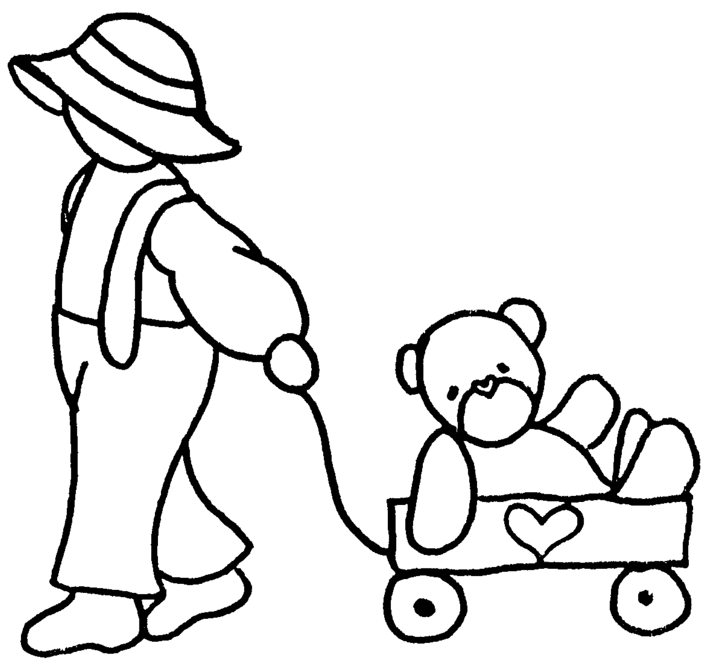
Applied Science

Our Technological World

FIFTH GRADE

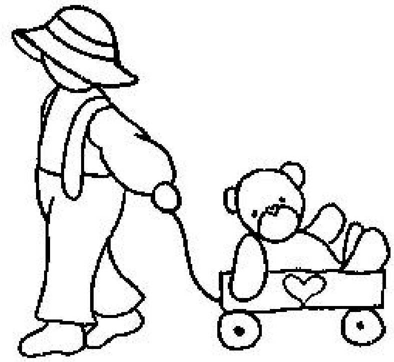
PHYSICS



3 WEEKS
LESSON PLANS AND
ACTIVITIES

APPLIED SCIENCE
OVERVIEW OF FIFTH GRADE

SCIENCE AND MATH



WEEK 1.
PRE: *Interpreting data from a graph.*
LAB: *Estimating data and comparing results on a graph.*
POST: *Exploring different types of graphs.*
WEEK 2.
PRE: *Measuring objects.*
LAB: *Obtaining and interpreting medical data.*
POST: *Researching a problem.*
WEEK 3.
PRE: *Researching background information for an experiment.*
LAB: *Experimenting, recording, and interpreting data.*
POST: *Analyzing data on sound.*

PHYSICS

WEEK 4.
PRE: *Distinguishing between electromagnetic and physical waves.*
LAB: *Comparing diffraction, refraction, and reflection.*
POST: *Interpreting the electromagnetic wave spectrum.*
WEEK 5.
PRE: *Discovering the components of light.*
LAB: *Exploring properties of light.*
POST: *Comparing reflection and refraction.*

TECHNOLOGY

WEEK 6.
PRE: *Distinguishing between incoherent and coherent light.*
LAB: *Analyzing laser beams.*
POST: *Exploring the uses of lasers.*
WEEK 7.
PRE: *Comparing and contrasting the different parts of the microscope.*
LAB: *Analyzing the focal distances in microscopes.*
POST: *Comparing the optics of the microscope with that of an eye.*

BUILT ENVIRONMENT

WEEK 8.
PRE: *Exploring how physical and electromagnetic waves are used.*
LAB: *Comparing different light bulbs.*
POST: *Investigating how knowledge of light and sound changes society.*

APPLIED SCIENCE - PHYSICS (5A)

PRE LAB

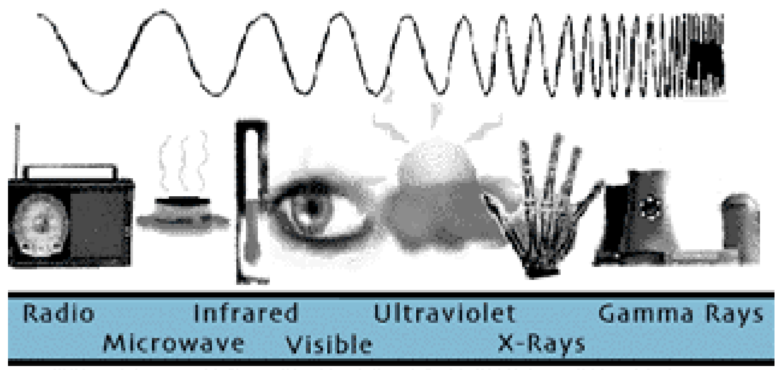
Students plot data on a graph.

OBJECTIVE:

1. Investigating different types of waves.
2. Distinguishing between electromagnetic and physical waves.

VOCABULARY:

electromagnetic
energy
physical
transverse
wave



electromagnetic waves

MATERIALS:

slinky
rope
eyedropper
pan of water
radiometer
radio

BACKGROUND:

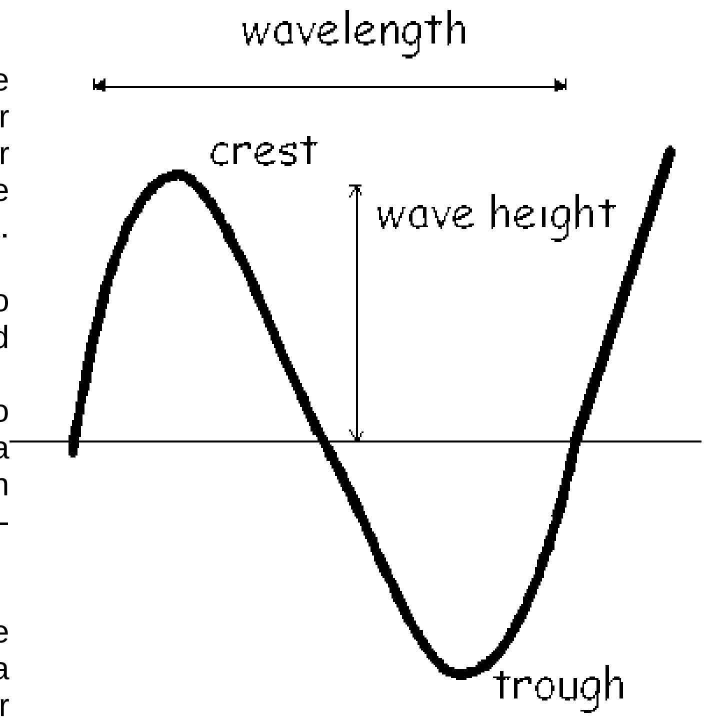
There are many waves generated by the release of energy but the two major types of waves are physical and electromagnetic. Physical waves need a medium to go through, and electromagnetic can go through many substances including a vacuum. They can best be described by their structure.

The more students review the different types of waves, the easier it will be for them to recognize the differences. You will be demonstrating the 2 major types of waves: electromagnetic and physical. The main point to stress is that sound is a physical wave, and light, microwaves, television and radio waves are all electromagnetic.

The term "wave" refers to both physical and electromagnetic. The different components include; the crest (top of a wave); trough (bottom of the wave); wave height (how high is the crest); and wavelength (distance from crest to crest or trough to trough). These terms even apply to the waves produced in oceans.

Waves are essentially a way in which energy can be transferred from one place to another. These concepts will be developed in high school physics.

PROCEDURE:



1. Discuss with students the components of a wave, whether physical or electromagnetic. Go over crest, trough, wavelength, and wave height, defined by the figure to the right.

2. Explain that there are two major types of waves, physical and electromagnetic.
Physical waves must have a medium to transfer energy, like water, a rope, or a slinky. An electromagnetic wave can go through a vacuum, like light or x-rays.

3. Demonstrate a physical wave by using a slinky. One student holds a slinky on one end. The teacher stretches the slinky about 2-3 feet. The teacher will transmit energy by pulling back several of the coils and then releasing them. The movement will be a push-pull or compressional wave. Instruct students to record what they see.

4. Demonstrate another example of a physical wave using a rope. Tie the rope to something stationary. From the opposite end, one student will hold the loose end of the rope and transmit energy by snapping his wrist toward the stationary end of the rope. Have students record the movement of the rope. This illustrates transverse (or shear) waves, a physical wave.

5. Using an eyedropper and a pan of water, drop water into a pan of water very slowly. Record the movement of the water's surface. These are physical waves.

6. If you have a radiometer, place it in the sun. Record what happens. Notice that the black and white panels move around. The electromagnetic waves of light are hitting the white panel and pushing the panels. It also demonstrates that light waves have a physical component, pushing is a mass effort. The mass of the light waves reflecting from the white surface cause kinetic energy derived from the potential energy.

7. Turn a radio on, and ask students where is the music coming from. Turn it off. Why doesn't the room fill with music if radio waves are all around? The radio concentrates radio waves. Make sure the students realize that the sound produced is not the actual radio waves.

Conclude that electromagnetic waves can travel through a vacuum and physical waves cannot. Sound waves are visible and some electromagnetic waves are invisible.

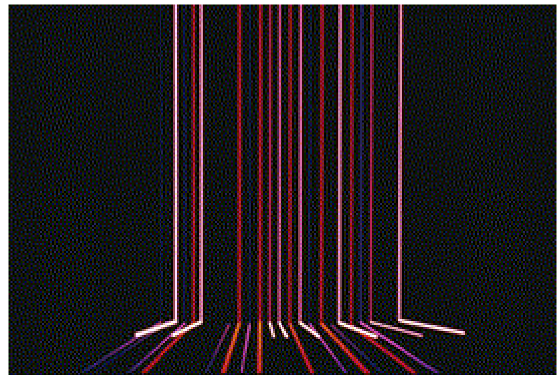
APPLIED SCIENCE - PHYSICS (5A)

LAB

Students determine types of waves generated by different items.

OBJECTIVES:

1. Distinguishing between electromagnetic and physical waves.
2. Comparing diffraction, reflection and refraction.



VOCABULARY:

diffraction
interference
reflection
refraction
wave

MATERIALS:

Applied Science - Technology (5A) or items listed in lab sheet
laser
flashlight

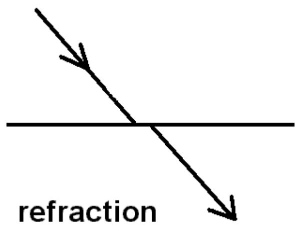
BACKGROUND:

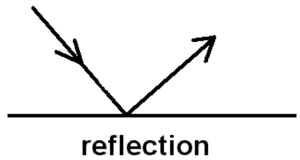
Waves are a means by which energy travels. Many different particles move in waves. The waves on an ocean are physical waves caused mainly by wind. Light is an electromagnetic wave caused by excited electrons. The movement of a wave is complicated, but both electromagnetic and physical waves use similar ways to describe the motion. Both electromagnetic and physical waves reflect, refract and diffract energy. These properties of wave motion are important because they explain how waves move. Waves (both physical and electromagnetic) if controlled, can produce products we use in our society. The phone, television, radio, microwaves, CD players, lasers, video players and many other items are products produced by understanding these waves. The details in these lessons emphasize the importance of understanding waves.

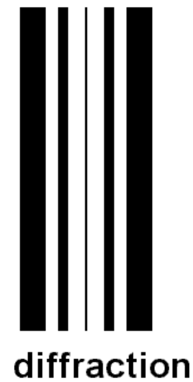
Diffraction is when a wave goes through a small hole and has a flared out geometric shadow of the slit. Diffraction is a characteristic of waves of all types. We can hear around a corner because of the diffraction of sound waves. For instance, if a wall is next to you when you yell, the sound will parallel the wall. The wall may stop, but the voice doesn't; sound will almost turn the corner of the wall. This is diffraction.

Reflection is when waves, whether physical or electromagnetic, bounce from a surface back toward the source. A mirror reflects the image of the observer.

Refraction is when waves, whether physical or electromagnetic, are deflected when the waves go through a substance. The wave generally changes the angle of its general direction.







PROCEDURE:

In this lab, students determine which situation illustrates diffraction, reflection, and refraction. Discuss the main definition of each term. Have students go to the different stations, perform the activity, and decide which motion the waves are producing.

The following will help in setting up stations.

1. Fill a clear glass partially with water and put a pencil or other type of rod in it. Instruct students to look at the side. The students will see an off-centered pencil. The light is being refracted by the water, so our eyes see the pencil in two different mediums. Answer: electromagnetic (light); refraction

2. Make 3 sets of slits with a razor in a sheet of aluminum foil (like diagram). Put the laser in a darkened corner with a box on the top (so students won't stare at the light). Instruct students to put each of the slits in front of the light and record what they see. The light will get elongated which illustrates that the light is actually diffracted or "flaring outward." Where the slits are double, the light will have bright and dark areas. This is called interference. Do not expect students to know what actually causes this. Answer: electromagnetic (light); diffraction

3. Instruct students to hit the tines of a tuning fork and place the tines on the surface of the water. Waves will move from the center of vibration. Notice that the pattern spreads from the center and causes little ripples. This shows not only diffraction but also interference similar to that in station 2. Answer: physical wave; diffraction

4. Using a spoon, instruct students to hit the surface of the water in a pan of water. The ripples should be large enough to hit the end of the pie tin and reflect backwards. However, students might only see the spreading outward and call this diffraction. Answer: physical wave, reflection and/or diffraction (students should justify answer)

5. Instruct two students extend the slinky in a straight line about 1 meter. One

student should push back several of the coils and then release them. The waves will go down the slinky and reflect from the other end and bounce back. Answer: Physical wave, reflection

6. Instruct two students to extend the rope. One should snap their wrist to create an oscillating wave. The wave reflects backwards when it hits the other student. Answer: physical wave, reflection

7. Instruct students to shine a small beam of light through a prism. If the light is angled correctly, they should get a rainbow effect. Also, put the prism on the laser light. (This shows the refraction better). Answer: electromagnetic (light); refraction

8. Instruct students to shine a light on a mirror. (Students may also try the laser light). The light bounces off. Answer: electromagnetic (light); reflection

9. If a beam of light is shone through a lens, the light will refract through the lens and create a different size image on the other side. Answer: electromagnetic (light); refraction

10. The yo-yo, if used correctly, will make a sound. This sound moves through the air. If the students look at the yo-yo, they will notice that there are different colors when viewed at different angles. This is because there are thin slits on the yo-yo that diffract the light into the different components of the spectrum. Answer: both physical (sound) and electromagnetic (light); diffraction of light and sound

APPLIED SCIENCE - PHYSICS (5A)

PROBLEM: How can you distinguish between diffraction, reflection, and refraction of waves?

PREDICTION:____

____

PROCEDURE: Go to the different stations and determine if the wave is physical or electromagnetic. Perform the activity and determine whether you are showing diffraction, reflection or refraction. Remember LASER SAFETY.

	PHYSICAL OR ELECTROMAGNETIC	DESCRIBE MOTION
STATION 1. Pencil in glass of water		
STATION 2. Use laser-slits in aluminum foil 0, 2 and 5 mm apart		
STATION 3. Tuning fork in pie tin half full of water		
STATION 4. Spoon hitting surface of water		
STATION 5. Slinky motion (push pull)		
STATION 6. Rope oscillating		
STATION 7. Flashlight through prism		
STATION 8. Mirror		
STATION 9. Flashlight through convex lens		
STATION 10. Turbo yo-yo		

CONCLUSIONS: How did you detect the different type of wave motion?

____

____

APPLIED SCIENCE - PHYSICS (5A)

POST LAB

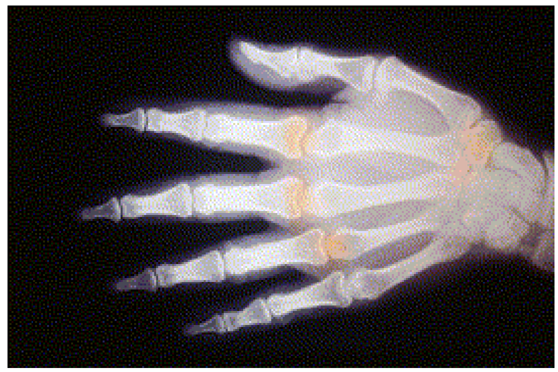
Students find the frequency of different components of electromagnetic wave spectrum.

OBJECTIVES:

1. Interpreting the electromagnetic wave spectrum.
2. Exploring the components of electromagnetic waves.

VOCABULARY:

frequency
gamma rays
infrared waves
micro waves
radio waves
ultraviolet waves
wave
x-rays



X-ray of hand

MATERIALS:

worksheet

BACKGROUND:

Electromagnetic waves are all around us and range from common light to radio waves and gamma rays. These waves are related to electricity and magnetism in that both sources produce these waves. All substances have a positive and negative side, no matter how big or small they are. Two positives or negatives repel each other, while positives and negatives attract each other. Atomic particles are constantly being hit and deflected. As the world is made up of negatives and positives, energy is constantly being generated. It is like a "bumper car" game. Electromagnetic waves are the consequence of all this bumping. It is difficult to understand this concept, but students need to become familiar with the terms to facilitate their understanding at a later time.

These waves act like the waves we have already seen. Unfortunately, we cannot see the wave motions with our eyes. When an electromagnetic charge is suddenly displaced, a ripple of electric and magnetic force is generated in the same manner in which water ripples are formed by dropping a pebble. Electromagnetic waves, unlike sound (physical) waves can move through a vacuum for they do not require a medium for their existence. They are waves of force.

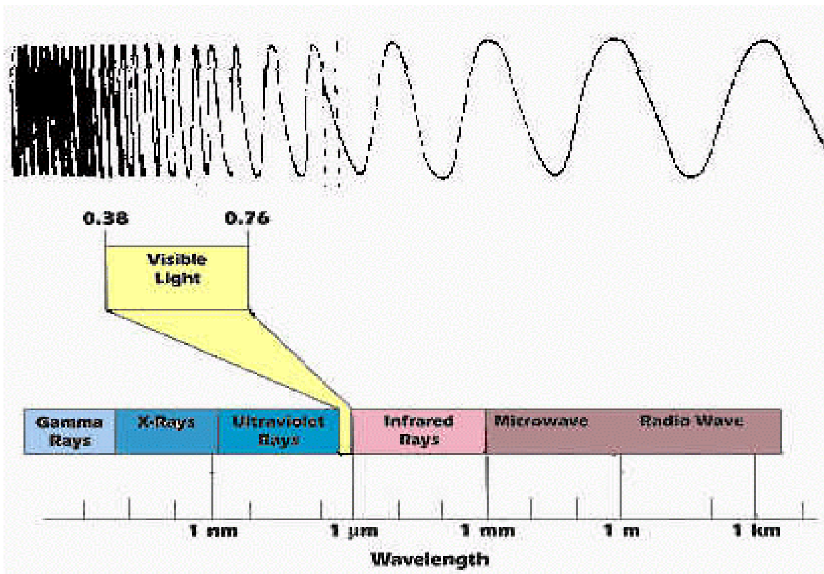
This activity tries to show the variety of waves that are included in electromagnetic waves. Familiarize students with the terms. Many of your students know about these waves, they just don't connect how they are related.

Radio waves' wavelength are the longest wavelength. On a radio, the channels refer to the frequency. There are two common ways to transmit radio, AM (amplitude modulation) and FM (frequency modulation). Modulation refers to how the wave is varied through its transmission. AM varies its amplitude (strength), while FM varies its frequency.

Television waves have shorter wavelengths than most radio waves. Television is transmitted from distant stations. The television at home picks up these waves and interprets them for us to see. There are UHF and VHF components of television waves.

Microwaves have a higher frequency and as their name suggests, have smaller wavelengths. Microwaves are used not only to cook but also in the communication industry.

Infrared waves are even smaller and are known for their use in detecting heat. A cat's eye can detect infrared light that is why they say a cat sees in the dark. Their eyes detect what human eyes cannot.



Visible light is the spectrum that we are most familiar with. Visible light can be broken into the colors of the rainbow, because each of the colors has a different wavelength and frequency.

Ultraviolet light is known to be harmful to human skin. It is the ozone layer that helps protect us from these rays. However, ultraviolet light can also help kill harmful bacteria.

X-rays are known for their use in viewing inside our body. X-rays can go through soft matter and can outline hard matter. The many uses for X-rays are still not completely known.

Gamma rays and cosmic rays are at the extreme right of the spectrum. Scientists are still trying to unravel their mysterious powers. The rays seem to be very powerful when concentrated, but only the future knows how they will be useful in our society.

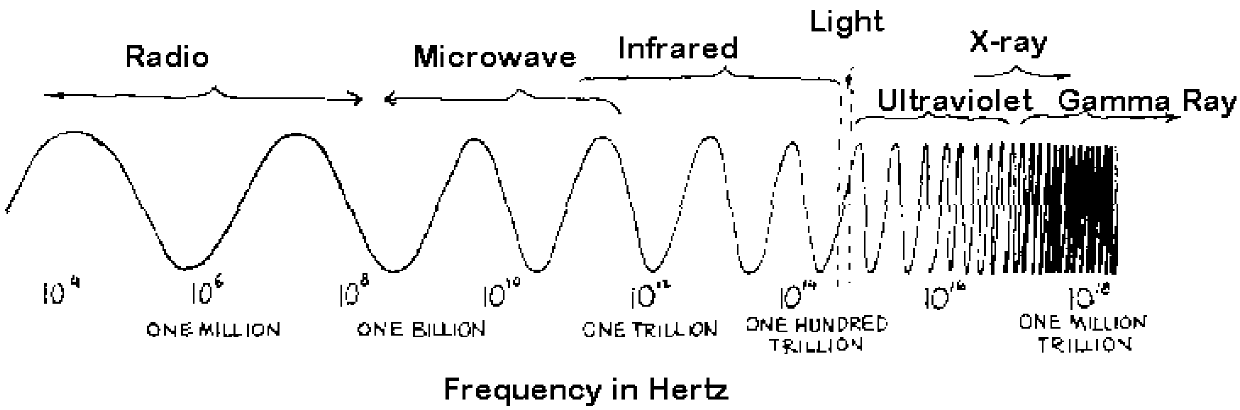
PROCEDURE:

1. Instruct students to use the worksheet to discover the parts of the electromagnetic wave spectrum.

ANSWERS: 1. gamma and cosmic rays; 2. Television and radio waves; 3. Visible light; 4. Sound wave, it is not an electromagnetic wave but a physical wave; 5. Microwave ovens, communications; 6.7. broadcasting station

ELECTROMAGNETIC WAVES

The illustrations below demonstrate most electromagnetic waves that we know. Frequency of a wave is the number of vibrations in a given time (measured in Hertz). The higher the frequency the smaller the wavelength, the lower the frequency the larger the wavelength.



1. Which wave has the highest frequency? ______________________________

2. Which wave has the lowest frequency? ______________________________

3. Which wave can we see? Circle and label this light on the diagram.

____

4. Which wave can we hear? Why isn't this wave on the chart?

____

5. Which wave can take a picture of your bones? ______________________________

6. What uses microwaves? ______________________________

7. Where do television waves come from? ______________________________

8. Where do radio waves come from? ______________________________

APPLIED SCIENCE - PHYSICS (5B)

PRE LAB

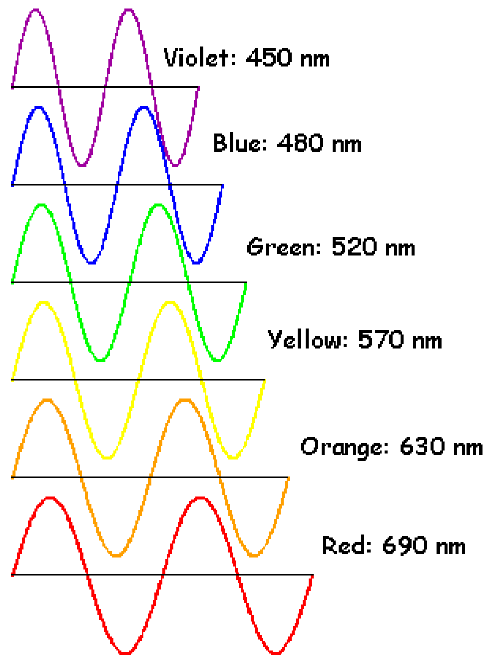
Students determine how light creates illusions.

OBJECTIVES:

1. Discovering the components of light.
2. Observing and explaining optical illusions.

VOCABULARY:

illusion
prism
reflection
refraction



MATERIALS:

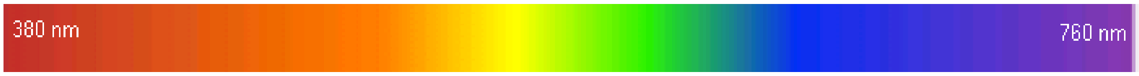
waxed paper
eye dropper
water
plastic cup
penny
pencil
water
prism
Internet

BACKGROUND:

Emphasize that this segment concentrates on visible light which is a part of the electromagnetic wave spectrum. Review how light carries energy in tiny packets of electromagnetic radiation called photons. Light travels at 296,000 meters per second or 186,000 miles per second and doesn't need a medium to travel in. All colors of light travel at the same speed, but they have different wave frequencies (short and long waves).

Light can be reflected or refracted. In reflection, light bounces off a surface and is diffused. Light travels in a straight line and refraction is the bending of this light. The light breaks up into different frequencies therefore causing a rainbow or a "broken" look.

This activity demonstrates different components of refracted light. If students do not know the light spectrum, give them the following pneumonic device to help them remember. ROY G. BIV = red, orange, yellow, green, blue, indigo and violet.



PROCEDURE:

1. There are several optical illusion Internet sites. You may want students to look at the following site http://www.illusionworks.com/ , or you may want to print some out and go over the different illusions and discuss why they see them differently. The reason is because the way our eyes detect black and white light.

2. Demonstrate for students the following:

DEMONSTRATION 1. REFRACTION IN WATER. Place a piece of waxed paper over a printed page. Using an eye dropper, put a few drops of water on the waxed paper and observe. Ask students to describe what happens. The drops of water act as a lens and refract the light which distorts the image.

DEMONSTRATION 2. ILLUSIONS (REFRACTION). Place a penny underneath (not in) an empty plastic cup. The penny should be visible through the side of the cup. Looking into the cup, keep your eye on the penny as your partner slowly pours water into the cup. (Be sure not to move your head). Ask students what happens. The penny appears to be in a different position. Immerse a pencil in the plastic cup of water. Look at it from the side, it appears to be broken. Another illusion!

DEMONSTRATION 3. REFRACTION IN A PRISM. Light is bent twice when it passes through a prism and the separation of color is quite noticeable - a rainbow. The prism separates the frequencies of light, so a rainbow appears. What colors can you separate from the white light? If your classroom has bright sunlight that is a good source of light; otherwise use a flashlight. Light must be shone correctly through a prism in order to get a rainbow.

APPLIED SCIENCE - PHYSICS (5B)

LAB

Students make a kaleidoscope.

OBJECTIVES:

1. Investigating how kaleidoscopes work.
2. Exploring properties of light.

VOCABULARY:

kaleidoscope
mirror
reflection
symmetry

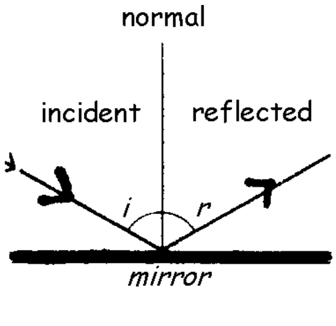
MATERIALS:

silver mylar
3.4 oz plastic portion cup
small colored beads or any other small bright objects
tape
toilet paper tube
paper towel

BACKGROUND:

Kaleidoscopes use the principles of symmetry and reflection to create brightly colored displays. A simple arrangement of mirrors produces multiple images of objects giving the effect that there are more than one object in an area. Reflection is when light bounces off a surface at the exact angle it enters.

PROCEDURE:



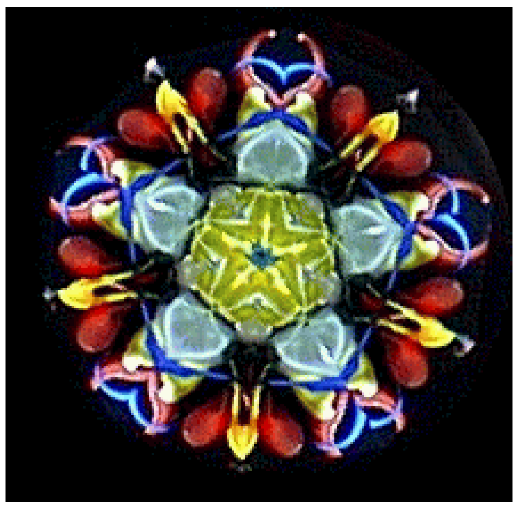
1. Draw the diagram on the right on the board. The ray of light that enters is called the incident ray and the ray that leaves is called the reflected ray.

2. Ask students where they have seen evidence of reflection. Perhaps they will mention seeing one in a mirror or shiny surface, or the reflection in a pond or lake. Make a list of their encounters with reflection. Ask students what is unique about a surface that gives good reflections; a polished, smooth surface is the best. A

rough surface creates many reflections causing a blurry image.

The POST LAB goes over the reflection that occurs in a kaleidoscope the students have made. The lab centers around students making their own kaleidoscope and then comparing theirs to others in the lab to try and find out why they work. The only differences between the kaleidoscopes are the colors being reflected. Instruct students to compare theirs with a manufactured kaleidoscope provided in the module.

3. The directions for making a kaleidoscope are on the student's lab sheets. Students should notice there are 3 sections they see when looking through a kaleidoscope. Students will put beads or other transparent items small enough to fit into their kaleidoscopes. When the lab is completed, have students return the beads and small items. Conserve as much as the material as you can. The image will be blurred if the mylar is not straight. The students should see 3 sections when they look into these kaleidoscopes. They should conclude that reflection makes a kaleidoscope work. If students want to keep their kaleidoscopes, they can find items at home to put in it.



APPLIED SCIENCE - PHYSICS (5B)

PROBLEM: How does a kaleidoscope work?

PREDICTION:____

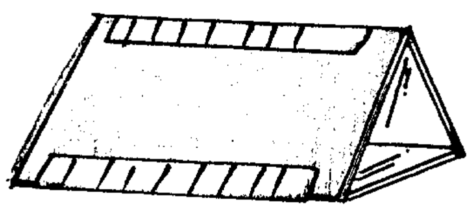
PROCEDURE: Materials: ruler, tape, silver mylar sheets, 3/4 oz plastic cup, toilet paper tube, paper towels

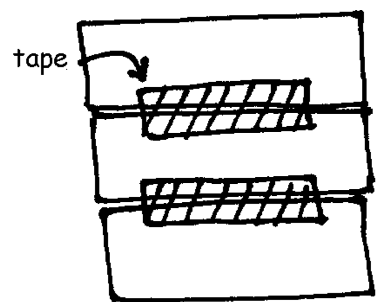
1. Measure 3 pieces of 2.5 cm by 10 cm piece of silver mylar that your teacher will provide. If you have a different size tube consult your teacher. Join the 3 pieces of silver mylar into a triangular prism. MAKE SURE YOU PUT THE SHINY SURFACE INSIDE. Tape the triangular prism together. (see picture below)

2. Put a small number of colored beads or any other materials in the plastic cup. Record what you put in your kaleidoscope. Position the cup in one end of the toilet paper tube. Put the lid on the cup.

3. Wrap the triangular prism in paper towel (you may need 2 or 3 sheets depending on the thickness of the towel) so it fits snugly in the tube.

Point the tube toward a light source and rotate the plastic cup as you look through the open end of the tube. You have just made a kaleidoscope. List what and how many items you put in your kaleidoscope.





LOOK AT YOUR KALEIDOSCOPE. Draw what you see in the tube without turning it. How many sections is it divided into?

____

Look through your partners kaleidoscope. Is it different from yours? How?

____

____

CONCLUSION: Why do you think a kaleidoscope works. Explain?

____

____

____

APPLIED SCIENCE - PHYSICS (5B)

POST LAB

Students use a worksheet to compare, reflect and refract.

OBJECTIVES:

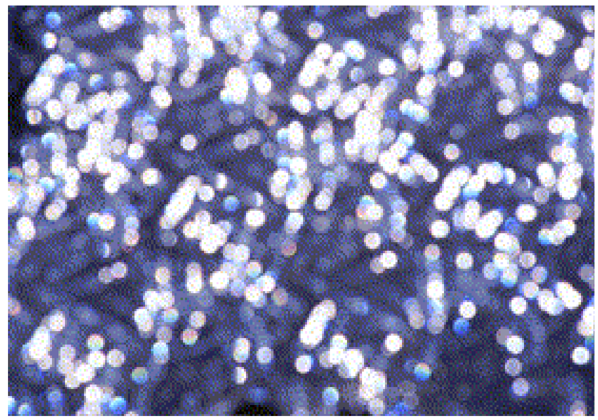
1. Comparing reflection and refraction.
2. Analyzing optical images.

VOCABULARY:

image
reflection
refraction

MATERIALS:

worksheet



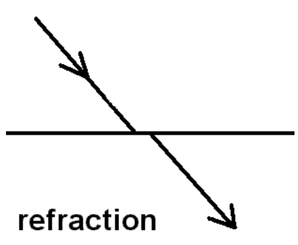
Refraction of light

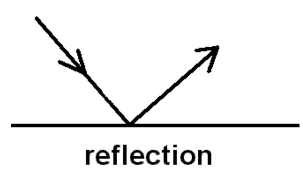
BACKGROUND:

When light hits a surface, part of the light is reflected. On a clean and polished metallic surface almost 100 percent of incident light is reflected, while on a surface of clear glass only a small amount is reflected. When light bends as it passes from one medium to another, this is called refraction.

PROCEDURE:

1. Draw the following diagrams on the board to illustrate both principles.



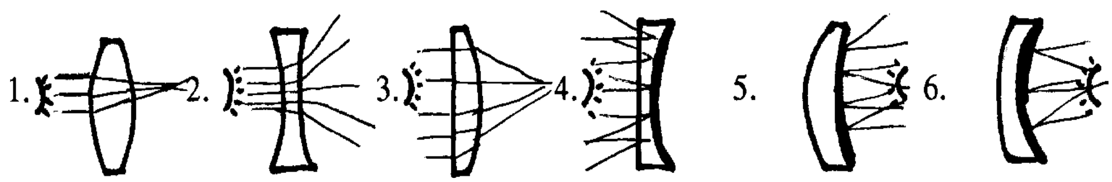


In the kaleidoscope that students made, reflection produces the images. Not all flat surfaces reflect as well as others. Aluminum foil in a kaleidoscope does not work as well as Mylar because aluminum is not as reflective as Mylar. Mylar is not as good as a mirror which has a backing of a silver compound.

2. Introduce how different lenses can move light by either refraction or reflection. Different lenses can control the type of picture we take or even how we see. Go over the different shapes of the lenses as shown in the worksheet. Introduce the terms biconvex, biconcave, plane convex, planar concave, meniscus convex, and meniscus concave which just refer to their shape.

3. Instruct students to try and figure out how light will react in each of the different situations. Remind students to look for a mylar surface. This will determine whether the light is reflected or refracted. The color and the clarity of the lens also determines if all light passes through or if some is refracted.

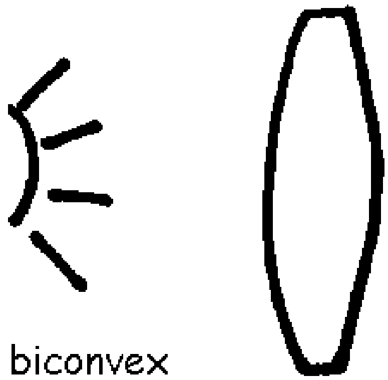
ANSWERS:



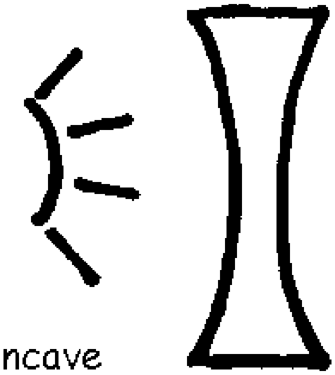
APPLIED SCIENCE - PHYSICS (5B) POST

REFLECT OR REFRACT?

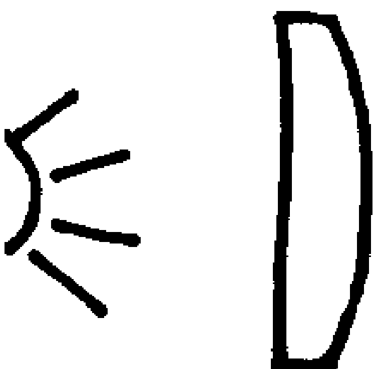
Trace the path of light from the different lenses. Note where the light source is and if there is mylar. Remember mylar will reflect light.



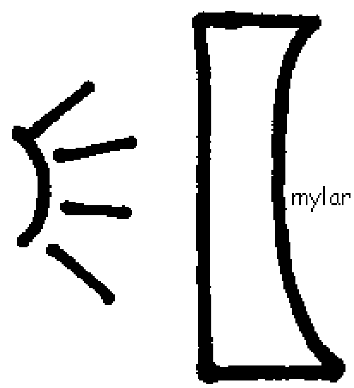
1. biconvex



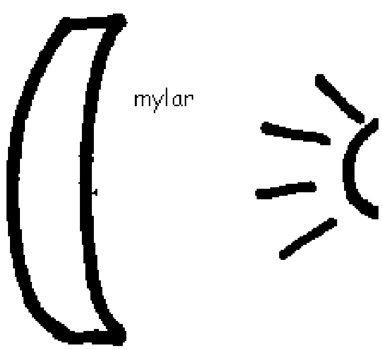
2. biconcave



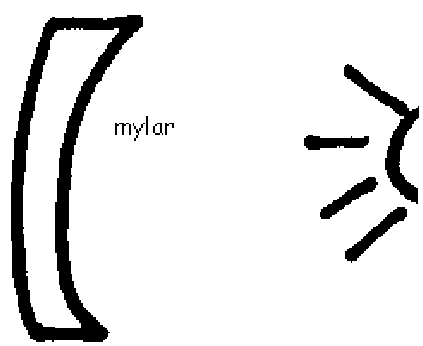
3. planar convex



4. planar concave



5. meniscus convex



5. meniscus concave