesn't cause ear damage. Muscles in the ear separate the ossicles bones (the hammer, the anvil and the stirrup) so the sound cannot travel to the bat's cochlea. The bat will 'turn' their hearing back on after their sound is made so that they can hear the echo. A bat's ear is similar to a human ear because both bats and humans are mammals. A bat's brain will interpret the echolocation signals to learn how to far prey or other objects are. Their ears are highly sensitive to hearing slight changes in the frequency of the echo.

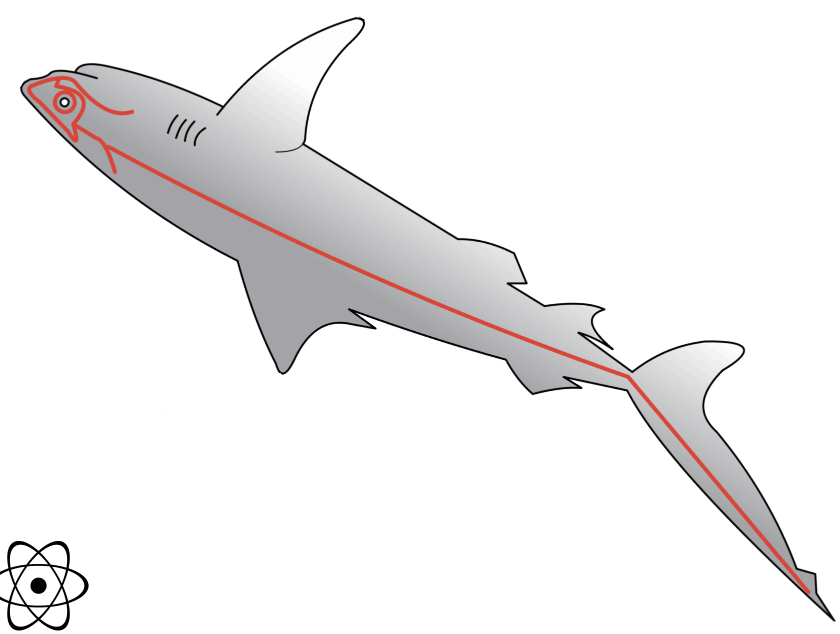


Elephant Ears

Elephants have big gigantic ears that help them in many ways. Elephant ears help to keep an elephant cool in the hot dry temperatures of the African Savannah. Elephants also have a large range of hearing and can hear sounds made at higher and lower frequencies than even humans can hear. Elephant ears can detect sounds and recognize voices and other elephant calls that are used to communicate. Their ears also act as a large funnel that help to filter sounds into their ears which helps them to hear sounds from further away. Elephants can communicate with other elephants from far away. Much of an elephants 'talking' is at a low frequency that human ears cannot hear. These low sounds are hard for mammals to hear but the elephant ear has adapted to hear these sounds. It has a very large ear drum that is protected by a longer ear canal that protects the delicate and larger ear drum. An elephant's cochlea is also adapted to ear these low frequency sounds. Much is still being discovered about how well and elephant can hear.







Ears Can Hear

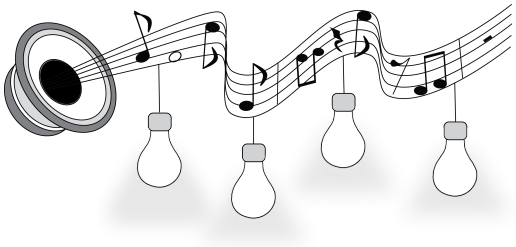
SUMMARY OF LEARNING

1. What did you learn about how people and animals hear?

2. Why do you think it is important for people and animals to hear sound?

3. Why can some animals hear better than others?

4. What might happen if an animal stopped being able to hear?

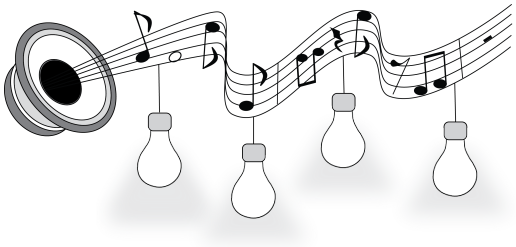


Lesson #9

LIGHT AND SOUND SAFETY

Lesson #9

	First Half	Second Half
Prep		
Gr. 4	**Light and Sound Safety:** Students will work together to come up with a list of things that use light and sound to keep us safe. Together with students have them brainstorm a list of things that help to keep them safe in the different areas that are listed. For students that may struggle with this concept they can use the sorting cards to help to get them started.	Have a knowledge building circle with the students about the light and sound safety devices. Talk about what life would be like: • Before this device? • Why might this device have been invented? • How does this help to keep people safe? • How does this device use light and sound to keep us safe? This lesson will help students activate some of their knowledge of light and sound devices which will help them for their final inquiry project.
Notes		



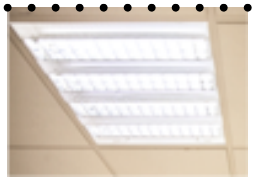
Light & Sound Safety

Home	School

Community

Light and Sound Safety Items

PA System



Florescent Lighting

Emergency Exit Signs

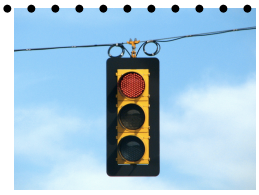
Fire Truck

Safety Vest

smoke

Home Alarm

Fire Alarm



Traffic Light

Street Light

Lamp

Insulation

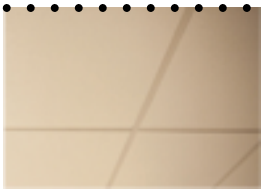
School Bell

Railway

Car Lights

Cell Phone

Alarm Clock



Acoustic

Light and Sound Safety Items

PA System

Florescent Lighting

Emergency Exit Signs

Fire Truck

Safety Vest

smoke

Home Alarm

Fire Alarm

Traffic Light

Street Light

Lamp

Insulation

School Bell

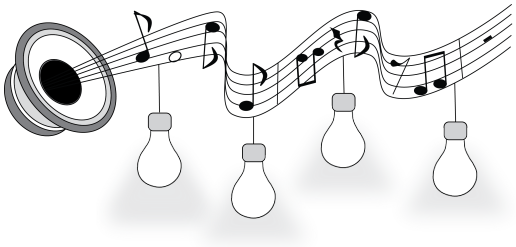
Railway

Car Lights

Cell Phone

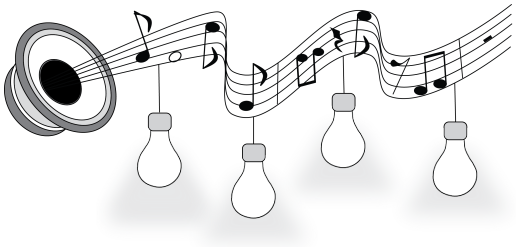
Alarm Clock

Acoustic



Lesson #10

INQUIRY BOOKLET



Student Inquiry

The purpose of student inquiry is to allow students to explore concepts of light and sound that interests them. To learn more, to solve problems, look at an issue from different perspectives and develop solutions.

There are many ways that this can be done. I have included a few inquiry pathways that you can use to help students explore ideas in light and sound. The steps of inquiry that students can follow include:

- Develop an idea
- Ask questions
- Research and grow background knowledge
- Apply learning
- Evaluate learning and draw conclusions

Choose one of the following lines of inquiry as a group. Depending on student readiness you could also allow for students to choose multiple lines of inquiry.

After choosing a line of inquiry, brainstorm problems that may need solving or improving. Students could look at systems that use either light or sound and brainstorm how to use both to make them safer. Students will then complete an inquiry report that explains how they could improve this system and then present their findings to the class. From there an extension activity would be to choose one of them and make it as a large group together.

LIGHTING

First: Choose an invention that uses light to help us.

Then: Decide how you could use this device in a new way to fix a problem.

ACOUSTICS

First: What things are used to improve or adjust the acoustics in an environment.

Then: How could you improve the acoustics in a home, school or community location?

HOME OR SCHOOL DEVICES

First: Choose an invention that uses light or sound in your home, classroom, or community.

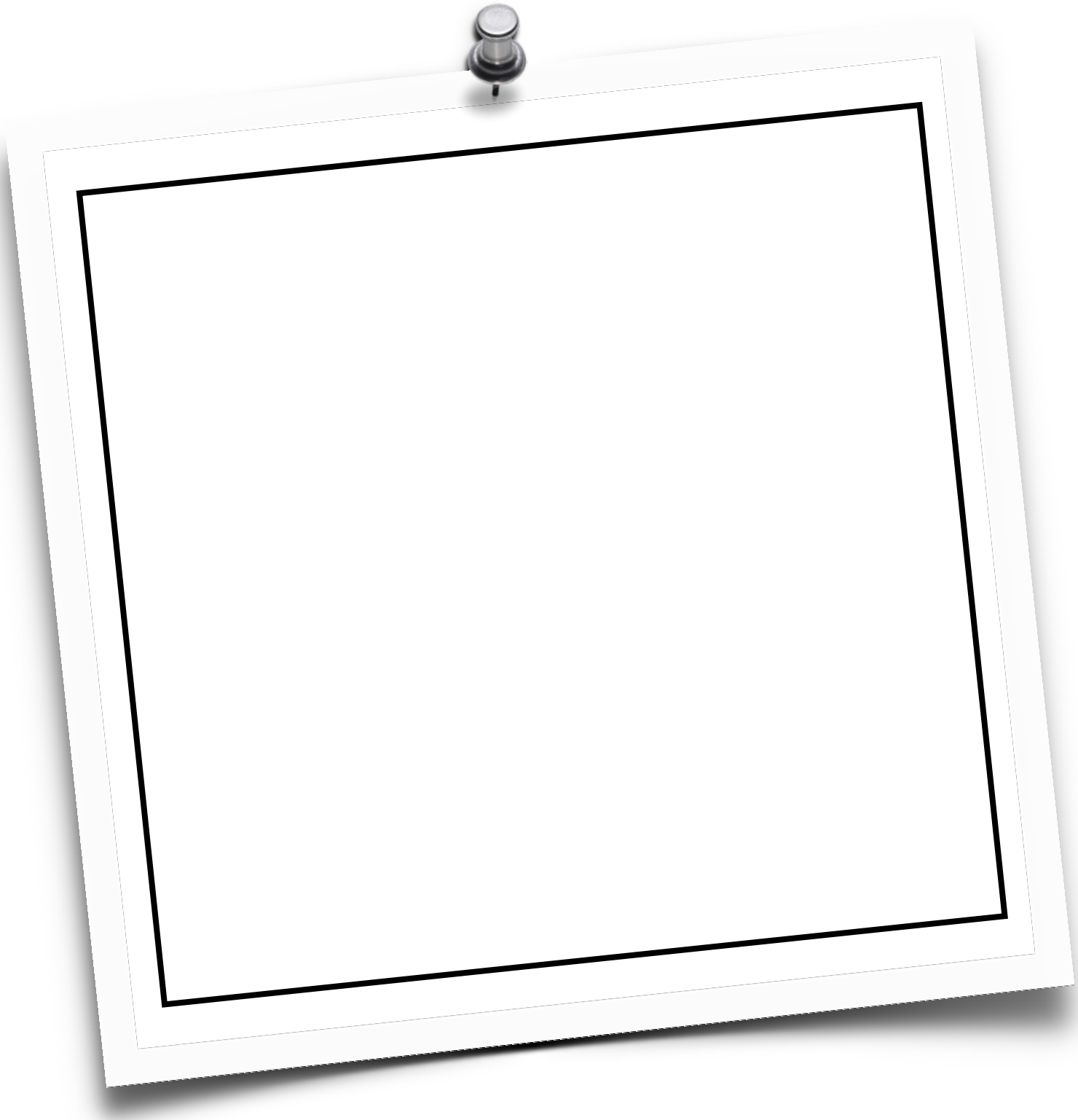
Then:
How could you make a classroom or school safer for someone who is blind or deaf?

COMMUNITY

First: Think of a device in your community that uses light and/or sound and keeps people safe?

Then: How could you use light or sound to improve the safety of something in our community?

MY INQUIRY



NAME: _____

<< BRAINSTORMIMG >>

Think about these 4 topics.
List what you already know or think about each topic:

Lighting

Acoustics

Devices

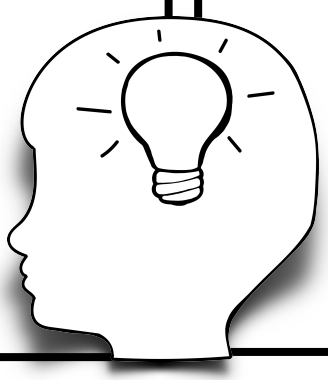
Community

<<<<< PLANNING >>>>>

BIG IDEA

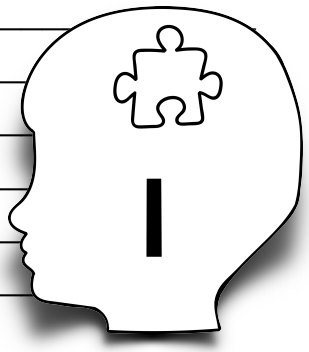
Success Criteria

Questions



<<<< RESEARCH >>>>

Source/Notes	Research



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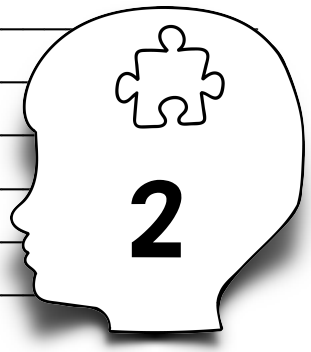

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Source/Notes	Research

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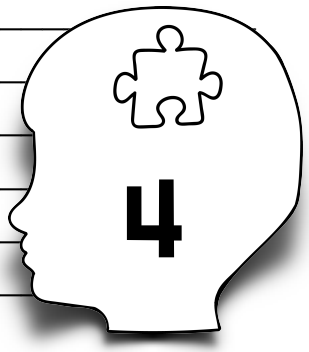


<<< SUMMARIZE >>>

Questions from success criteria	Research

<<<<<<< ACTION >>>>>>>

What's the problem/issue?

Think about what you researched. What action could you take to make a change or raise awareness about your issue? How could you make it better?

<<<<<< SHARING >>>>>>

Write a persuasive paragraph to your classmates persuading them to take action on your issue.

How will you present this information?

Assessment Pages

How are light and sound used to keep us safe in our daily life. Give a few examples and explain how these devices use light and sound to keep us safe.

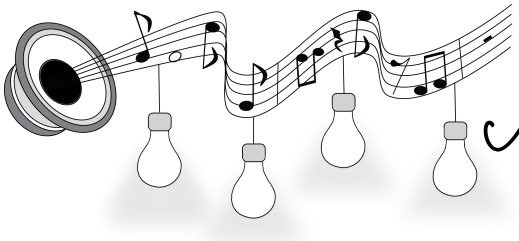
Describe what three of the following mean:

* Pitch
* Volume
* Vibration
* Loud
* Absorbtion

What are some of the positive and negative consequences of light and sound devices?

Describe what three of the following mean:

* Light
* Colour
* Natural and Artificial
* Reflection
* Refraction



Assessment Tracking

	Student name / **Lesson**					
1	Light and Sound in our World.					
2	Artificial and Natural Light.					
3	How Light Travels - Experiments.					
4	Light: Bend, Bounce, Absorb.					
5	Light and Colour.					
6	What is Sound?					
7	How Sound Travels.					
8	Detecting Sound.					
9	Light and Sound Safety.					
10	**Inquiry Project** - How light and sound inventions have changed the way we live.					

Light and Sound

Presenters Name: _____

What are they presenting? _____

_____

	Level 1	Level 2	Level 3	Level 4
Knowledge and understanding of **key features** light and sound	Very poor understanding of light and sound properties.	Student has some knowledge and understanding of light and sound properties.	Students has a good knowledge and understanding of light and sound properties.	Student has a thorough understanding of light and sound properties.
Thinking: Student is able to describe how light and sound impacts people in positive and negative ways.	Students can describe with limited effectiveness how people are impacted by light and sound.	Students can describe with some effectiveness how people are impacted by light and sound.	Students can describe with considerable effectiveness how people are impacted in various ways by light and sound.	Students can describe with thorough effectiveness how people are impacted in various ways by light and sound.
Application: Students can apply their knowledge of light and sound and propose solutions to improve or solve problems in everyday life.	Student struggles to apply their knowledge of the basic features of light and sound and identifies a limited understanding of light and sound technologies, and solutions or improvements to problems in everyday life.	Student applies their knowledge of the basic features of light and sound and identifies some understanding of light and sound technologies, and solutions or improvements to problems in everyday life.	Student applies their knowledge of the basic features of light and sound and identifies a good understanding of light and sound technologies, and solutions or improvements to problems in everyday life.	Student applies their knowledge many features of light and sound and identifies a superior understanding of light and sound technologies, and solutions or improvements to problems in everyday life.
Communication: Quality of Presentation	Student shows poor speaking skills. Student struggles to explain their work in a clear way.	Student shows some speaking skills. Student can explain some of their work clearly.	Student is easily heard by audience. Student can explain their work clearly.	Student shows excellent speaking skills. Student can explain their work in a clear and organized way.

2 stars and a wish _____

_____

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_____

This presentation was assessed by: _____