

5E Unit Plan

Light



4th grade

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Teacher Notes

Google Resources & More

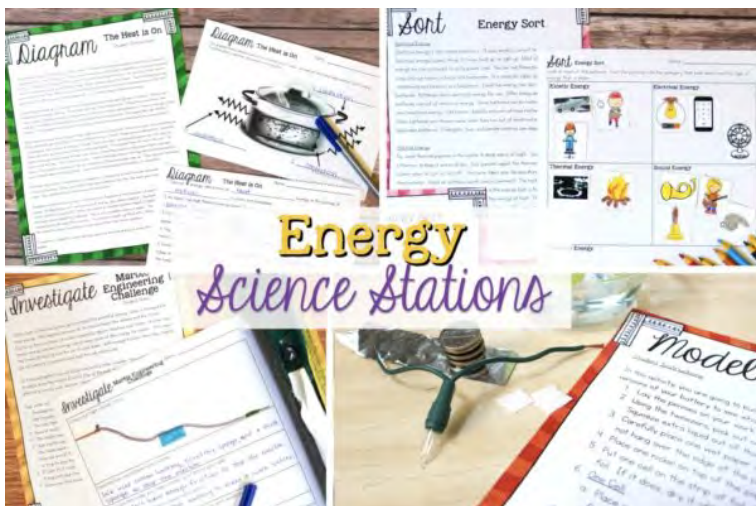
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- Teacher Presentation (Google Slides)
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Teacher Notes

5E Instructional Model

5E Instructional Model

This Lesson Plan is an inquiry-based unit using the 5E Instructional Model. The 5E Model is student-led, with the teacher acting mainly as the facilitator. Through open-ended questions, real-life experiences, guided investigations, and research, the students gain a deep understanding of the scientific topics that are covered in the lessons. Each stage of the model serves as a foundation to the next, creating a coherent model that frames lessons, activities, and units.

The 5 E's of this method are as follows:

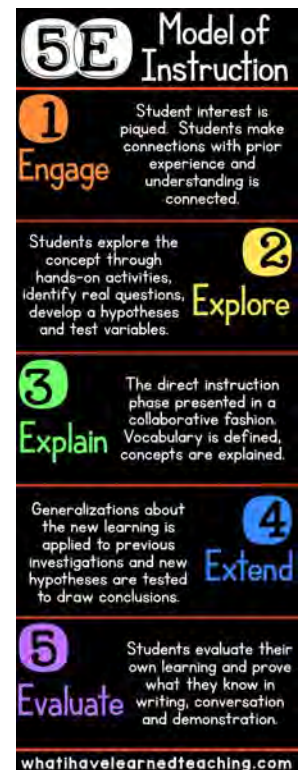
Engagement: Student interest is engaged. They ponder everything they already know about a topic. The teacher identifies any misconceptions at this point.

Exploration: Students explore the topic through hands-on activities. They gain experience with the topic and reflect more with their classmates on what they know and experience. The teacher continues to guide by asking open-ended questions.

Explanation: Students connect prior knowledge to experiences in the exploration. The teacher explains the concepts, and students draw conclusions about their investigations.

Extension: Students take their new knowledge and apply it to novel situations. The teacher poses new questions and provides opportunities for students to investigate answers. This is when students' knowledge about specific topics begins to generalize and deepen.

Evaluation: Students evaluate their learning process. They are able to prove what they know by performance, informal, and formal assessment. The teacher uses multiple forms of assessment to evaluate the students.



For more information on the 5 E's, [read the blog post series on 5E Instruction](#). We explain why we chose to use the 5E method of instruction and provide an in-depth explanation of each stage of the model. [Click here to get the poster on the right for free.](#)

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Vocabulary Cards & Big Idea Posters			11
Engage	- Students will access their prior knowledge about light, how light travels, and the factors that affect light in different ways. - Student interest in light will be elicited. - The teacher will be able to identify student misconceptions about light.	- Part 1 (What Is This?): 10 minutes - Part 2 (My Experiences): 15 minutes - Part 3 (Introducing...Light): 15 minutes	45
Explore	- Students will work together to investigate light. They will do this by observing what happens when light is reflected and refracted. - Students will gather general information about light. - Students will begin to think about the factors that affect light. - Students will analyze and interpret data to provide evidence that light is a type of energy.	- Part 1 (Check It Out): 15 minutes - Part 2 (Read This): 15 minutes - Part 3 (You Try It): 15 minutes	55
Explain	- Students will work collaboratively to observe the properties of light. - Students will listen to the teacher's explanation about light. - Students will use the new information to revise their explanations about light energy, how it is perceived by the brain, and the factors that affect how light travels.	- Part 1 (What Does It Mean?): 15 minutes - Part 2 (What Is Light?): 20 minutes - Part 3 (Putting It All Together): 20 minutes	70
Extend	- Students will apply what they have learned about light to a new situation. - Students will deepen their understanding of light, gaining a more generalized knowledge of this specific scientific concept. - The teacher will resolve all persisting student misconceptions about light.	- Part 1 (Where Is the Light?): 20 minutes - Part 2 (Show What You Know): 20 minutes - Part 3 (Have Fun With It): 20 minutes	107
Evaluate	- Students will evaluate their own understanding of light. - Students will be able to demonstrate knowledge of the concepts and vocabulary. - The teacher will encourage students to ask questions that could lead to future investigations.	- Part 1 (What I Know): 15 minutes - Part 2 (Showing Light): 30 minutes - Part 3 (Going Forward): 15 minutes	134
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Teacher Notes

Light

Next Generation Science Standards

Next Generation Science Standards are written to be “Three Dimensional.” The following section explains how this set of science stations addresses the three dimensions of Performance Expectation, Disciplinary Core Idea, and Science and Engineering Practices/Crosscutting Concepts.

In this unit, students will learn about the electromagnetic spectrum. While the scope of this standard is limited to visible light, we are also including wavelengths of light that are not visible to the eye, i.e., infrared and ultraviolet light.

In Fourth Grade, students are expected to demonstrate understanding in the following **Performance Expectation**:

- **4-PS4-2:** Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

This correlates with this **Disciplinary Core Idea**:

- **4-PS4.B: Electromagnetic Radiation**
 - An object can be seen when light reflected from its surface enters the eyes.

This unit meets the Performance Expectation and Disciplinary Core Idea, helping students gain an understanding of these NGSS science concepts.

All sections meet the **Science and Engineering Practice**:

- **Developing and Using Models:** Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
 - Develop a model to describe phenomena.

All sections meet the **Cross-Cutting Concept**:

- **Cause and Effects:** Cause and effect relationships are routinely identified.

Teaching Timeline Options

Light

Below and on the following page are four different timeline options for how you might consider structuring your teaching time with the 5E Light Unit. If you have the [Images and Vision Science Stations](#), these are included in Option 4.

Option 1: Using Only 5E Unit Plans as Written

Day 1	Day 2	Day 3	Day 4	Day 5
Engage Activities 40 minutes	Explore Activities 45 minutes	Explain Activities 55 minutes	Extend Activities 60 minutes	Evaluate Activities 60 minutes

Option 2: Using Only 5E Unit Plans in Shorter Time Blocks

Day 1	Day 2	Day 3	Day 4	Day 5
Engage Activities (40 minutes)	Explore Activities Parts 1 & 2 30 minutes	Explore Activity Part 3 15 minutes	Explain Activities Part 1 15 minutes	Explain Activity Parts 2 & 3 40 minutes

Day 6	Day 7	Day 8	Day 9
Extend Activities Parts 1 & 2 40 minutes	Extend Activity Part 3 20 minutes	Evaluate Activity Part 2 30 minutes	Evaluate Activities Parts 1 & 3 30 minutes

Option 3: Using only 5E Unit Plans Abbreviated

Day 1	Day 2	Day 3	Day 4	Day 5
Engage Activity Part 3 15 minutes	Explore Activity Part 1 15 minutes	Explain Activity Part 2 20 minutes	Extend Activity Part 3 20 minutes	Evaluate Activity Part 1 15 minutes

Teaching Timeline Options

Light

Option 4: Supplementing 5E Unit Plans with the [Images and Vision Science Stations](#) as Whole Group Lessons

Day 1	Day 2	Day 3	Day 4	Day 5
5E Unit Plan Engage Activities 40 minutes	Images and Vision WATCH Light video Questions are optional. Videos are less than 5 minutes each.	5E Unit Plan Explore Activities Parts 1 & 2 30 minutes	5E Unit Plan Explore Activity Part 3 15 minutes Images and Vision Properties MODEL None of the Reading 20 minutes	5E Unit Plan Explain Activities Parts 1 & 2 35 minutes

Day 6	Day 7	Day 8	Day 9	Day 10
5E Unit Plan Explain Activity Part 3 20 minutes Images and Vision SORT 20 minutes	5E Unit Plan Extend Activities Parts 1 & 2 40 minutes	5E Unit Plan Extend Activity Part 3 20 minutes Images and Vision EXPLORE 20 minutes	Evaluate Activities Parts 1 & 2 45 minutes	Evaluate Activities Part 3 15 minutes Images and Vision DIAGRAM 20 minutes

Materials Checklist

Light

Use the following checklist to make sure you have all the materials for your lessons.

Engage

- ☐ Activity Sheets
- ☐ Two different transparent objects (Drinking glass, lens, plastic box, etc.)
- ☐ Two different translucent objects (Light-colored plastic or glass, piece of glass with film on it, etc. You might need to buy transparent film to cover transparent glass or plastic.)
- ☐ Two different opaque objects (anything that does not allow light to pass through--thick cardboard, stone, metal, etc.)
- ☐ Flashlight

Explore

- ☐ Activity Sheets
- ☐ 2 Glass beakers (250-mL or larger)
- ☐ 2 Pencils (or any straight object)
- ☐ Water
- ☐ Prism
- ☐ Flashlight
- ☐ Laser pointer
- ☐ Mirror with a flat edge
- ☐ Yellow, red, green, and blue colored pencils

Explain

- ☐ Activity Sheet
- ☐ Colored paper (white, blue, yellow, green, and black)
- ☐ Colored transparent film (red, blue, yellow, and green)
- ☐ Flashlight
- ☐ Scissors
- ☐ Tape
- ☐ Colored pencils
- ☐ Cardboard tubes
- ☐ Diffraction grating (1 square inch)
- ☐ Recommended light sources:
 - ☐ Incandescent flashlight
 - ☐ LED flashlight
 - ☐ Fluorescent light (like a classroom light)
 - ☐ Glow sticks in 2 colors
 - ☐ Candle
 - ☐ Gas burner (Bunsen burner, camp stove, chafing dish fuel, etc.)
- ☐ Optional: Laser pen, but CAUTION: Have an adult shine the laser light into the spectroscope at an angle so that the light hits the inside of the tube and does not go directly into the eye.

Extend

- ☐ Activity Sheets
- ☐ Cardboard box, such as a shoe box, large cereal box, etc.
- ☐ Paperclip
- ☐ Scissors
- ☐ Ruler
- ☐ 5-inch square wax paper
- ☐ Tape
- ☐ Blanket
- ☐ Candle or small lamp
- ☐ Introducing Light Activity Sheet
- ☐ Check It Out Activity Sheet
- ☐ You Try It Activity Sheet
- ☐ What Does It Mean Activity Sheet

Evaluate

- ☐ Activity Sheets
- ☐ "What I Know" Self-Check
- ☐ Assorted pictures that represent the different types of light energy on the electromagnetic spectrum (radio, microwave, infrared, each color of white light, ultraviolet, x-ray, gamma radiation). These pictures can be from the internet (either obtained by you or by the students on a web search), magazines, or a combination.
- ☐ Poster board or large piece of paper
- ☐ Glue and scissors

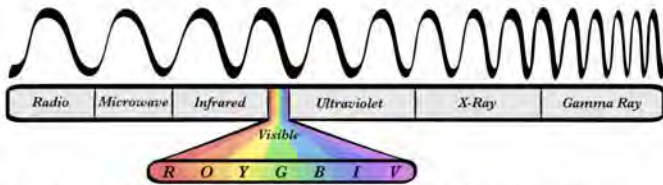
Explain Part 2: Where is Light?

Name: _____

On a dark and rainy day, the landscape seems bleak. Clouds cover the sky, and a constant drizzle soaks everything. Then the rain stops, the clouds pull apart, and the sun shines through. Suddenly, a beautiful rainbow appears and completely changes the dreary scenery. Have you ever seen such a sight? How does this happen?



Rainbows are a type of light, and light is a type of energy. **Energy** is the ability to do work. **Light energy** is a type of energy that can be detected by the eye. To understand how light forms rainbows, we need to understand the **electromagnetic spectrum**.



The **electromagnetic spectrum** is a group of waves with both electric and magnetic properties. These waves can carry an electric charge and are affected by magnetism. Electromagnetic waves include radio, microwave, infrared, visible light, ultraviolet, x-ray, and gamma ray.

just the passage

is the part of the wave with the greatest amount of energy. The **trough** is the part of the wave with the least amount of energy.



A wave's **amplitude** describes how tall a wave is and shows the amount of energy in a wave. Waves with a higher amplitude have more energy. Waves with a lower amplitude have less energy.

p. 1

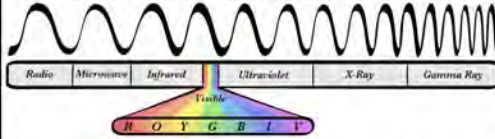
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The **electromagnetic spectrum** is a group of waves with both electric and magnetic properties. These waves can carry an electric charge and are affected by magnetism. Electromagnetic waves include radio, microwave, infrared, visible light, ultraviolet, x-ray, and gamma ray.

All energy waves can be described in several different ways. First, the **peak** is the part of the wave with the greatest amount of energy. The **trough** is the part of the wave with the least amount of energy.



What is energy?

What is light energy?

What is the electromagnetic spectrum?

Name at least two types of waves on the electromagnetic spectrum.

What is the greatest amount of energy?

What part of the wave has the least amount of energy?

p. 1

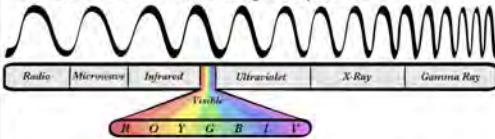
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The **electromagnetic spectrum** is a group of waves with both

with note taking space

energy. The **trough** is the part of the wave with the least amount of energy.



p. 1

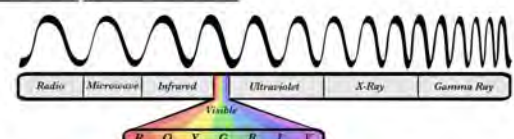
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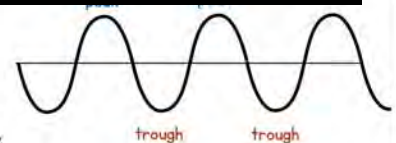


_____ are a type of light, and light is a type of energy. _____ is the ability to do work. _____ **energy** is a type of energy that can be detected by the eye. To understand how light forms rainbows, we need to understand the _____



cloze reading with blank spaces

All energy waves can be described in several different ways. First, the _____ is the part of the wave with the greatest amount of energy. The _____ is the part of the wave with the least amount of energy.



p. 1

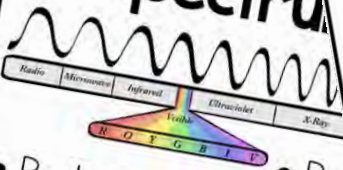
Differentiated Reading Passages

Light energy



is the energy that
be detected by the
It travels in straight
lines and is part of the
electromagnetic
spectrum

Electromagnetic Spectrum



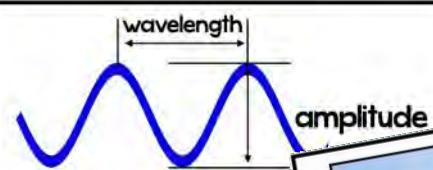
- Radio
- Microwave
- Infrared
- Ultraviolet
- X-Ray
- Red
- Orange
- Yellow
- Green
- Blue
- Indigo
- Violet

Absorption



happens when
energy is transferred
to an object.
It does not pass through

If an object is **opaque**,
no light can get
through. It makes a
dark shadow.



Amplitude

much energy
wave, while

wavelength

the distance
between the



The **peak** of the
wave is where there
is the most energy.
The **trough** is
where there is the
least energy.

If an object is transparent



all the light can
get through. It
makes no shadow.

If an object is translucent



some light can
get through. It makes
a dim shadow.

Reflection



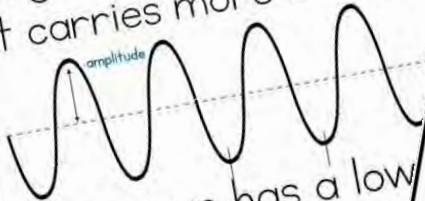
happens when
waves bounce off
an object and into
another medium

Refraction

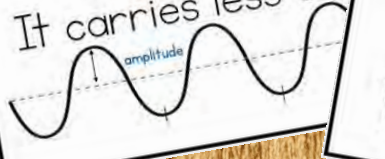


happens when light
bends as it passes
from one material
into another

This wave has a
higher **amplitude**.
It carries more energy.



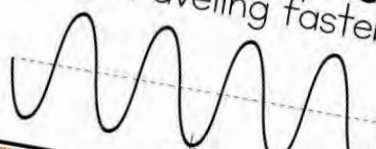
This wave has a low
amplitude.
It carries less energy.



This wave has a
longer **wavelength**.
It is traveling slowly.



This wave has a
shorter **wavelength**.
It is traveling faster.

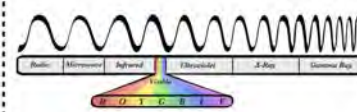


Big Idea Posters



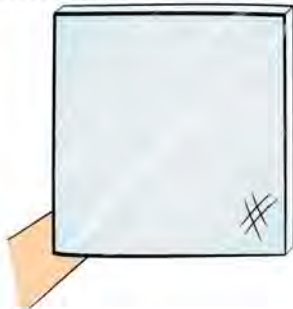
absorption

transfer of energy from light waves to an object; light does not pass through or bend when it is absorbed by an object



Electromagnetic spectrum

the group of waves that have both electric and magnetic properties, arranged by wavelength



opaque

no light passes through; makes a dark shadow



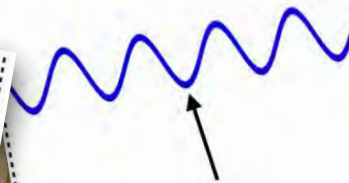
light energy

a type of energy that can be detected by the eye; travels in straight lines and makes up the electromagnetic spectrum



white light

light from the sun that is made up of all the colors of the rainbow: red, orange, yellow, green, blue, indigo, and violet



trough

the part of the wave with the least amount of energy

Vocabulary Cards

Engage

Teacher Guide

Objectives

- Students will access their prior knowledge about light, how light travels, and the factors that affect light in different ways.
- Student interest in light will be elicited.
- The teacher will be able to identify student misconceptions about light.

Duration

- Part 1 (What Is This?): 10 minutes
- Part 2 (My Experiences): 5 minutes
- Part 3 (Introducing Light): 5 minutes

Materials

- Activity Sheets
- Two different transparent objects (Drinking glass, lens, plastic box, etc.)
- Two different translucent objects (Light-colored plastic or glass, piece of glass with film colored plastic or glass, piece of transparent film to cover transparent glass or plastic.)
- Two different opaque objects (anything that does not allow light to pass through—thick cardboard, stone, metal, etc.)
- Flashlight

Virtual Learning

This can easily be completed as a digital activity.

Part 1: What Is This?

Materials:

- Activity Sheet

Teacher Instructions:

You could do this as a Think-Pair-Share activity or as a whole-class activity. The point of this activity is to get students to start thinking about light energy.

As you are going over this activity with students, begin asking questions to pique their curiosity about what they think the source of energy is in various situations. Consider asking questions along the lines of, "What does the light look like in this picture? Where do you think the light comes from? What is happening to the light in this picture? Do you think that different things could affect the light in this picture? What do you think causes the light in this picture to do what you are seeing?" Don't look for right or wrong answers, don't teach concepts yet. Just ask questions, encouraging students to begin thinking.

Part 2: My Experiences

Materials:

- Activity Sheet

Teacher Instructions:

- Discuss the question. It's a big day.
- Have students

Virtual Learning

This can easily be completed as a digital activity.

Engage

Teacher Guide

Part 3: Introducing . . . Light

Materials List:

- Activity Sheet
- Two different transparent objects (Drinking glass, lens, plastic box, etc.)
- Two different translucent objects (Light-colored plastic or glass, piece of glass with film on it, etc. You might need to buy transparent film to cover transparent glass or plastic.)
- Two different opaque objects (anything that does not allow light to pass through—thick cardboard, stone, metal, etc.)
- Flashlight

Virtual Learning

Students can do the activity at home at home and record the data digitally.

Teacher Instructions:

In this activity, students are going to shine light through a variety of objects. This activity is designed to help students start formulating hypotheses about the different things that can happen to light as it moves through (or does not move through) different objects.

As you walk around the classroom supervising this activity, you can ask "I wonder" or "Why do you think" questions. "Why do you think the light shines through it that way?" "Using what you remember from the Energy units, what kind of energy does the flashlight use?" "What are some different ways light shines through objects?"

Engage Part 3: Introducing . . . Light

Student Instructions:

- Shine the flashlight through each object.
- Record what light looks like as it shines through the

Engage

Part 2: My Experiences with Light

Name: _____

- Write down everything you know about light.

- When did you use light today?

- Do you think you can always see light? Explain why or why not.

Engage

Part 1: What is This?

The pictures show different ways light is used in our everyday lives. In the blank space next to the picture, write your observations about how light is used in the picture. There are no right or wrong answers. Give your best guess!

1



2



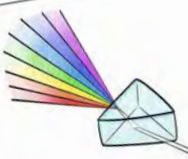
3



4



5



6



7



8



9



10



11



12



Engage

Part 3: Introducing . . . Light Activity Sheet

Name: _____

- Shine the flashlight through each object.
- Record what light looks like as it shines through the object.

Object 1: _____
Describe what you see.

Draw a picture of how the light shines through the object.

Object 2: _____
Describe what you see.

Draw a picture of how the light shines through the object.

Object 3: _____
Describe what you see.

Draw a picture of how the light shines through the object.

Object 4: _____
Describe what you see.

Draw a picture of how the light shines through the object.

Object 5: _____
Describe what you see.

Draw a picture of how the light shines through the object.

Object 6: _____
Describe what you see.

Draw a picture of how the light shines through the object.

Engage Activities

Teacher Guide

- Students will work together to investigate light. They will do this by observing what happens when light is reflected and refracted.
- Students will gather general information about light.
- Students will begin to think about the factors that affect light.
- Students will analyze and interpret data to provide evidence that light is a type of energy.

- Part 1 (Check It Out): 15 minutes
- Part 2 (Read This): 15 minutes
- Part 3 (You Try It): 15 minutes

- ☐ Activity Sheets
- ☐ 2 Glass beakers (250-mL or larger)
- ☐ 2 Pencils (or any straight object)
- ☐ Water
- ☐ Prism
- ☐ Flashlight
- ☐ Laser pointer
- ☐ Mirror with a flat edge
- ☐ Yellow, red, green, and blue colors

Virtual Learning

Students can do the activity at home fairly easily and record the data digitally.

- ☐ Activity sheet
- ☐ 2 Glass beakers (250-mL or larger)
- ☐ 2 Pencils (or any straight object)
- ☐ Water
- ☐ Prism
- ☐ Flashlight

This activity is designed to sharpen students' observational skills. These are key skills in conducting scientific investigations. Encourage students to think critically about what is happening in this investigation. They should begin to draw connections between what they know about light and the conditions under which light changes.

When students have completed their investigation, debrief as a class. Project a copy of the Activity Sheet on the whiteboard or make a copy of it for your bulletin board. Students should either raise their hands to describe

Teacher

Virtual Learning

This can easily be completed as a class activity.

☐ Article

Have students read the passage and either take notes or answer the questions. There are two options. One option has questions and space for answers. The other option has a blank space for students to take notes.

Virtual Learning

Students can do the activity at home fairly easily and record the data digitally.

- ☐ Activity Sheet
- ☐ Laser pointer
- ☐ Mirror with a flat edge
- ☐ Yellow, red, green, and blue colored pencils

Note: Students do not need to know how to use protractors with this experiment. But this experiment will give them experience with a protractor and provide scaffolding for when they begin to learn how to use one in math.

1. Hand out Activity Sheets and supplies.
2. Review the instructions with students.

Name: _____

Name: _____

Beaker with water:

Empty Beaker:

Empty Beaker:

Draw your observations. Below the drawing, use complete sentences to describe what you saw.

1. Shine the flashlight until the beam of

2. Record your c

Name: _____

You are going to investigate light as it reflects off a surface at different angles.

1. Hold your mirror perpendicular to the protractor along the flat edge so that the protractor is reflected in the mirror.
2. Notice that there are two sets of numbers on the protractor. These numbers measure angles in units called degrees ($^{\circ}$). The inside set of numbers starts with 0 on the left and ends with 180 on the right. The outside set of numbers starts with 0 on the right and ends with 180 on the left. For this activity, you will use the inside set of numbers.
3. Hold your laser pointer flat against the protractor, and pointed at the 0 degree mark.
4. Measurement #1 (use a yellow string)
 - a. Align your laser pointer at the 0 degree mark.
 - b. Draw a solid line to show the angle.
 - c. Draw a dashed line to show the angle.
5. Measurement #2 (use a red string)
 - a. Align your laser pointer at the 0 degree mark.
 - b. Draw a solid line to show the angle.
 - c. Draw a dashed line to show the angle.
6. Measurement #3 (use a blue string)
 - a. Align your laser pointer at the 0 degree mark.
 - b. Draw a solid line to show the angle.
 - c. Draw a dashed line to show the angle.
7. Measurement #4 (use a green string)
 - a. Align your laser pointer at the 0 degree mark.
 - b. Draw a solid line to show the angle.
 - c. Draw a dashed line to show the angle.



Norme

Measurement #1
Measurement #2
Measurement #3
Measurement #4



yellow
red
blue
green



Explore Activities

Explain Part 2: Where is Light?

On a dark and rainy day, the landscape seems bleak. Clouds cover the sky, and a constant drizzle soaks everything. Then the rain stops, the clouds pull apart, and the sun shines through. Suddenly, a beautiful rainbow appears and completely changes the dreary scenery. Have you ever seen such a sight? How does this happen?

Rainbows are a type of energy that can be detected by the eye. To understand how light works, we need to understand the **electromagnetic spectrum**.

The **electromagnetic spectrum** is a group of waves with both electric and magnetic properties. These waves can carry an electric charge and are affected by magnetic fields. Electromagnetic waves include radio, microwave, infrared, visible light, ultraviolet, and gamma radiation.

All energy waves can be described in several different ways. First, the **peak** is the part of the wave with the greatest amount of energy. The **trough** is the part of the wave with the least amount of energy.

A wave's **amplitude** describes how tall a wave is and shows the amount of energy. Waves with a higher amplitude have more energy.

Explain Part 2: Where is Light?

This wave has a higher amplitude.

This wave has a lower amplitude.

This wave has a longer wavelength.

This wave has a shorter wavelength.

Wavelength is the distance between two peaks of a wave.

On the electromagnetic spectrum, waves are arranged by wavelength. Radio has the longest wavelength. They are the slowest of all the energy waves. At the other end of the spectrum are gamma radiation waves. They have the shortest wavelength and travel the fastest.

In the middle of the electromagnetic spectrum is **white light**. This is light that is made up of all the colors of the rainbow: red, orange, yellow, green, blue, indigo, and violet. When these colors are combined, the color that we see is white light, like from the sun and light bulbs.

Light travels from its source in straight lines in all directions. It moves in straight lines until it hits an object. A **transparent** object allows light waves to move through it without scattering them. A glass window is transparent. Light moves directly through. Colored glass is **translucent**. Objects that are translucent scatter light somewhat. Some light can pass through these objects, and they cast a faint shadow. If light cannot pass through an object at all, it is **opaque**. The object casts a dark shadow.

Explain Part 2: Where is Light?

Light travels quickly through air because air molecules are spaced far apart. When light moves into a liquid, like water, it slows down because water molecules are closer together. This causes light to **refract**, or bend. Suppose you are looking at a spoon sitting in a glass that is partially filled with water. Because the light bends once it hits the water, it makes the spoon look like it is bent. This happens because of refraction.

When light hits an object, at least part of the light **reflects**, or bounces off it. The light then travels into your eye, allowing you to see the object. Any light that does not pass through or reflect off an object is **absorbed by it**. When this happens, light energy is transferred to the object.

Think back on how we learned that white light is actually made up of all the colors of the rainbow. Each color of the rainbow has a different wavelength of light. Red light has the longest wavelength of all the colors and moves slowest. Violet light has the shortest wavelength and moves fastest.

If sunlight hits a bright red apple, the apple reflects red light and absorbs all the other colors of light. The reflected red light enters your eye, telling your brain that the apple is red.

What happens with a rainbow? How are rainbows formed? Rainbows are formed when sunlight shines through tiny droplets of water in the air. Light is refracted through those droplets. Since each color of light travels at a different speed, they all bend a little differently. If you notice rainbows in nature, red is on top and violet is on the bottom. Red light moves more slowly, causing it to bend, or refract, the least. Fast-moving violet light has the greatest amount of refraction.

Explain

Objectives

- Students will work collaboratively to observe the properties of light.
- Students will listen to the teacher's explanation about light.
- Students will use the new information to revise their explanations about light energy, how it is perceived by the brain, and the factors that affect how light travels.

Duration

- Part 1 (What Does It Mean?): 15 minutes
- Part 2 (What Is Light?): 20 minutes
- Part 3 (Putting It All Together): 20 minutes

Materials for all three parts:

- Activity Sheet
- Colored paper (white, blue, yellow, green, and black)
- Colored transparent film (red, blue, yellow, and green)
- Flashlight
- Scissors
- Tape
- Colored pencils
- Cardboard tube
- Diffraction grating
- Recommended:
- Incandescent light bulb
- LED flashlight
- Fluorescent light bulb
- Glow sticks
- Candle
- Gas burner

Explain Part 1: What Does It Mean: Student Instructions

You are going to investigate what happens to light as it passes through different colors of film.

- Prop a book or a binder up.
- Column 1: White Paper
 - Tape a piece of white paper to the back of the book.
 - Hold the red film about 1 inch from the flashlight.
 - Shine the flashlight through the red film.
 - Record your observations.
 - Repeat the same steps with the other colors of film.
- Replace the white paper with yellow paper.
- Do the same with yellow, green, and blue film.

Explain Part 1: What Does It Mean: Activity Sheet

	White Paper	Blue Paper	Yellow Paper
Red Film	Red film, white paper	Red film, blue paper	Red film, yellow paper
Blue Film	Blue film, white paper	Blue film, blue paper	Blue film, yellow paper
Yellow Film	Yellow film, white paper	Yellow film, blue paper	Yellow film, yellow paper
Green Film	Green film, white paper	Green film, blue paper	Green film, yellow paper

Explain Part 3: Putting It All Together: Activity Sheet

Construct the Spectroscope:

- Line the tube with black paper.
- Cut out the circles on your Spectroscope Sheet. Cut out the square and rectangle inside the circles.
- Tape the diffraction grating over the square in the middle of Circle A.
- Tape two pieces of black paper over the rectangle in the middle of Circle B, leaving open a tiny slit in the middle of the rectangle.
- Tape the edges of the circles to secure them to each end of the tube. You now have a spectroscope!

Spectroscope Activity:

- Circle B (the end with the narrow slit) is the end you will look through.
- Look at each light source on your Activity Sheet. Using colored pencils, draw your observations. Describe what you see.

Explain Activities

Extend Part 1: Where is the Light? Student Instructions

Construct the Pinhole Camera

1. Unbend the paperclip. Use the paperclip to poke a hole in one of the short ends of the box.
2. Draw a square in the middle of the other short end of the box. The square should have sides of four inches. Carefully cut out the square.
3. Tape the piece of wax paper over the square hole. You now have a pinhole camera!

Pinhole Camera Activity

4. Cover yourself and your camera with the blanket, leaving the "lens" end (the end with the pinhole) out.
5. Hold the camera at least six inches from your face and point the pinhole toward the light source.
6. Observe what happens on the wax paper.
7. Draw your observations and answer the questions on the Activity Sheet.



Extend Part 1: Where is the Light? Activity Sheet

Part 1: Draw a diagram of your pinhole camera. Label the parts of your camera.

When you pointed your camera at the light source, what did you see? Describe your observations in complete sentences.

Draw your observations and label your drawing.

Did the image look the way you expected it to? Why or why not?

Remember from the reading section that light travels in straight lines. Light reflects (bounces) off surfaces, goes through the pinhole, and places its image on the back of the box. The dotted lines in the diagram below show how reflected light travels to a pinhole and then continues to the back of the box. The image of the candle shows up back of the box. Considering these lines, draw how you would expect the image of the light to look?



How, besides what you learned above, why did your image look like that?

Extend Part 3: Have Fun With It

Student Instructions

1. For this game, there will be two players and one referee.
2. The first player rolls the die and waits to move.
3. The first player chooses a card from the pile, reads it, and answers it.
4. The referee will hold the answer key and decide if the player answered the question correctly.
5. If the player is correct, he or she can move the number of spaces on the die.
6. If the player is incorrect, he or she does not move.
7. The first person to reach the end wins.



Extend Part 3: Have Fun With It

Questions	Answers
27. Describe how light travels from its source.	In straight lines in all directions
28. What does transparent mean?	Light waves pass through an object without scattering.
29. Name something that is transparent.	Examples might include clear glass, plastic, or air.
30. What does translucent mean?	Some light passes through an object, so the object casts a faint shadow.
31. Name something that is translucent.	Examples might be colored glass or plastic, fog, smoke.
32. What does opaque mean?	Light waves cannot pass through an object, so the object casts a dark shadow.
33. Name something that is opaque.	Example is any solid object that does not allow light to shine through it.
34. What is refraction?	When light bends.
35. What happens when light that does not shine through an object?	It is absorbed by the object.
36. What happens when light hits an object?	Light reflects off objects and travels into your eye.

Extend Part 2: Show What You Know: Activity Sheet

Think back on the Introducing Light Activity in which you observed light shining through several different objects.

1. Write down everything you now know about what happens when light shines through objects. What factors affect how much light will shine through an object?

2. Decide whether each of the objects was transparent, translucent, or opaque. Write down each object in the appropriate column below.

Transparent Objects	Translucent Objects	Opaque Objects

Think back on the Check It Out Activity in which you observed light shining through a beaker of water with a pencil in it.

1. The light that shines through a beaker of water is bent.

2. The light that shines through a beaker of water is bent.

3. The light that shines through a beaker of water is bent.

4. The light that shines through a beaker of water is bent.

5. The light that shines through a beaker of water is bent.

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35. The light that shines through a beaker of water is bent.

36. The light that shines through a beaker of water is bent.

37. The light that shines through a beaker of water is bent.

38. The light that shines through a beaker of water is bent.

39. The light that shines through a beaker of water is bent.

40. The light that shines through a beaker of water is bent.

What is energy?

What is light energy?

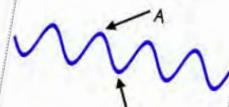
What part of the wave has the greatest amount of energy?

What does the trough of a wave show?

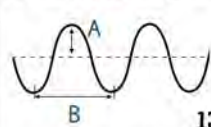
What is the electromagnetic spectrum?

What part of the wave has the least amount of energy?

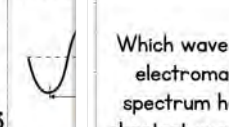
What is letter A pointing to?



In this picture, what is Arrow A referring to?



In this picture, what is Arrow A referring to?

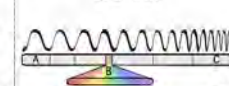


Which waves on the electromagnetic spectrum have the shortest wavelength?

Which waves on the electromagnetic spectrum travel the slowest?

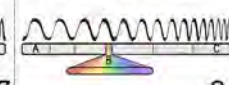
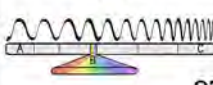
Which waves on the electromagnetic spectrum travel the fastest?

On this diagram, which letter points to radio waves?



On this diagram, which letter points to white light?

On this diagram, which letter points to gamma radiation waves?



Extend Activities

Evaluate

Teacher Guide

Objectives

- Students will evaluate their own understanding of light.
- Students will be able to demonstrate knowledge of the concepts and vocabulary.
- The teacher will encourage students to ask questions that could lead to future investigations.

Duration

- Part 1 (What I Know): 15 minutes
- Part 2 (Showing Light): 30 minutes
- Part 3 (Going Forward): 15 minutes

Materials for all three parts

- Activity Sheets
- "What I Know" Self-Check
- Assorted pictures that represent the different types of light energy on the electromagnetic spectrum (radio, microwave, infrared, each color of white light, ultraviolet, x-ray, gamma radiation). These pictures can be from the internet (either obtained by you or by the students on a web search), magazines, or a combination.
- Poster board or large piece of paper
- Glue and scissors

Part 1: What I Know

Materials:

- "What I Know" Activity Sheet
- "What I Know" Self-Check

Teacher Instructions:

Students will work on this part individually. When they have answered the questions, they will share their answers with the class. If you want to assess their understanding of the concepts using the rubric. If you want to practice together with the class.

Optional: Debrief with the entire class. Students don't need to tell the class their answers. They can share their revised answers.

Part 2: Showing Light

Materials:

- Activity Sheet
 - Activity Sheet
 - Assorted pictures that represent the different types of light energy on the electromagnetic spectrum (radio, microwave, infrared, each color of white light, ultraviolet, x-ray, gamma radiation). These pictures can be from the internet (either obtained by you or by the students on a web search), magazines, or a combination.
 - Poster board or large piece of paper
 - Glue and scissors
- (continue on next page)

Virtual Learning

This can easily be completed activity

Evaluate

Part 2: Showing Light (continued)

Teacher Instructions:

The purpose of this section is for students to physically demonstrate what they have learned. You have two options for this section. The Performance Assessment is optional. If you are short on time, the Worksheet Activity will be useful.

For the Performance Activity, there are several ways students may demonstrate their understanding. One idea is to have them record a video. Another idea is to have parents or class members observe the demonstrations and check off the mastery. Finally, you can do a "show and tell" where students complete what they can. They can begin working on Evaluate Parts 1 and 2.

Optional: Go over the answers with the whole class.

Part 3: Going Forward

Materials:

- "Going Forward" Activity Sheet

Teacher Instructions:

Having students think about what they know and consider what they don't yet know is a valuable tool in solidifying and generalizing the knowledge they have acquired in this unit. In this section, students will hypothesize an answer to a question they have. They will plan an investigation in order to find answers to the question.

If your students have difficulties coming up with questions, you might want to give them prompts such as:

What makes _____ happen?

Why does _____ cause this to happen?

Optional: _____ their responses with the class.

Virtual Learning

This can easily be completed activity

Evaluate

Part 1: What I Know: Self-Check

Use the rubric:

- Underline or highlight the sentence that has the same amount of information as your answer. The words don't have to be exactly the same.
- Decide if you have mostly 1s, 2s, or 3s. Write this score at the bottom.
- Rewrite your answers to match statements from the 3 row.

Rubric

Score	Question 1
3	The red shadow from the red heart is because the heart is translucent, allowing only some of the light to shine through. There is no shadow from the clear heart because it is transparent, allowing all the light to shine through. The chains holding the pendants are opaque, not allowing any light to shine through. Light is completely absorbed by the chain. The clear heart causes some of the light to refract, splitting the colors into a rainbow. One pendant only lets some light through. One pendant lets a lot of light through. The chains let no light through. One pendant is translucent. One pendant is transparent. The chains are opaque. One pendant causes refraction. Rainbows happen when light bends (or is refracted). The pendants let different amounts of light through.
2	
1	
My Score	

Evaluate

Part 1: What I Know: Activity Sheet

Answer these questions. When you have finished, check your learning by using the rubric.

Key Words: Absorption (absorb), opaque, refraction (refract), translucent, transparent

Question 1:

You have two necklaces with crystal pendants like these. You turn off the lights in your room and hold the pendants up in front of the wall. As you shine your flashlight through them, you notice that the red heart makes a red shadow on the wall, but that the light shines right through the clear one, not creating a shadow. You also notice that the clear heart makes rainbows around the room. For both necklaces, there are dark shadows on the wall of the chains that are holding them.

Using all of the key words above, explain why you see:

- a red shadow of the red heart
- no shadow from the clear heart
- a dark shadow from the chains
- rainbows

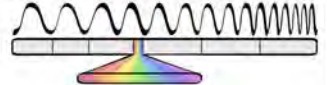


Keywords: Electromagnetic spectrum, light energy, wavelength, white light

Question 2:

Use all of the key words to explain:

- What this diagram shows
- How it is arranged



Evaluate

Part 2: Showing Light: Performance Activity

Using the materials provided, make a large diagram of the electromagnetic spectrum. Find pictures to show each type of energy, including the different colors that make up white light. Also, in your diagram, show how the wavelength changes from left to right. Label your diagram.

Evaluate

Part 2: Showing Light: Worksheet Activity

Match the pictures to the most correct statement.



- This type of energy can be used to cook our food.
- These waves are found to the right of and next to white light. They are the type of waves responsible for sunburns and why we should wear sunscreen.
- These waves have the longest wavelength.
- This is the light color with the shortest wavelength.
- This is the light color with the longest wavelength.
- These waves have the shortest wavelength. They are used to produce energy in nuclear power plants.
- This type of light is made of all the colors of the rainbow.
- This type of light energy helps doctors to see inside your body.
- These waves are found to the left of and next to white light. They are used in remote controls.

Evaluate

Part 3: Going Forward: Activity Sheet

Question: Think about what you have learned about light. You have learned that light is a type of energy. You have learned that light energy is part of the electromagnetic spectrum. You have learned that light has properties, such as wavelength, amplitude, transparent, translucent, and opaque. You have also learned that light can be reflected, refracted, and absorbed.

But is there more to learn about light? Yes!

Think about the different types of light waves. What is the difference?

My question about waves is _____

My hypothesis about waves is _____

What is your guess? Use your hypothesis to answer the question.

My hypothesis about waves is _____

Draw how you would set up your experiment:

Evaluate

Part 3: Going Forward: Activity Sheet

Experiment: Using your hypothesis, plan an experiment. How would you answer this question? Write the steps in the experiment:

My question about waves is _____

My hypothesis about waves is _____

What is your guess? Use your hypothesis to answer the question.

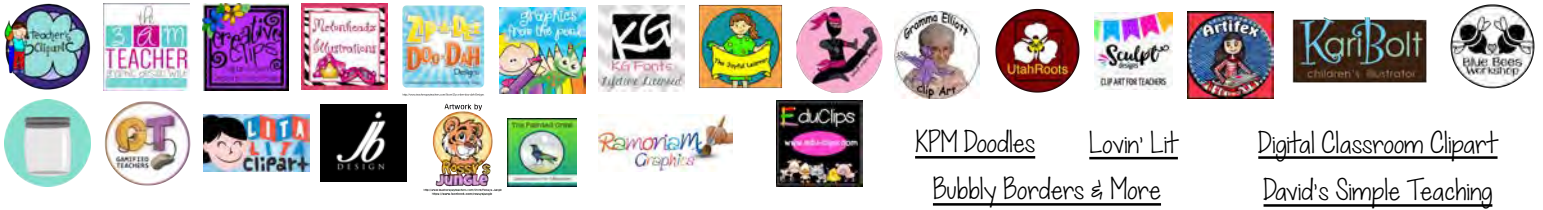
My hypothesis about waves is _____

Draw how you would set up your experiment:

Evaluate Activities

THANK YOU

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WHAT I have
LEARNED



WORD PROBLEMS	CURRICULUM MAP TEMPLATE	ADDITION & SUBTRACTION
		
This is perfect for teachers whose students struggle solving word problems. Have you ever thought of removing the numbers from word problems? Great for first and second grades.	Do you struggle with long range planning? This curriculum map template will get you started on planning for your whole year!	Two-digit addition and subtraction can be tricky for students. Here is a sample of resources to help them explore different models and strategies.
Name Email* Grade (choose the best fit) YES! I WANT IT!	Name Email* What Grade Do You Teach? * YES! I WANT IT!	Name Email* Grade (choose the best fit) YES! I WANT IT!

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