Bouncing Around Ideas about Light

(Adapted from Ohio's Science Institute)

Lesson Summary
Students are expected to explore and summarize observations of the transmission, refraction and reflection of light

Ohio Standards Correlations
Standard: Physical Sciences

Grades 3-5 Benchmark F: Describe the properties of light and sound

Indicator(s)
Grade Five
5. Explore and summarize observations of the transmission, bending (refraction) and reflection of light.
6. Describe and summarize observations of the transmission, reflection, and absorption of sound.
7. Describe that changing the rate of vibration can vary the pitch of a sound.

Standard: Scientific Inquiry

Grades 3-5 Benchmark B: Organize and evaluate observation, measurement and other data to formulate inferences and conclusions.

Indicator(s)
Grade Five
2. Evaluate observations and measurements made by other people and identify reasons for any discrepancies.

Standard: Scientific Ways of Knowing

Grades 3-5 Benchmark B: Describe different types of investigations and use results and data from investigations to provide the evidence to support explanations and conclusions.

Indicator(s)
Grade Five
2. Develop descriptions, explanations and models using evidence to defend/support findings.

Time
2 ½ hours or 5 (30 min.) lessons

Materials (per group)
General Materials: A set of each task card (See Attachments A-J) glued to file folders (if possible, laminate the folders), chart paper, markers, a set of student journals (one per student) to allow for teachers to record observations (see Attachment K); 5 boxes, bags or containers to store station materials.
Getting started: flat mirror per person, one flashlight per group.
Station 1 (Reflection**):** flat mirror, small amount of clay, flashlight, white cardboard, assortment of contrasting materials: black paper/white paper; smooth/rough (flat and wrinkled paper); shiny/dull; metal/plastic
Station 2 (Reflection): flashlight, comb, 2-3 mirrors, protractor, several sheets of white paper, masking tape
Station 3 (Refraction): clear glass or plastic cup, container of water, pencil, and a penny
Station 4 (Refraction): various objects with lenses (such as magnifiers, camera, microscope, binoculars, and/or eyeglasses); a flashlight, glass of water; light box (a shoe box with a horizontal rectangle cut out on the end with a small comb covering the rectangular hole; line the box with black construction paper; the lid is not needed); a clear 2-liter bottle filled with water; and newspaper
Station 5 (Transmission): flashlight, various objects made of a variety of materials (i.e., glass, plastic wrap, foil, tissue paper, wood, waxed paper, thick paper, cloth)

Background (Includes content information and misconceptions)
Properties of Light
According to the ray model of light, light travels in a straight line unless it comes to a boundary where the materials change. When light hits a boundary between two materials, it can reflect, refract (going into the new material), or be absorbed. As light travels through a material, it can be absorbed or it can be scattered by particles in the material.

The focus of the 5th grade indicators involving light is being able to qualitatively describe this behavior. We also will focus on the fact that light can transmit energy, as will be seen when light from the sun is used to cook food in a solar cooker on one of the days.

Basics of Reflection
When light is reflected from a smooth surface, it bounces back at the same angle that it hits the surface. This is called specular reflection. A mirror or the smooth surface of water exhibits specular reflection. We often

talk of the angle of incidence and the angle of reflection. In specular reflection these are equal. Conventionally, these angles are measured to the perpendicular to the surface as shown in the diagram.

When possible, have students measure angles relative to the perpendicular line, even though it's less convenient. When studying reflection and refraction in later grades, they will need to measure angles from the perpendicular line.

Light also reflects from other materials: a sheet of white paper, a pencil, a penny; but it doesn't always seem to follow the rule for the angles. This is called diffuse reflection. It is not true that the rules for the angles are broken, but rather that the surface is microscopically rougher, so light reflects in a lot of different directions.

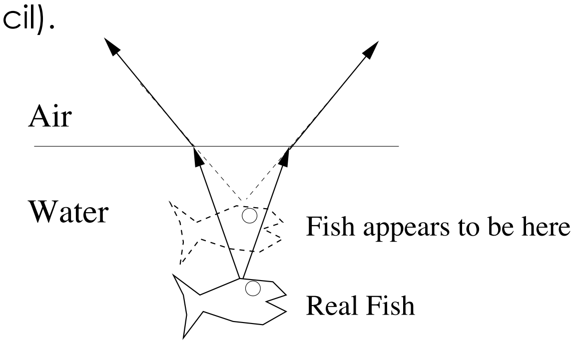
Basics of Refraction

The speed of light is different in different materials. The speed of light is a maximum in a vacuum (300,000,000 m/s!). In water light travels only 3/4 the speed that it travels in vacuum. In typical glass it travels only 2/3 the speed of light in vacuum. This speed is represented by the index of refraction of the material (the higher the index of refraction, the slower the speed).

When light travels between materials with different speeds, it will bend or refract. We talk here of the angle of incidence and the angle of refraction. These are traditionally measured with respect to the perpendicular to the surface (see the figure). You can calculate the angles using the indices of refraction and Snell's Law, but that is not what this grade-level indicator is after. The students need to observe that light bends as it enters new material, and they need to qualitatively be able to show how it might bend for common materials (air, water, glass). The basic rule of thumb is this: as light travels from a high-speed material (like air) into a low-speed material (like water), the ray bends towards the perpendicular. As light travels from a low-speed material to a high-speed material, the light bends away from the normal. The greater the difference in speeds, the greater the difference in the angles.

Seeing Objects

We see an object because light either originates from that object (a light bulb, a star) and travels to our eye or light from another source reflects from the object and travels to our eye. Our eyes can tell which direction the light is coming from as it enters the eye. This is the direction we tend to believe the object is located. Our eyes can be 'fooled' by reflection and refraction into thinking things are in a different location. Light bouncing off a fish at the bottom of a stream will refract as it comes out of the water and fool us into the thinking the fish is where it isn't. As shown in the diagram, the fish will seem to be closer to the surface than it is. Refraction leads to some fun experiments that are a part of the included stations (the penny, the pencil).



If you have a fish tank in your room, there is another fun observation you can make. Look at a corner of the tank from an angle, so that you can see two faces at once. Look closely as a fish swims towards the corner. You will actually see two images of the fish! Light bounces off the fish in all directions. Some light is bent towards your eye as it leaves one side of the tank. Different rays of light are bent towards your eye as the light leaves the other side. To your eye, it looks like the fish is in two places at once!

Common Misconceptions

We begin experiencing and exploring the physical world from the day we're born. Your students have been formulating ideas about how things work for a long time. Many of these ideas describe really well how different things in the world behave. Other ideas are based on a limited set of experiences and `miss the mark.' Further experimentation and thought would show some of your students that the ideas they hold need to be modified in order to explain the physical world more accurately.

A lot of education research in the sciences goes into trying to identify alternate conceptions or misconceptions that students have. Here are several from the study of light.

Misconception	More Correct View
Light is associated only with either a source or its effects. Light is not considered to exist independently in space; and hence, light is not conceived of as "traveling".	Light is thought of a packet of energy. Once this packet is created, it travels around until it is absorbed. Light from some stars left millions of years ago. The star may have exploded, but we still see the light that left it before it exploded.
A shadow is something that exists on its own. Light pushes the shadow away from the object to the wall or the ground and is thought of as a "dark" reflection of the object.	A shadow is just the absence of reflected light from a surface. If an object blocks light from reaching a surface, a shadow can be created.
Light from a bulb only extends outward a certain distance, and then stops. How far it extends depends on the brightness of the bulb.	Once light is created by a bulb, it travels out according to its surroundings. The light will continue until it is absorbed. You will see less light further away from a typical bulb simply because the light spreads out more.
The effects of light are instantaneous. Light does not travel with a finite speed.	Light has a finite speed, but it's really fast (300,000,000 m/s in a vacuum) so it's hard to observe.

Misconception	More Correct View
The mirror image of an object is located on the surface of the mirror. The image is often thought of as a picture on a flat surface.	Images are created by objects that modify the direction of light (mirrors and lenses). The image is said to be at the location the rays of light seem to come from or actually converge. They are not a separate object of their own.
The way a mirror works is as follows: The image first goes from the object to the mirror surface. Then the observer either sees the image on the mirror surface or the image reflects off the mirror and goes into the observer's eye.	It is the rays of light that are physically bouncing around and being manipulated, not the image. (see above)
Light reflects from a shiny surface in an arbitrary manner	Light reflecting from a shiny surface follows the law of reflection. The angle of reflection is equal to the angle of incidence.
Light is reflected from smooth mirror surfaces but not from non-shiny surfaces.	If we see an object, it means there is light bouncing off of it. Non-shiny surfaces reflect light in lots of different directions because the surface is microscopically rough.
Light shines on a translucent material and illuminates it so it can be seen. Light does not travel from the translucent material to the eye.	The only way we see objects (which do not produce their own light) is by light which reflects from that object and ends up in our eye.
Light always passes straight through a transparent material without changing direction.	Light can be refracted (bent) anytime it moves into a new material. Whether the direction changes passing through a transparent object depends on the shape of that object.
When an object is viewed through a transparent solid or liquid material the object is seen exactly where it is located.	If the rays of light are bent at all, the object can appear to be someplace it really isn't.

Teacher Tips (Optional)

1. Have stations ready ahead of time (in baggies or paper bags, or trays).
2. Have Station Cards on Cardstock and laminated.
3. Have journals copied ahead of time, one per student.

Procedures

<u>Assessment</u>

<u>Pre-Assessment</u>

At the beginning of the lesson, it will be determined if students have an understanding of reflection, refraction, or the transmission of light. A pre-assessment worksheet is included in the journal (see Attachment K). Ask students to record any knowledge they have about the three concepts or add any additional knowledge they may have about light. Next, draw the graphic organizer similar to the one in the journal on chart paper. Lead a discussion about present knowledge of light and record in the appropriate boxes on the chart paper. Record all responses but explain that it will later be determined whether this information is accurate or misconceived.

Assessment Criteria: Monitor individual work during the completion of the graphic organizer. Take note of any misconceptions as well as accuracy of student knowledge. Use the information gathered to identify students who need support in achieving the indicators and those who may need to be challenged with more advanced work.

<u>Ongoing Assessments</u>

During the lesson, students are to record their observations in their journal on graphic organizers and summarize their observations.

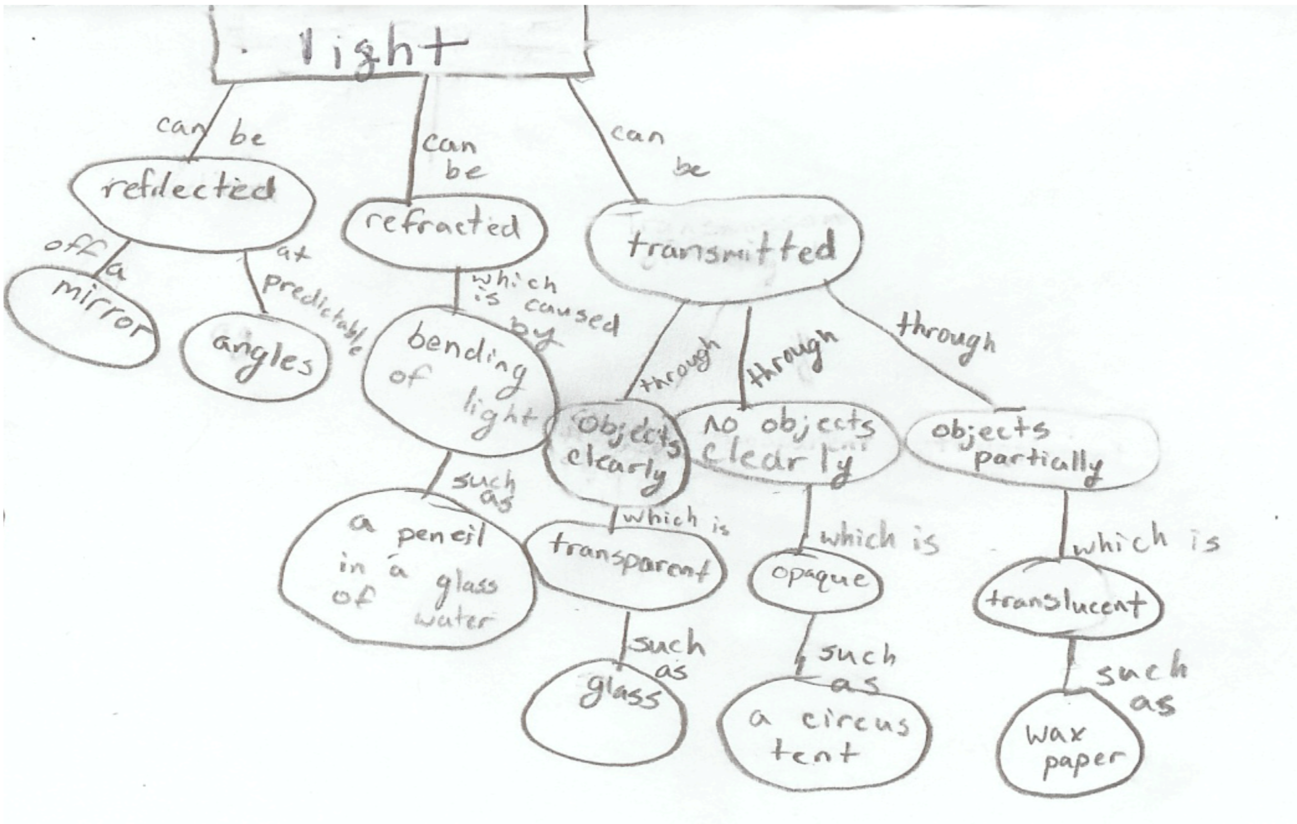
Assessment Criteria: Monitor the completion of the graphic organizers and observations written in the journal. If misconceptions or inaccurate information are recorded, redirect students to further exploration.

<u>Post-Assessment</u>

At the end of the lesson, students will conceptualize the reflection, refraction and transmission of light on a concept map.

Assessment Criteria: Assess the content in the student-generated concept maps. Realize that students may be new to concept mapping but assess students on correctly written knowledge.

Sample Student-Generated Concept Map:



<u>Getting Started</u>

<u>Light Bounce</u>

- Place a mirror for each person and a flashlight on each table.
- Put this prompt on the overhead when it is time to begin the activity: Using the materials at your table, get the light to "bounce" from one person to another. (Prepare the transparency in advance. A PowerPoint slide may be used if a computer and projector are available.)
- If groups finish quickly, combine two tables for a challenge to bounce the light to all individuals in the larger group.
- Walk around to help facilitate groups that may have difficulty.

Doing Science

1. Determine the best pedagogical approach for presenting the group of activities to students. Possibilities include: setting up two stations at a time and developing deep conceptual understanding of a topic (such as reflection) before setting up the next two stations (refraction) followed by the final activity on transmission of light for a total of 3 sessions; or setting up one station at a time over the period of 5 sessions which may be best for the purposes of management and concept development.

2. Distribute the student journals. Instruct students to complete the pretest to determine students' present knowledge and possible misconceptions of reflection, refraction and transmission of light.

3. Explain to students that they are going to be involved in a series of 5 investigations or tasks about reflection, refraction and transmission of light. Explain the layout of the journal. Students are expected to record observations on the appropriate graphic organizers and summarize their findings.
4. Review safety considerations when working with science equipment:
   a. Know the locations and operating procedures of all safety equipment.
   b. Report any accident or injury to the instructor immediately.
5. Set up stations according to the specific task cards (See attachments A-J). The outside of the file folder should contain the task and the inside of the file folder should contain the explanation.
6. Direct students not to open the file folder. Explain that the inside of the file folder contains explanations about the explorations and should only be opened once each exploration is complete.
7. Monitor student progress during the explorations. Encourage and redirect students who are off task or frustrated. Pose additional questions for students who have mastered the concepts. Monitor students' appropriate selection and use of the science equipment.
8. Set the expectations for the completion of each task. For example, students must address all questions listed in the "Let's Reflect" and "Let's Connect" and each student must record a minimum of 4 detailed observations on the graphic organizer during each activity.
9. Once each exploration is complete, instruct groups to read the inside of the file folder and compare and discuss their findings.
10. At the completion of each activity or set of activities (i.e., both reflection activities), facilitate a discussion about student observations. Any misinformation given by the student should be redirected for further study or modeled correctly to all. Refer back to the class graphic organizer developed during the pre-assessment and address any misconceptions that have now been clarified.

11. After each discussion, instruct students to write a summary of their understanding in their journals. Set the expectation for its completion. For example, in a summary about reflection students must define reflection, cite examples and make at least one connection to the real world based upon what was learned in the activities. A scoring rubric is included on each page as a means to assess content development.
12. After the completion of all explorations and debriefings, facilitate the development of a Concept Map for Light.
13. Assess student's concept maps and conduct any re-teaching, if necessary.

Wrapping Up

Safety

Discuss any concerns related to the darkness of the room and moving around. Discuss any concerns about the use of glass materials (e.g., glass mirror, glasses).

Reading

Bring a selection of non-fiction books to share with the students to reinforce the development of science concepts.

Social Studies

Research the timeline of the development of such things as: the light bulb, lenses, eyeglasses, the microscope, telescope, etc.

Health

How is light being used to improve health? (lasers for surgery – both to cut and to stop bleeding (cauterize), optical fibers that can see around corners in the body, using light to measure oxygen content of the blood)

Extensions

Homework Options and Home Connections

- If time is a factor, assign the journal writing portion of the lesson to be completed at home.
- Research light in the internet or through library books with the purpose of extending their understanding of light.
- Extend the learning of each activity by asking students to conduct further explorations at home and summarize

Key Vocabulary
Absorb—to take in without reflection or transmission
Concave—a surface that curves inward
Convex—a surface or boundary that curves or bulges outward
Converging Lens or Mirror—takes parallel rays of light and focuses them
Diverging Lens or Mirror—takes parallel rays of light and causes them to diverge away from each other
Mirror—a smooth and shiny surface that reflects light
Opaque—a material that allows no light to pass through
Reflect—to bounce back from a surface
Refraction—the bending of light as it enters the surface of a new material
Shadow—the rough image cast by an object blocking rays of illumination.
Translucent—a material that only allows some light to pass through
Transmission—the passage of light through an object
Transparent—a material that allows nearly all of the light to pass through

Key Light Concepts
- We see objects because of light.
- Light travels in straight lines.
- Light can be reflected or absorbed.
- Light waves are reflected at predictable angles.
- The angle at which light strikes a mirror is the same size as the angle of the light reflecting from the mirror.
- Light moves faster through air than it moves through water.
- Light moves faster through water than it moves through glass.
- Refraction is the bending of light as it passes through different materials.
- Light can bend or be refracted at the boundary between materials.
- A converging lens is a lens which is thicker at the center than it is on the edges.
- Light passing through a magnifying lens bends at different degrees depending upon which part of the lens the light strikes.
- As parallel rays of light pass through a converging lens, the bending of the light causes the light to converge to a point called the focal point.
- Transmission is the passing of light through an object. Different objects and different materials transmit light differently.
- Objects can be transparent, translucent, or opaque.
- A transparent material allows nearly all of the light to pass through.
- A translucent material allows some light through but some light is scattered in all directions by particles within the matter.
- An opaque object allows no light to pass through. All light is either reflected or absorbed by the material.
- An opaque object casts a dark shadow on the side of the object opposite to the light.

Notes

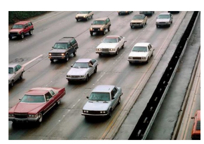
Reflection: Task Card #1

Materials: flat mirror, small amount of clay, flashlight, white cardboard, assortment of contrasting materials: black paper/white paper; smooth/rough (flat and wrinkled paper); shiny/dull; metal/plastic

Task: Compare how different materials reflect light onto the white cardboard using the materials provided. Try bouncing the light from the objects onto the white cardboard. Use the clay to hold the objects.

Let's Reflect:
- Describe and summarize your observations.
- Which materials were best at reflecting light?
- Did some materials seem to not reflect light? Why?
- Add your observations to your "Reflection" Graphic Organizer.

Let's Connect: (Real World Applications)
- Why do ball players smear black under their eyes?
- What color clothing would be best to wear on a hot, sunny day to stay cooler? Why?
- What are some examples of ways reflective materials are used to keep people safe?



Reflection: Task Card #1 (Explanation)

Let's Shed Some Light:

We see objects because of light. Light created by an object, a light bulb for example, can enter our eyes. Light can also be reflected from objects and enter our eyes. Light can be reflected, refracted or absorbed. The surface of an object affects how light is reflected. A very smooth or shiny surface will reflect light in very specific directions. The mirror reflected most of the light from the flashlight, but only in certain directions. A rougher surface will reflect light in a lot of different directions. The white paper reflected the light from the flashlight in lots of directions. The color and type of material will affect how much light is absorbed. Both the mirror and the white paper reflect a lot of light, but darker objects like the black paper absorb more light and reflect less. Carbon black, or soot, absorbs about 97 percent of the energy from light. Silver reflects about 96 percent of the light that hits it. Only 4 percent is absorbed.

Let's Connect:

Ball players smear black under their eyes to absorb the light so the light will not reflect from their lighter color face and into their eyes. In the summer, it's best to wear lighter colors to reflect the sun's light. Dark colors absorb the light and transfer the light into thermal (heat) energy. Some examples of ways reflective materials are used to keep people safe are: reflective paint on the streets show the division of lines and safety patrol belts, bike reflectors are designed to provided safety, and some clothing and shoes offer reflective pieces in their design. Traffic signs use special reflective paints so they can be seen easier at night.

Reflection: Task Card #2

Materials: Part 1: flashlight, comb, 2-3 mirrors, protractor, several sheets of white paper; Part 2: mirror, masking tape, paper

Task: Part 1: Shine a flashlight through the teeth of a comb that is upright on the piece of paper. Observe the rays of light. Place a mirror in the path of the beams at an angle. Draw a line at the base of the mirror. Observe. Use your pencil to trace the path of one of the beams of light from the comb to the mirror and after leaving the mirror. Repeat this process again with a new piece of paper, this time changing the angle of the mirror. Experiment with the protractor to measure each angle.

Part 2: (Can be used as an extension activity) Tape a mirror to a wall at eye level and cover the mirror with a sheet of paper. Place a 3 ft piece of tape perpendicular to the wall directly under the center of the mirror on the floor. Work with a partner. Predict where each person will have to stand in order to be able to see one another in the mirror. Mark this spot with a piece of masking tape. Remove the paper and check for your reflections. If you are unable to see one another, cover the mirror and try again. Once you are able to see one another, place a long piece of masking tape from each person's spot to the wall directly under the mirror. Observe.

Let's Reflect:

Part 1:

- Describe and summarize your observations.
- What did you notice about the angle in which light strikes a mirror and the angle at which the beam bounces off?

Part 2:

- What did you notice about the angle in which you were able to see one another's reflection?
- If time permits, cover the mirror back up. Where would you place a 3rd or 4th student so that they look like they are standing right in front of the other student but are only half the distance from the mirror?

Let's Connect: (Real World Applications)

- The mirrors in cars are typically used to determine what is behind or beside the driver. How can knowing about angles of reflection be helpful to the driver?

Reflection: Task Card #2 (Explanation)

Let's Shed Some Light:

Light travels in straight lines. Light is reflected at predictable angles. When light hits an object and is reflected, it will be reflected in a straight line. If the light hits the object at an angle, it will be reflected at an equal angle. Mirrors are smooth and shiny. When you see your face in a mirror you are seeing light from your face reflecting off of the mirror. The way light bounces off a mirror is similar to the way a ball bounces. If the ball is thrown straight down the ball will come straight back up. If the ball is bounced at an angle, the ball will bounce off the floor at the same angle away from you. Light reflects from a mirror at an equal angle to its arrival.

Let's Connect:

Knowing about angles of reflection can help a driver predict the exact location of the objects or cars behind them. It also makes the driver aware that there is something known as "the blind spot" which is a location next to a car at a particular angle that neither the rear view or side view mirrors can detect.

Refraction: Task Card #3

Materials: clear plastic cup, container of water, pencil, and a penny

Task: Light travels in straight lines. Light travels at different speeds through different types of matter (mediums). Experiment with the materials to determine how the changing speed of light through different mediums (plastic, water and air) affects objects. This affect is called refraction.

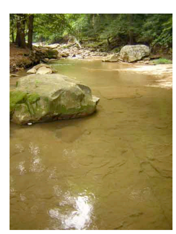
Let's Reflect:

- What does a pencil look like at different angles in the cup of water?
- What does your thumb look like at different angles when placed in the water?
- Look at the penny from an angle while it is underwater. Poke your pencil at an angle into the water to try and touch the penny. Look from above. Did it hit the penny?
- Place a penny at the bottom of the empty cup. Slowly pour water into the cup. View this at different angles. What do you observe?
- Add your observations to your "Refraction" Graphic Organizer.

Let's Connect: (Real World Applications)

- When looking down the road on a hot summer day you notice what appears to be a "pool" of water up ahead. When you get closer, you notice the "pool" of water disappear. Explain how this may be similar to the explorations from above.

- Swimming pools and shallow rivers and streams look shallower than they really are. Why do you think this is true?



Refraction: Task Card #3 (Explanation)

Let's Shed Some Light:

Light travels at a speed of 186,282 miles per second (300,000,000 m/s) through the vacuum of space. At this speed you could go around the earth seven times in one second! When light passes through some materials such as glass or water, it looks bent. This "bending" of light as it passes from air through water is called refraction. Light moves faster through air than it moves through water and moves faster through water than it moves through glass. To bend, light must strike a surface at an angle. It does not bend if it goes straight in. The light bends or refracts at the boundary between the two materials.

Let's Connect:

A mirage happens due to differences in the speed of light through different air temperatures. The air near the ground is much hotter than the air higher up. Light that is coming from above is refracted as the air gets hotter. Instead of continuing in its path toward the road, the light is bent up toward your eyes. This looks similar to a reflection from a pool of water (even though it is refraction). The image is of the blue sky where you would normally see the road. Swimming pools and shallow rivers and streams appear shallower than they really are because of the way the light from the bottom of the water source is refracted as it moves from the water into the air.

Refraction: Task Card #4

Materials: various objects with lenses (such as magnifiers, camera, microscope, binoculars, glasses); glass of water; a container of water with a flat surface that will fit in the shoe box; light box (a shoe box with a horizontal rectangle cut out on the end with a small comb covering the rectangle hole; Line the box with black construction paper; the lid is not needed); a clear 2-liter bottle filled with water; flashlight; newspaper

Task: Explore materials to determine how lenses affect the bending of the light.

Let's Reflect:

- Place the glass of water inside the center of the light box. Shine the light from the end of the box onto the glass of water. Do you see the light bending through the water and meeting on the other side? Why is this happening?
- Place a container of water which has a flat surface inside the center of the light box. How does the light bend going into the water? Coming back out into air?
- Use the 2-liter bottle as a magnifier. Read the newspaper. What do you observe? Do the words closer to the sides of the bottle appear any different than the words in the center of the bottle?
- Explore the objects that have lenses. How do the lenses work together to extend your senses?
- Add your observations to your "Refraction" graphic organizer.

Let's Connect: (Real World Applications)

- Lenses are used to bend light in many forms of technology from magnifying glasses and microscopes, to binoculars and telescopes. Lenses allow us to extend our senses. A camera lens brings the rays of light to a focus on the film to record a clear image. The lenses in microscopes, telescopes and magnifiers make objects appear larger than they really are. Eyeglasses are also magnifiers. Think about how the lenses of eyeglasses are formed to fit the needs of the user.

Refraction: Task Card #4 (Explanation)

Let's Shed Some Light:

A magnifying lens has two bulging (convex) surfaces. As light passes through a magnifying lens, the light bends at different degrees depending upon what part of a lens the light strikes. When light hits the middle of a lens, which tends to be more flat, the light rays go straight through. At the edges of a lens, the glass is curved so light hits the glass surface at a steeper angle. As the light leaves the other side of the lens, the rays are bent again. In the light box experiment, the comb separates the light into separate rays. As the light passes through the glass of water, the bending of the light causes the light to converge to a point called the "focal point". These types of lenses are also called converging lenses. The 2-liter bottle of water acts as a converging lens and magnifies the image.

Let's Connect:

A person who cannot clearly see far is said to be "nearsighted". This happens because a person's eyeball is too long for light rays from a distant object to focus on the retina. The eyeglass lenses for a nearsighted person are diverging to force the light rays to come together farther back so they focus on the retina. The opposite is true for a person who cannot see objects close up. The eyeball is too short for light rays from the nearby objects to be focused on the retina. The eyeglass lenses for a "farsighted" person are convex to start to refract the light rays before they reach the eye allowing the light rays to then focus on the retina. The exact thickness and shape of the lenses is dependent upon the person's ability to see.

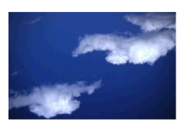
Absorption: Task Card #5

Materials: flashlight, various objects made of a variety of materials (i.e., glass, plastic wrap, foil, tissue paper, wood, waxed paper, thick paper, cloth)

Task: Explore the materials to determine whether each material is translucent (allows some light through), transparent (allows all or nearly all light to pass through), or opaque (allows no light to pass through; all light is reflected, refracted or absorbed). Make predictions before testing each object. Study the shadows created by each type of material. Make a chart in your science journal.

Let's Reflect:
- Describe and summarize your observations.
- What similarities are there between all transparent objects? Translucent? Opaque?
- Compare the shadows of all the objects. What similarities and differences exist?
- Add your observations to your "Absorption" graphic organizer.

Let's Connect: (Real World Applications)
- How do sunglasses affect the transmission of light?
- Are clouds in the sky transparent, translucent or opaque? Explain your answer.
- Do clouds cast shadows?



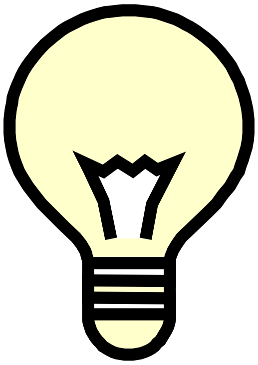
Absorption: Task Card #5 (Explanation)

Let's Shed Some Light:

The passage of light through an object is called *absorption*. Objects transmit light differently. A material that is *transparent* allows nearly all of the light to pass through. A transparent object does not create a shadow. Examples include: plastic wrap, glass, a plastic water bottle, a transparency, etc. A material that allows only some light through is called *translucent*. The rest of the light is scattered in all directions by particles within the matter or absorbed. Translucent objects cast shadows that are faint. Examples include: waxed paper, thin paper, frosted glass, thin cloth, tissue paper, etc. *Opaque* materials allow no light to pass through. All light is either reflected or absorbed by the material. An opaque object casts a shadow on the side of the object opposite to the light.

Let's Connect:

Clouds are translucent. Clouds allow some light to pass through, but not clearly. Clouds cast shadows that are faint (we still see light despite the clouds). Sunglasses are also translucent. They let only some light pass through. The rest is absorbed or scattered by the lenses. This allows the wearer to see clearly but reduces the amount of light that reaches the eye.



A Study of Light Journal

Name: ____________________________

Date: ____________________________

Notes

Light Pre-Assessment

Directions: List and/or draw what you know or think you know about each topic.

Reflection of Light

Refraction of Light

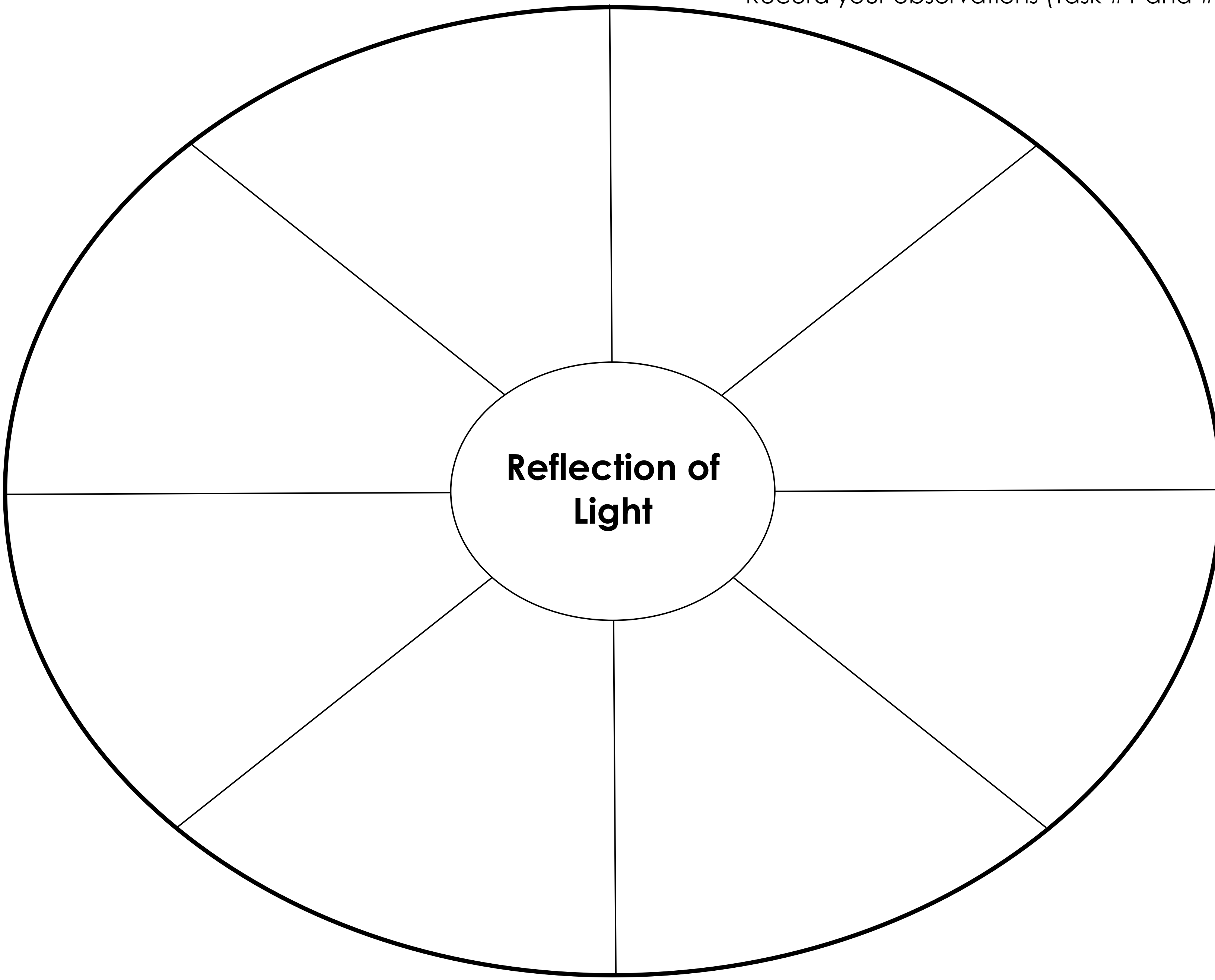
Absorption of Light

Light Pre-Assessment

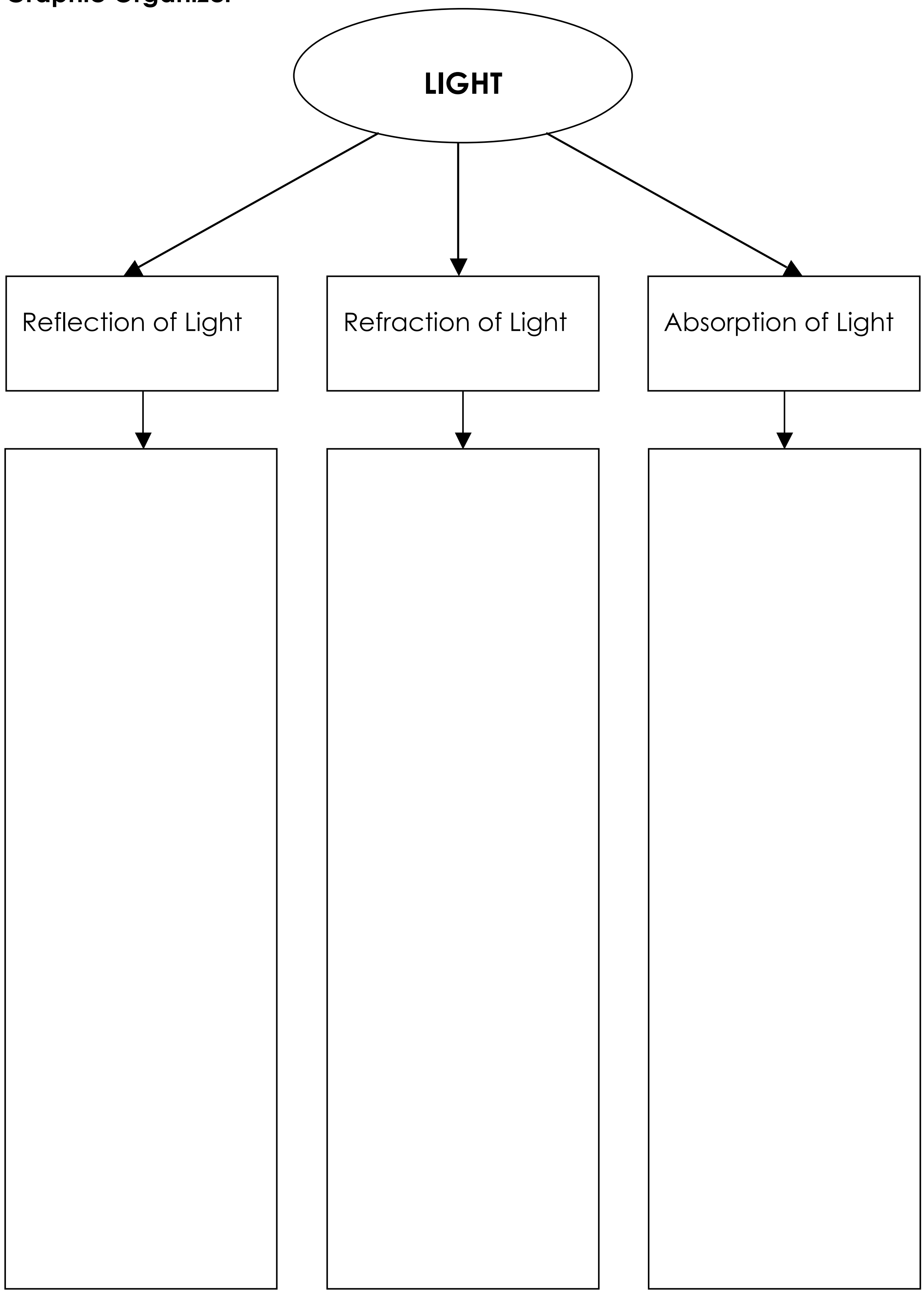
Directions: Write a “T” if the statement is TRUE and write a “F” if the statement is false.

Light Statements	T or F
Light travels in straight lines.	
Sometimes we are able to see in the dark with no light around.	
Writing paper can not reflect light.	
Light travels in curvy waves.	
Mirrors can only reflect light.	
Light travels at the same speed through different materials.	
A convex lens is a lens with at least one surface curving outwards.	
Objects can not absorb light.	
Light can only pass through things that are clear or transparent.	
An opaque object allows no light to pass through.	

Record your observations (Task #1 and #2)



Graphic Organizer

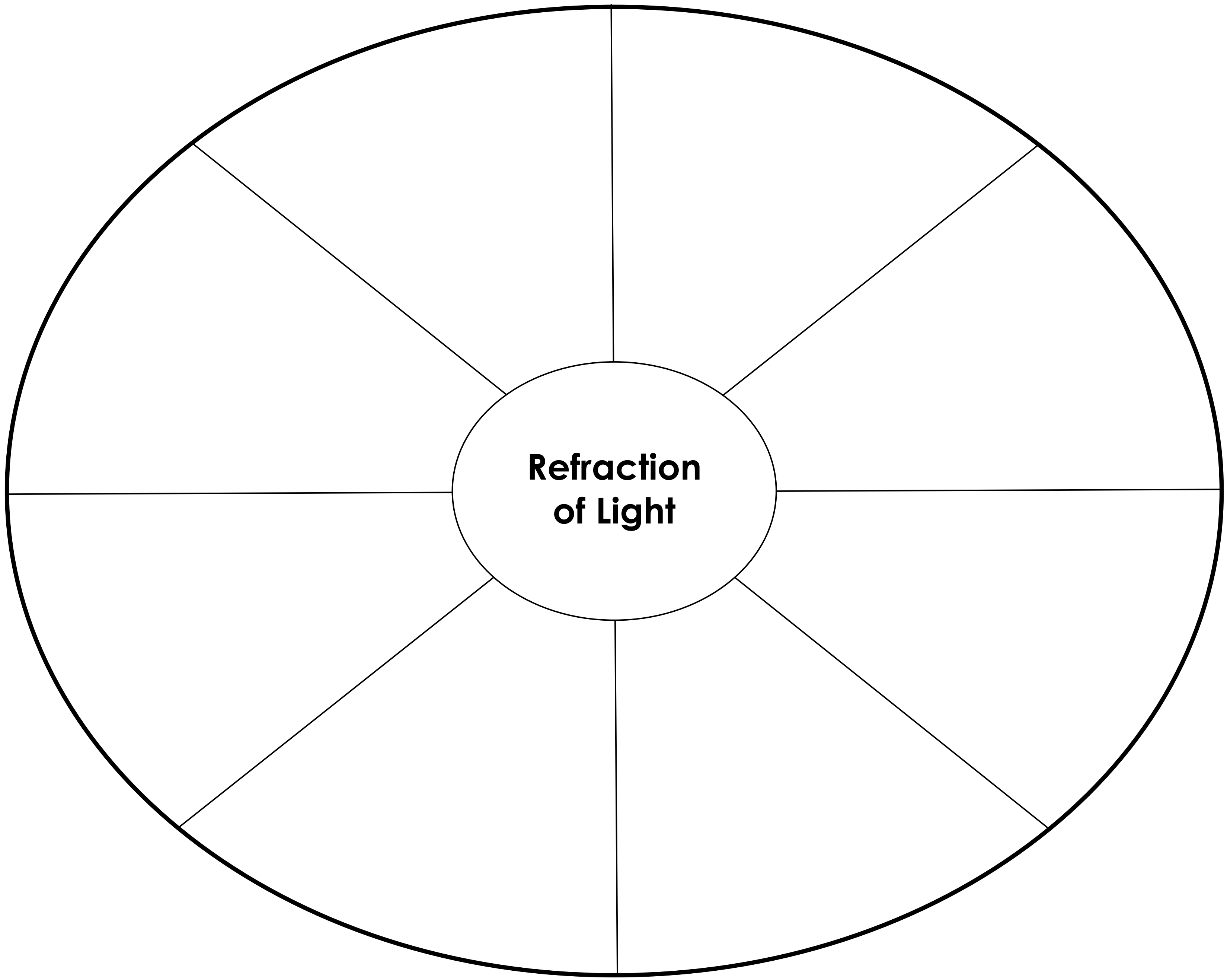


Rubric:
4 - Outstanding (correct, complete and detailed)
3 - Satisfactory (correct and complete)
2 - Improvement Needed (partially correct and complete)
1 - Unsatisfactory (incomplete)

A Summary of What I Learned About Reflection

(Include its meaning, some examples and at least one connection to the real world. You may use words and pictures.)

Record your observations (Task #3 and #4)

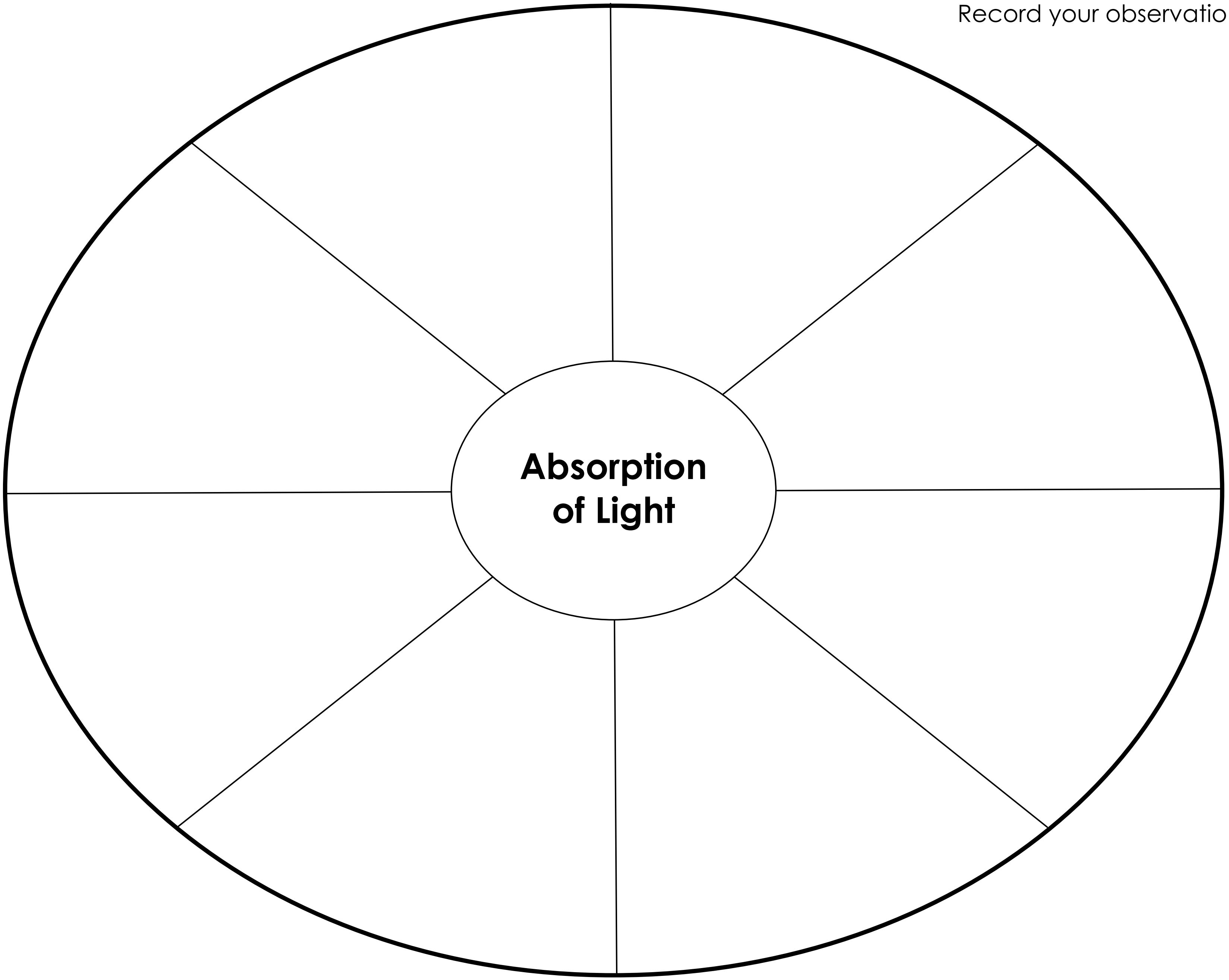


Rubric:
4 - Outstanding (correct, complete and detailed)
3 - Satisfactory (correct and complete)
2 - Improvement Needed (partially correct and complete)
1 - Unsatisfactory (incomplete)

A Summary of What I Learned About <u>Refraction</u>

(Include its meaning, some examples and at least one connection to the real world. You may use words and pictures.)

Record your observations



Rubric:
4 - Outstanding (correct, complete and detailed)
3 - Satisfactory (correct and complete)
2 - Improvement Needed (partially correct and complete)

A Summary of What I Learned About "How Light is Absorbed."

(Include its meaning, some examples and at least one connection to the real world. You may use words and pictures.)

Notes