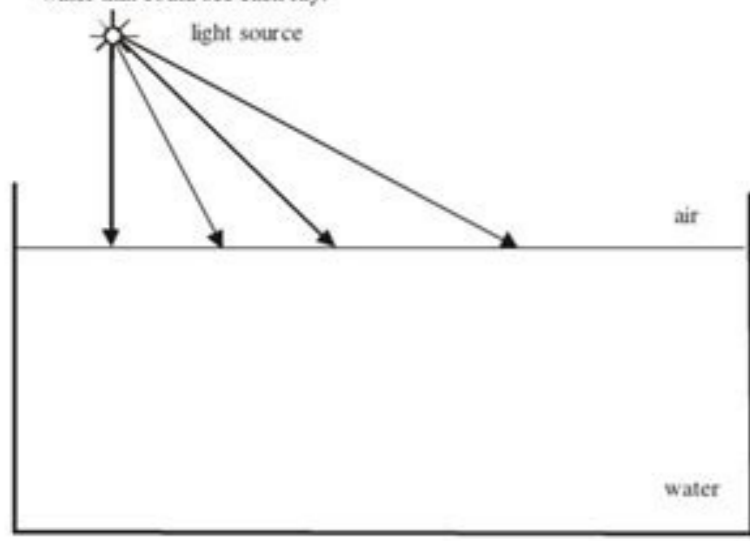


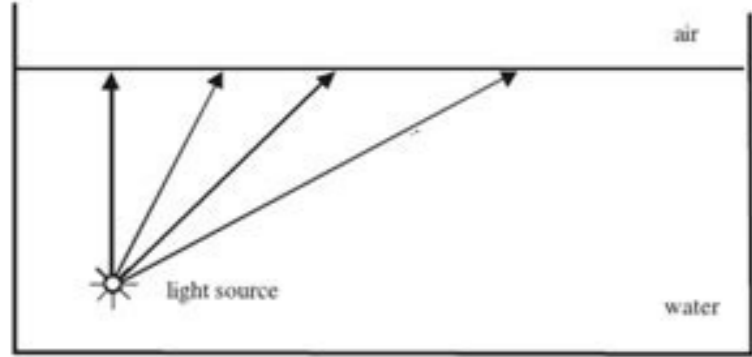
I'm not robot!

Particle Model of Light Worksheet 7: Refraction

1. Sketch the path of the rays as they pass from the air into the water. Draw observer's eyes in the water that could see each ray.



2. The light source is now under water. Sketch the path of the rays as they pass from the water into the air. Draw observer's eyes in the air that could see each ray.



Light

Part 1:

Match each word with the correct definition.

Light	Reflection	Prism	Surface
Medium	Refraction	Mirror	Lens

- _____ the bending of light rays.
- _____ form of energy that travels in a straight line and can move through empty space.
- _____ tool used to show refraction, and separate light into colors.
- _____ the bouncing of light rays.
- _____ material that light travels through.
- _____ an object made out of glass or plastic that bends light rays.
- _____ shiny flat surface that reflects light.
- _____ something light rays bounce off of when they strike.

Part 2:

Under each picture write which form of light travel is taking place, reflection, refraction, or absorption.

9.

10.

Move on the Back

WHEN WAVES HIT WAVES = INTERFERENCE!

- CAN CHANGE WAVELENGTH, FREQUENCY OR AMPLITUDE!

TWO WAVES @ SAME PART
CONSTRUCTIVE INTERFERENCE
= BIGGER WAVES

TWO WAVES @ DIFFERENT PART
DESTRUCTIVE INTERFERENCE
= smaller WAVES



simulation

Quiz & Worksheet - Lab for Diffraction & Interference

1. What is light diffraction?

- The process by which a beam of light is spread out as it passes through an aperture or across the edge of an object.
- The process by which a beam of light spreads out as it moves through space.
- The process by which a beam of light bends as it enters a different medium.
- The process by which a beam of light reflects as it bounces off a shiny surface.
- The process by which light moves through a vacuum.

2. What is light interference?

- A region of light and dark areas created by overlapping of multiple light waves.
- An area of light area created by overlapping of multiple light waves.
- The spreading out of light as it goes through an aperture.
- The way light bounces off shiny surfaces.
- The way light bends as it moves from one medium (material) to another.

3. You shine a laser through a single slit, and produce an image on a screen. If you make the slit smaller, what will happen to the image?

- The pattern will get wider, as will the central maximum.
- The pattern will get wider, but the central maximum will get smaller.
- The pattern will get smaller, but the central maximum will get wider.
- The pattern will get less wide, as will the central maximum.
- The pattern won't change at all.

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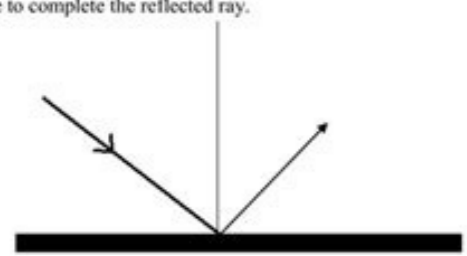
Name: _____ Date: _____ Block: _____

Law of Reflection Review: Answer Key

1. How does the size of the angle of incidence compare to the angle of reflection?

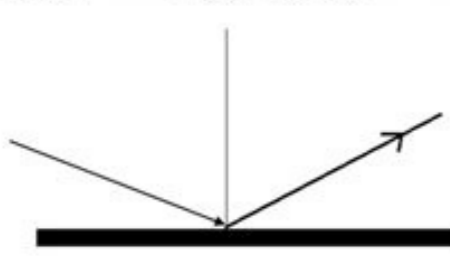
They are equal

2. Measure the angle of incidence with your protractor. _____
Use this angle to complete the reflected ray.

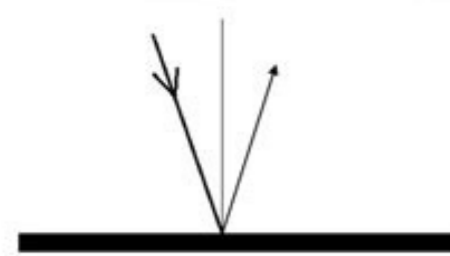


3. Use what you know about the Law of Reflection, your protractor and ruler to complete the ray diagrams.

Angle of Incidence: _____ Angle of Reflection: _____



Angle of Incidence: _____ Angle of Reflection: _____



Reflection refraction diffraction interference practice worksheet answers.

Lesson Objectives and Overview: Reflection, Refraction, Diffraction teaches students about how light reacts in different settings. While students may be familiar with reflection and refraction, diffraction might be a new concept to them. Students will be able to define each of these three terms and explain their meaning. They will also be able to describe the traits of these three properties of light. This lesson is for students in 4th grade, 5th grade, and 6th grade. Classroom Procedure Every lesson plan provides you with a classroom procedure page that outlines a step-by-step guide to follow. You do not have to follow the guide exactly. The guide helps you organize the lesson and details when to hand out worksheets. It also lists information in the yellow box that you might find useful. You will find the lesson objectives, state standards, and number of class sessions the lesson should take to complete in this area. In addition, it describes the supplies you will need as well as what and how you need to prepare beforehand. Options for Lesson There are a number of suggestions in the "Options for Lesson" section that you can take advantage of if you have time or want to extend the lesson further. One idea is to plan an additional activity in which students use a number of objects (e.g., laser pointer, flashlight, glass of water, mirror, etc.) to demonstrate and explain the three properties of light. Hands-on activities help students better understand the concepts they learn about. Another idea is to assign students one of the three properties to study and research. Students can then present a more detailed report about that particular property. Teacher Notes The paragraph on this page provides a little extra guidance or instruction as you prepare the lesson. It suggests using this lesson in conjunction with others that relate to light or physical science in general. You can use the blank lines to write down any other ideas you have before giving the lesson to students. REFLECTION, REFRACTION, DIFFRACTION LESSON PLAN CONTENT PAGES Light The Reflection, Refraction, Diffraction lesson plan contains four pages of content. The first page provides students with background information on light. Students will learn that light is a form of energy that becomes visible when it reflects off the surface of an object. Light travels at a speed of 186,000 miles per second, so it actually takes eight minutes for light from the sun to reach the earth. Nothing in the universe can travel faster than light. It can also travel through liquids and gases, as well as some solids if they are transparent or translucent, such as glass. Light easily passes through transparent objects, like clear water or glass. Translucent objects scatter light waves in different directions. Opaque objects, however, such as a tree or a person, do not allow light to pass through. There are several ways light can be controlled or changed: reflection, refraction, or diffraction. Reflection The first way to change or control light is through reflection. In physics, reflection occurs when a light wave encounters an object that acts as a barrier, or reflects or bounces off a surface. This causes the light wave to return to the original medium. This is how mirrors allow people to see themselves reflected on their smooth surfaces. Light can reflect off any surface at different angles, and the angle of the reflection depends on the angle at which the light hits the object's surface. Light waves travel in straight lines, so the angle of reflected light on a smooth surface will be the same angle at which the light wave hit the surface initially. The lesson provides a small object lesson using a small light or laser and a mirror to demonstrate this concept. Euclid, in 300 BC, was the first person to scientifically study the concept of reflection. He discovered that when light hits an object, the object will absorb certain wavelengths of the light and reflect others. The wavelengths it absorbs or reflects depend on the chemical and physical composition of the object. The lightwaves that reflect off the object determine the color of that object. Refraction The second way light changes is through refraction. Refraction happens when a light wave changes direction upon moving from one medium to another with a different density. The angle of the original light wave and the angle of the refracted wave are different. For instance, when someone puts a pencil in a glass of water, the pencil no longer looks the same. This is because the different densities of the mediums of air and water in a glass cause the light waves to refract in different angles. Students will learn at this point about the concept of prisms and how they refract light. As white light enters a prism, the different wavelengths do not refract in the same way. Instead, each wavelength separates into the colors of the rainbow and appears at a different angle. As another example, stars appear to twinkle due to the refraction of their light by the earth's atmosphere. The first person to study refraction was a Roman scientist named Ptolemy in the 2nd century. He discovered that the angle of the original light wave was proportional to the angle of reflection. Later, a mathematician developed an equation to represent this concept. Diffraction The final way to change or control light is through diffraction. This occurs when a light wave stays in the same medium but bends around an obstacle. This aspect about light led scientists to conclude that light had wave-like properties and consist of a linear stream of particles. Italian physicist Francesco Grimaldi was the first to use the term diffraction to describe this property. Grimaldi described an occasion when a single beam of light traveled through a narrow slit. The light split into different directions and created an interference pattern. In other words, lightwaves can bend or go around an object. This phenomenon makes light waves similar to water waves that hit a boat and bend around the boat. Similarly, students will discover that water waves and sound waves can travel around corners, around objects, and through openings. The lesson provides a diagram to illustrate how light diffracts when passing through a slit or when encountering a barrier. Light waves display the same ability as sound and water waves. The interference occurs due to the diffraction of light around the sides of the object. The waves break into different wavelengths once the light passes through the slit in the first picture and goes around the coin in the second picture. Key Terms Here is a list of the vocabulary words students will learn in this lesson plan: Light: a form of energy that is visible when it reflects off the surface of an object Transparent: a term to describe an object that allows light to pass through it, such as air, water, or glass Opaque: a term to describe an object that does not allow light to pass through and instead reflects the light waves off the surface Translucent: a term to describe an object that scatters light waves into different directions Reflection: when light waves encounter a barrier that causes them to return to the original medium Refraction: when light waves change direction upon moving from one medium to another with a different density Diffraction: when light waves stay in the same medium but bend around an obstacle REFLECTION, REFRACTION, DIFFRACTION LESSON PLAN CONTENT PAGES There are four pages of content in this lesson. At the start, students will learn all about light. They will discover that light is really fast, that it travels at 186,000 miles per second! They will also learn that light can travel through liquids and gases, but it can't pass through solids. This introduces students to how the properties of different objects cause light to react in a certain way. The lesson defines reflection as light bouncing off a surface. The amount of light that reflects off the object depends on the object's traits. A mirror, for example, is so smooth that it easily reflects light. The lesson continues on to define refraction as a wave changing direction when moving from one medium to another. This is what happens when you put an object in water. The object looks distorted because of the various angles of the light waves. Finally, students will learn about diffraction. Diffraction occurs when a light wave stays in the same medium but bends around an obstacle. The lesson shows a couple diagrams of what this would look like. REFLECTION, REFRACTION, DIFFRACTION LESSON PLAN WORKSHEETS The Reflection, Refraction, Diffraction lesson plan includes three worksheets. Each one will help reinforce the concepts that the lesson covers in different ways. The guidelines on the classroom procedure page delineate when to hand out each worksheet to the class. PROPERTIES OF LIGHT POSTER ACTIVITY The activity requires students to work with a partner. Students will create a poster board that displays the three properties of light. They should include diagrams, text, images, and other helpful resources to illustrate each property. In addition, they need to label each property correctly and use the correct terminology. They should also add information if necessary as well as create a catchy title for the poster. The bottom of the worksheet has a blank box that students can use to sketch a rough draft before they begin on the poster itself. After the students finish their posters, they will then present them to the class. You can use the rubric on the worksheet to grade students' work. LIGHT IMAGES PRACTICE WORKSHEET There are two parts to the practice worksheet. The first section displays nine different images. Students must write whether each image represents an example of reflection, refraction, or diffraction. For the second part of the worksheet, there is a list of 10 prompts from the lesson. Students must write which property the prompts relate to. For instance, "a prism" relates to refraction. And "bends around an obstacle" relates to diffraction. REFLECTION, REFRACTION, AND DIFFRACTION HOMEWORK ASSIGNMENT The homework assignment splits into two parts as well. The first 10 questions require students to match terms in a word bank to the statement that they represent. For the second part, students must read 10 statements and decide whether each statement is true (T) or false (F). Worksheet Answer Keys The last two pages of the lesson plan document are answer keys for the practice and homework worksheets. The answers are in red for both worksheets. In addition, both of these assignments are fairly straightforward. There should be no variation in students' responses when comparing them with the answer keys. However, the picture for number 9 on the practice worksheet can be considered both reflection and refraction. Either of these responses are correct. If you choose to administer the lesson pages to your students via PDF, you will need to save a new file that omits these pages. Otherwise, you can simply print out the applicable pages and keep these as reference for yourself when grading assignments.

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