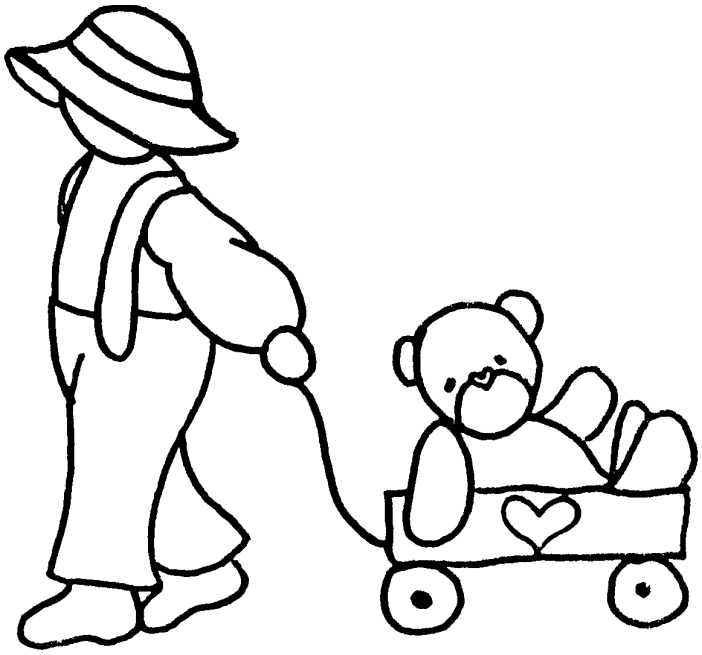
Applied Science

Our Technological World

FIFTH GRADE

TECHNOLOGY



3 WEEKS
LESSON PLANS AND
ACTIVITIES

SCIENCE AND MATH
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.*

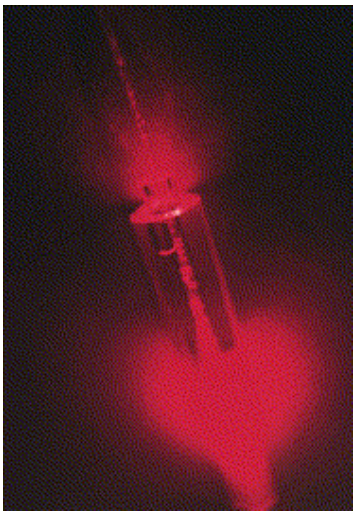
APPLIED SCIENCE - TECHNOLOGY (5A)

PRE LAB

Students plot data on a graph.

OBJECTIVES:

1. Exploring how lasers work.
2. Distinguishing between incoherent and coherent light.



VOCABULARY:

coherent
incoherent
lasers

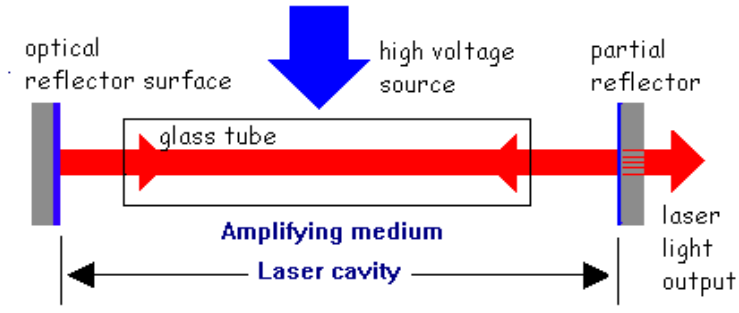
MATERIALS:

worksheet
Internet

BACKGROUND:

Lasers excite children as well as adults. Lasers are used in the check out stand at the grocery store, in surgery, and in measurement. However, many people do not know what lasers are and how they operate. In this activity, students are introduced to lasers by reviewing light and going over the properties of light that help lasers work. In lab, students will look at lasers more closely.

Lasers are basically excited light waves. Light is a component of the electromagnetic wave spectrum. The name itself stands for ***L****ight* ***A****mplification by* ***S****timulated* ***E****mission of* ***R****adiation.* Students must first understand two terms: coherent and incoherent light. Light emitted by normal means such as a flashlight or a bulb, is incoherent or the photons of the many wave frequencies of light are oscillating in different directions. It is not a stream of light. Coherent light is a beam of photons (almost like particles of light waves) that have the same frequency and are all at the same frequency.



Movement of light in a laser.

Only a beam of laser light will not spread and diffuse. In lasers, waves are identical and in phase, which produces a beam of coherent light. There are many types of lasers that use gases such as helium, neon, argon, and carbon dioxide. Lasers also use semiconductors (Galiodium and Arsenic), solid-state material (ruby,

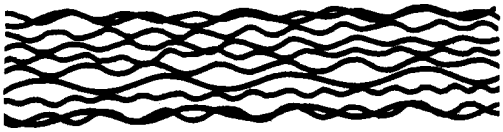
glass), and even chemicals (hydrofluoric acid) in their operation.

With the cavity of the laser the beam of light is reflected back and forth along the central tube, until the waves of light become coherent.

PROCEDURE:

1. Draw the following diagrams on the board to illustrate coherent and incoherent light waves. Lasers themselves are not a source of energy, they simply convert the energy of a particular source.

Coherent light wave pattern

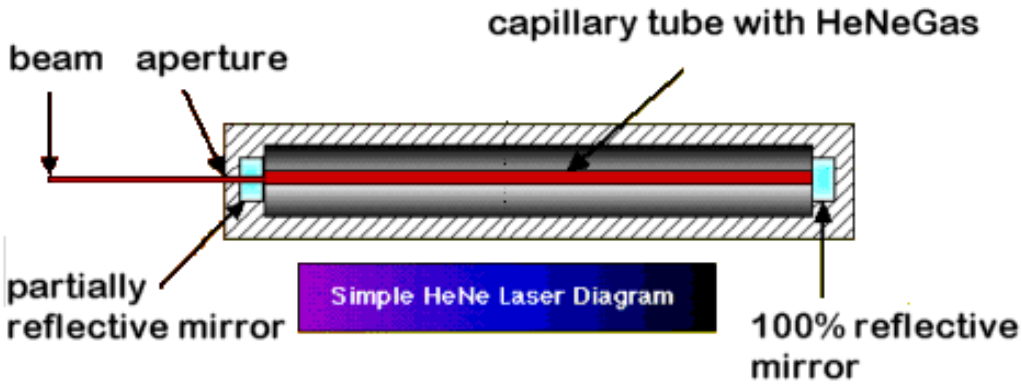


Incoherent light wave pattern

2. Searching the web for information on Lasers can be exhausting if you use the "adult" search engines. The subject matter in the adult search engines will give you career and industry information, which is too difficult for young students. We suggest using a children's search engine like http://www.yahooligans.com . This search engine with give students sites that may help them understand what lasers are all about. As the students are filling in the worksheet, have them search the web if they wanted to learn more about lasers.

APPLIED SCIENCE - TECHNOLOGY (5A)

Lasers are neat! It almost seems like the photons of light have joined together to make a powerful and beautiful tool. The term “laser” really is a condensed word meaning: **L**ight **A**mplification by **S**timulated **E**mission of R*adiation.*



The above picture shows how light from helium and neon can become a laser light. Can you explain?

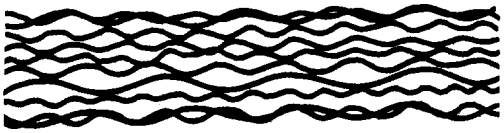
_____
_____
_____

List some places or items where you may have hear the word laser and write them down.

_____
_____
_____
_____

Which one of the following is the type of pattern generated by laser? Which one is produced by sunlight? _____
_____

Coherent light wave pattern



Incoherent light wave pattern

APPLIED SCIENCE - TECHNOLOGY (5A)

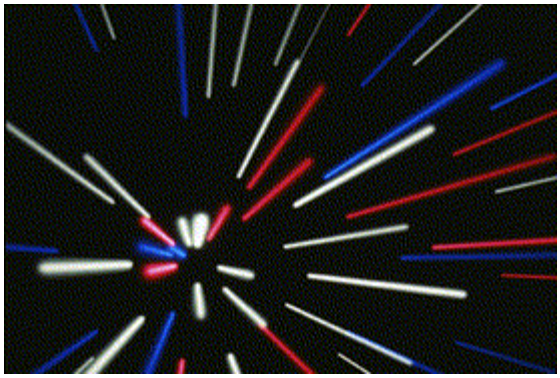
LAB

Students experiment with light using lasers and flashlights.

OBJECTIVES:

1. Comparing light from a laser with a flashlight.
2. Exploring other types of electromagnetic waves.

VOCABULARY:



crest
electromagnetic
frequency
light
trough
wavelength

MATERIALS:

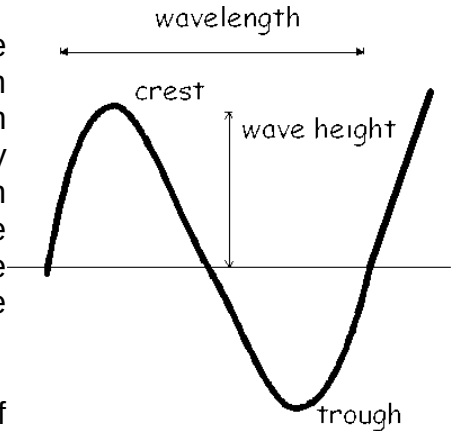
Applied Science - Physics (5A) or
prism, quartz, mirror, cube magnifier, convex lense, ulexite per station
laser
flashlight

BACKGROUND:

Visible light is only a small part of the entire electromagnetic wave spectrum, as shown in the diagram below. In nature, waves differ in frequency and wavelength, however all have the same speed (186,000 miles per second or 296,000 meters per second).

PROCEDURE:

1. Illustrate the parts of a wave in the electromagnetic spectrum. An electric field radiates from every substance in the form of these waves. Wavelength refers to the distance between crest to crest; frequency refers to the number of times the wave cycles in a given time. The shorter the wavelength, the higher the frequency. The longer the wavelength, the lower the frequency. The waves of the spectrum reflect the difference in frequency.



2. Using the material in the module, give a group of

students a flashlight and one prism, quartz, mirror, cube magnifier, convex lens, ulexite, and calcite. Students should shine the light through the items to see what the light does. Have them draw a picture of what they see. The room must be dark in order for the students to observe the phenomena. Repeat the activity with a laser and compare the differences. The laser light is sharper than light from the flashlight. In an upcoming lab, students will look at a laser in more detail. Have students become familiar with the laser and go over the instructions for safety. LASERS ARE NOT TOYS!

3. Conclude that light can be modified by different mediums. Convex lenses will concentrate the light, mirrors will reflect the light. The flashlight will make the quartz shine, but the laser will almost irradiate it. When shown through calcite, the laser will double the light, however the flashlight will not produce any doubling. The laser light will go through the ulexite, but the flashlight will not. This may vary some with the materials and the light source you use. Students will learn more about the laser in the post lab. This lab serves to illustrate that there is a difference between laser light and flashlight light.

4. The answers are dependant on the individual specimens. The key objective is to observe laser and incoherent light.

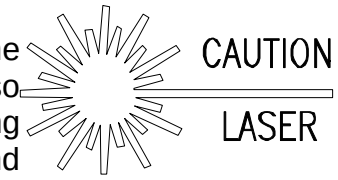
APPLIED SCIENCE - TECHNOLOGY (5A)

PROBLEM: Is there a difference between light from a laser and a flashlight?

PREDICTION: _____

MATERIALS: lens, prism, cube magnifier, ulexite, quartz, mirror, laser, flashlight

PROCEDURE: IF YOU ARE USING THE LASER, LISTEN TO YOUR TEACHER'S INSTRUCTIONS. LASERS ARE NOT TOYS AND MUST BE HANDLED WITH CARE. DO NOT STARE AT LASER LIGHT!



Shine the light of the flashlight through your items. If the room is not dark, use a black piece of paper as the backing so your images will show up. Record what you see. If you are using a laser, shoot one of the beams through the same material and draw what you see in the appropriate space below.

ITEM	FLASHLIGHT	LASER
PRISM		
QUARTZ		
ULEXITE		
CUBE MAGNIFIER		
MIRROR		
BICONVEX LENS		
CALCITE		

CONCLUSION:_____

APPLIED SCIENCE - TECHNOLOGY (5A)

POST LAB

Students research the uses of lasers in our society.

OBJECTIVES:

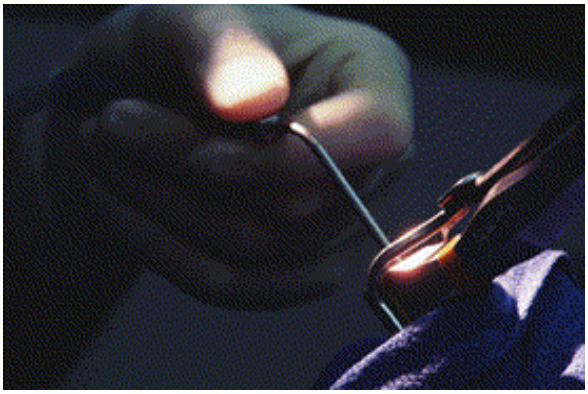
1. Exploring the uses of lasers.
2. Predicting future use of laser technology.

VOCABULARY:

hologram
laser

MATERIALS:

Internet
holograms (green, red, etc)
worksheet



Surgery using a laser

BACKGROUND:

The list of practical applications for the laser is growing rapidly. Laser's properties have practical uses in measurement and are used by many people from surveyors to machinists. When engineers were constructing the Bay Area Rapid Transit system, lasers were used to line up the dredging equipment for the underwater tunnel in San Francisco Bay. Laser beams have also been bounced off reflectors on the moon to provide information about the movement of the Earth's crust. Eye surgeons use lasers to "weld" detached retinas back into place without making an incision. The laser is simply brought to focus in the region where the welding is to take place. Lasers are used to measure the speed of light in a laboratory. They can also measure distances on a street or movement along an earthquake fault. In grocery stores, the bar code pattern is read by a laser to decode the price of the product. Nearly all major sewer pipe and storm drain pipe installations are aligned using helium-neon lasers. In the auto business, lasers are used for wheel alignment. In biology, lasers are used to measure blood cell diameter. The applications are unlimited.

Lasers are also used to make holograms. Holograms are three-dimensional pictures, which when illuminated, produce images so realistic that the sides of objects can also be seen. Let students observe how a hologram is made when laser light is used to take a picture of an object. Laser light is projected on a photographic plate to produce these images.

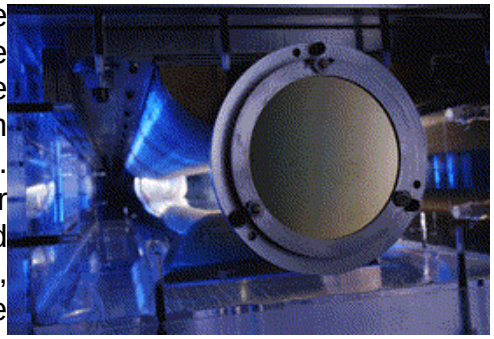
Helium-neon lasers are the cheapest visible light presently available and is used in a supermarket scanner. The laser is scanned across a bar code on a package which is detected by the laser as 0 and 1. This is a language the computer (cash register) can

interpret to represent the price of the package. Semiconductors are also used to produce lasers with invisible light. Home entertainment systems use the optical disc to provide digital audio or video signals. Information is stored by using a laser beam to punch a series of holes in reflecting layers. In the disc player, a semiconductor laser output is reflected from the disc to a detector. The pattern of holes is converted to a digital signal that contains the coded audio information. Semiconductors also are used in laser printers. Carbon dioxide lasers are used for cutting and heating. Argon lasers are used in the medical profession.

PROCEDURE:

1. Show students the different holograms. These were all created by different lasers. If you view them in natural light, the holograms stand out more.

2. Talk about the uses of lasers. Lasers are used in the grocery store to cutting steel. Use the Internet to search for companies that use or produce lasers. Search under "laser" for general information in the "adult" search engine, like http://www.yahoo.com. Students will find a host of products that use laser technology. Have them list the products that they find on the worksheet. Laser technology changes rapidly, with new products being developed all the time. Make students as familiar with lasers as you can. They are in your students' future.


Laser laboratory

3. On the worksheet it shows the how lasers are used in making holograms, which is just a "3D" picture on a piece of holographic film. Taking the picture is more involved than using a camera. The laser helps to define the object better. Show students the different holograms, which are created through different film.

APPLIED SCIENCE - TECHNOLOGY (5A)

FIND DIFFERENT TECHNOLOGIES THAT USE LASERS?

Use the Internet to search “lasers” and list the different products that you can find.

_____
_____
_____
_____
_____
_____

Many of you have seen holograms. Many stickers that “flicker” are actually holographic images. There are artists that specialize in holograms. Holograms are made by lasers. But how are they made. Search the web for “holograms” and see if you can understand what and how holograms are made. The picture and information below were found searching the web. After your search, see if you can explain how a hologram is made with your own words. Write them down in the space provided.

HOW IS A HOLOGRAM MADE?

The custom artwork is then sent to our holography laboratory where the holographer creates and combines the necessary photographic and holographic elements to produce a "master" hologram on special photosensitive emulsions.

As with all holograms, the multidimensional image is recorded as a unique "interference pattern" which is created using laser light and precision optical techniques.

_____
_____
_____
_____
_____
_____

APPLIED SCIENCE - TECHNOLOGY 5B

PRE LAB

Students use a worksheet to compare microscopes.

OBJECTIVE:

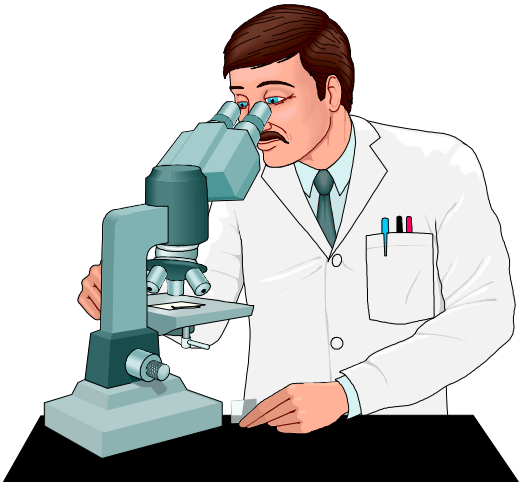
1. Comparing and contrasting the different parts of the microscope.
2. Exploring how light helps view objects.

VOCABULARY:

refraction
reflection

MATERIALS:

worksheet
Swift GH microscope

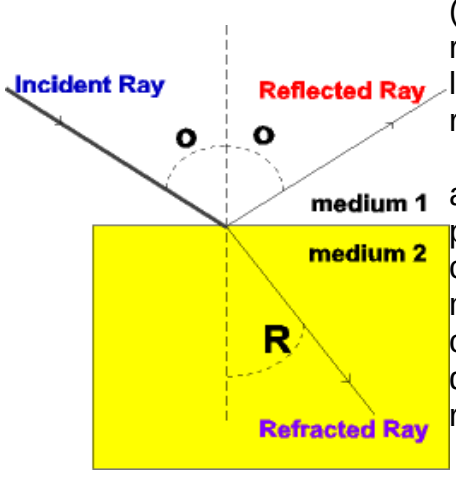


BACKGROUND:

The lens system classification divides the microscope into simple or compound microscopes. A simple microscope consists of a single lens or several lenses grouped in one unit and is only used to enlarge an object. The lens system ranges from double convex to two plano-convex lenses. Examples of simple microscopes include reading glasses, jewelry eyepieces, and pocket magnifiers.

A compound microscope includes an eyepiece and one or more objectives where the eyepiece enlarges the resolved image created by the objective. There are a series of different types of lens within the optic tube. Resolved images actually enlarge and add detail to the observed object.

There are two types of compound microscopes that use light to observe transparent (or translucent) and opaque objects. An opaque object requires light that reflects from the object through the lenses in the optic tube. This type of microscope is referred to as a "dissecting" or reflecting" microscope.

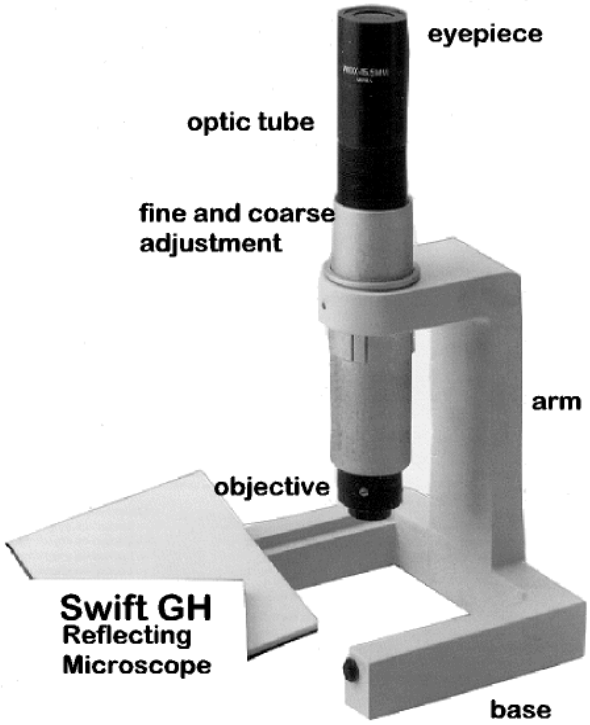


A microscope that uses the light to transmit through a transparent object up the ocular and eyepieces uses the principle of refraction (diagram to the left). Light from a condenser goes through an object that is mounted in a medium. The object and the medium must provide contrast (called index of refraction) so that you can distinguish the medium from the object. These are usually referred to as transmitting light microscopes.

PROCEDURE:

1. Go over the components of a transmitting light microscope using the worksheet. The components that should be pointed out are the eyepiece, objective, optic tube, adjustment mechanism, base, stage, condenser, and arm. Have the students compare the transmitting light microscope with the Swift GH. Students should answer the questions on the worksheet. Use the Swift GH to point out the reflecting microscopes do not have condensers. Refer to the figure of the Swift GH below.

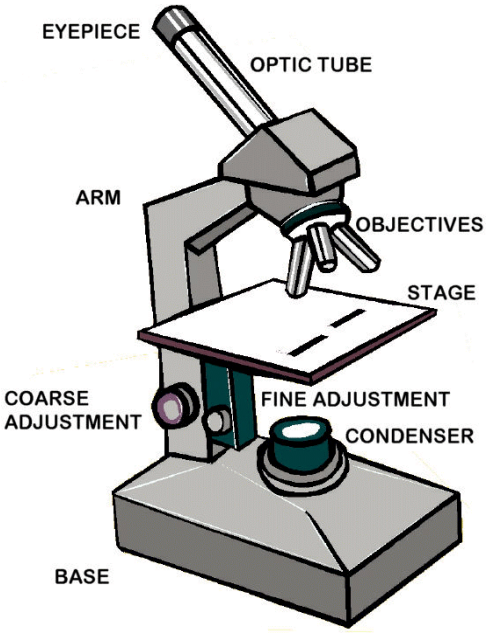
adjustment mechanisms - an apparatus that moves the optic tube up and down to focus on the specimen
arm - portion of microscope that connects the body to the base
base - a stable bottom for the microscope to stand upright
condenser - a lens or combination of lenses that gathers and concentrates light in a specified direction, under the stage
eyepiece - lenses at the viewing end of a microscope or telescope
objective - lens at the end of a microscope nearest the object
optic tube - a long cylindrical tube that moves up and down to focus on a specimen
stage - a platform on top of the base of the microscope on which specimen are placed



APPLIED SCIENCE - TECHNOLOGY 5B

COMPARING HOW LIGHT IS USED IN A MICROSCOPE

1. Draw the **Swift GH** in the space below and label the appropriate parts.



2. Define the function of the following parts.

ARM	
CONDENSER	
EYEPIECE	
OBJECTIVE	
STAGE	

3. Trace how light goes through an object and through the optic tube of the transmitting light figure and the **Swift GH** figure you drew.

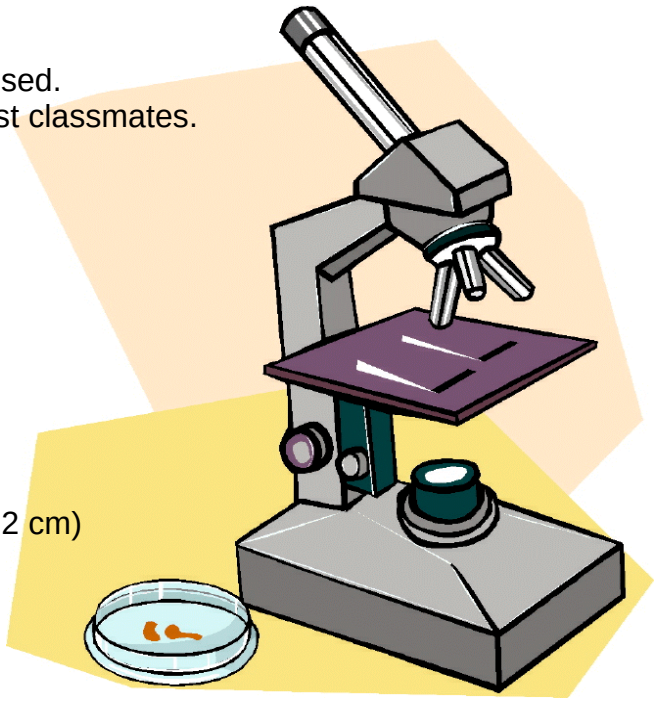
APPLIED SCIENCE - TECHNOLOGY(5B)

LAB

Students determine focal distances

OBJECTIVES:

1. Analyzing how objects can be focused.
2. Comparing focal distances amongst classmates.



VOCABULARY:

focal point
focal distance
optics

MATERIALS:

Swift GH microscope
different objects (range in size 3mm - 2 cm)
biconvex lense
ruler
index card

BACKGROUND:

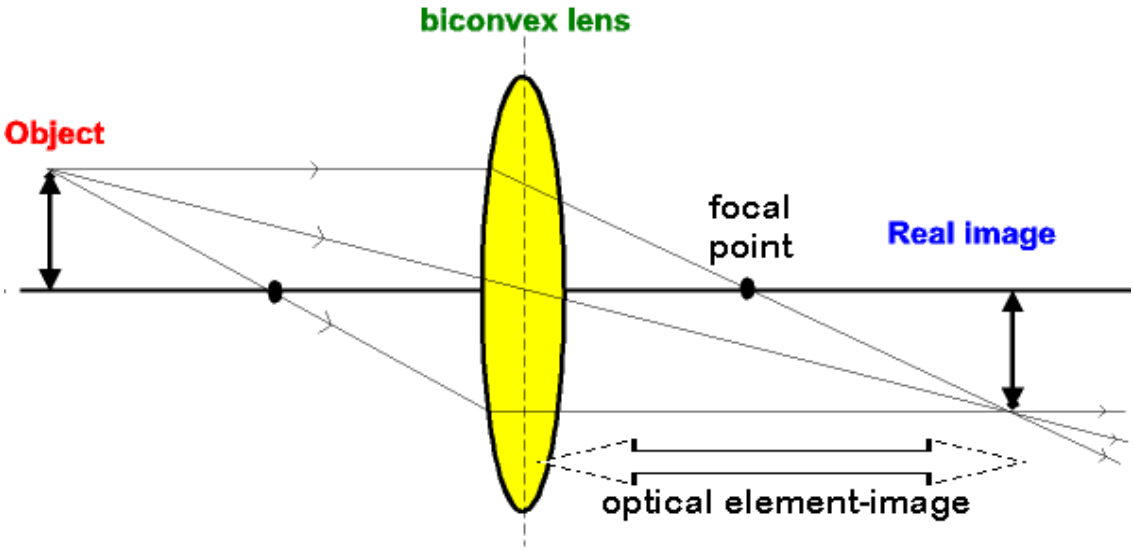
The study of lenses and light is called optics. Students will discover how images can be controlled by lenses to help observe small things. A microscope uses the physics of optics to allow us to see small things our eyes cannot detect. The principles of optics of the Swift GH microscope are the same as those in more complex microscopes. This activity has students discover how far an object must be from the objective. They will learn that this distance for the Swift GH, with a 2.5X objective and 10X eyepiece is 5.5 cm and is constant for all objects.

The focal length or focal distance is the distance between the center of a converging thin lens and the point at which parallel rays of incident light converge; or the distance between the center of a diverging lens and the point from which parallel rays of light appear to diverge. The point at which it intersects the focal plane is called the “focal point.” The distance from the lens to the image is called the “optical element-image distance.”

PROCEDURE:

1. In exercise 1 on the lab sheet, students will find the optical element-distance image. Give each student a biconvex lens and an index card. Have the students create an inverted image on the card by focusing on an object. It will work much better if students stand by a window. See figure which traces the movement of the light. Students should

measure the distance between the lens and the placement of the image in focus. All students should come up with the same answer (5.5 cm) if you purchased the lenses from the Math/Science Nucleus..



2. In exercise 2, students work as partners with a Swift GH. Have each partner determine the distance where an object is in focus using different specimens. Have students measure the distance from the top of the specimen to the objective. The reason for this exercise is to learn the approximate distance from the objective to a specimen, in order for the object to be to be in focus. Provide students with objects like a small block, clothes pin, or other small objects with flat surfaces. Have students record the information on the lab sheet. Compare their information with 2 other groups and determine if the distance is the same for each object.

APPLIED SCIENCE - TECHNOLOGY (5B)

LAB

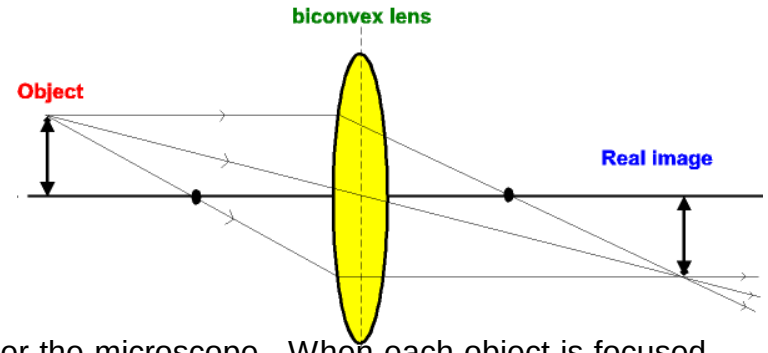
PROBLEM: Do people focus differently using the same objective on the microscope?
PREDICTION:_____

_____

MATERIALS: reflecting microscope, ruler, 5 objects, lens, index card
PROCEDURE:

EXERCISE I. Find the optical element-image distance. Using a convex lens and a source of light (near a window), create an inverted image. Look at diagram below. Measure the distance from the inverted image (or index card) to the lens. Record your answer and compare it with the image your partner found.

YOUR DISTANCE: _____
PARTNER'S DISTANCE: _____



EXERCISE II. Look at 5 objects under the microscope. When each object is focused, measure the distance from the object to the objective. Record the focal distance in the graph below. Compare with 2 other groups and see if the focal distance is the same or not. Write your observations under the conclusions.

Specimen Used	Your Data	Group 1	Group 2

CONCLUSIONS: Is the focal distance the same for all objects? How did you prove this?_____

APPLIED SCIENCE - TECHNOLOGY (5B)

POST LAB

Students use a worksheet to compare the technology of a human eye.

OBJECTIVES:

1. Comparing the optics of the microscope with that of an eye.
2. Discovering how the eye sees.

VOCABULARY:

cones
cornea
iris
light
microscope
optic nerve
optics
pupil
retina

MATERIALS:

worksheet

BACKGROUND:

Technology uses the "physics" of light to aid humans in increasing vision. Many students are curious about exactly how they see. It is understanding the eye and how it works, that allows technology to improve our sight by improving glasses and contact lens.

The human eye sees images upside down and backward. Your brain is sent the image and then turns it the way it really is. The optic nerves take the image from the retina to the brain.

The inner layer of the eye is called the retina and is sensitive to light. The retina has layers of tightly packed cells called rods and cones. Rods are very sensitive to light and help you see at night. Cones need more intense light to work and allow you to see color.

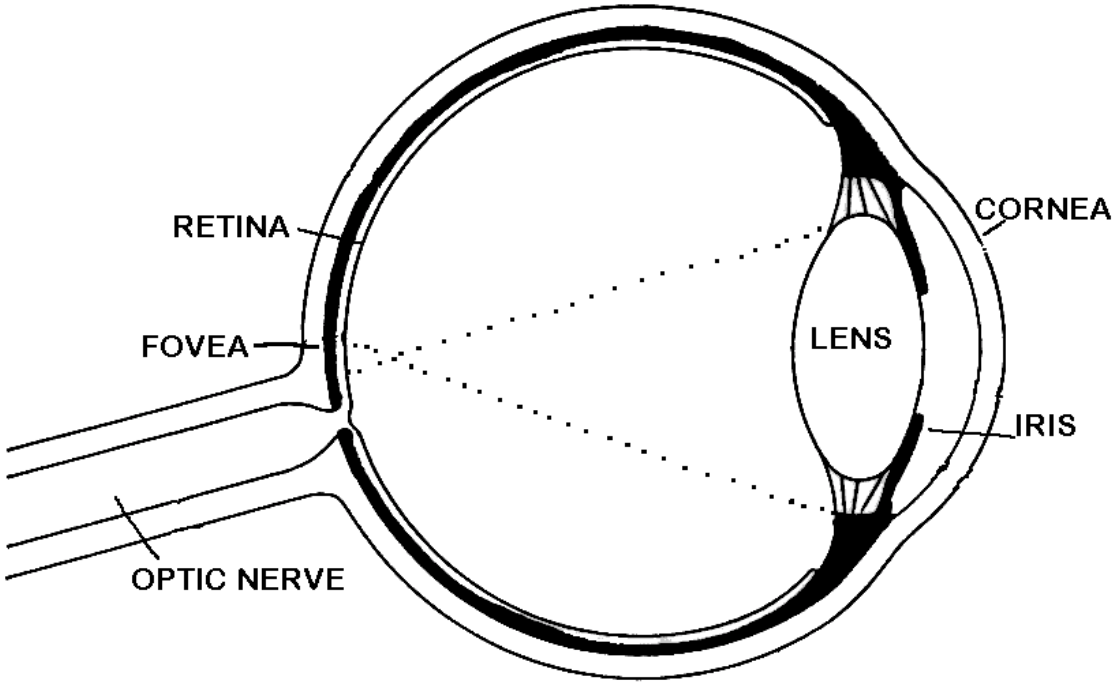
Light passes into the eye through a clear, protective shield called the cornea. Behind the shield is the iris which gives the eye its color. The opening in the center is called the pupil. The lens is behind the pupil and is about the size of a pea. The rest of the eye is called the vitreous humor with is a clear, jelly-like substance. This prevents the eye from collapsing. At the back of the eye is the retina, which is where the image is projected. It contains nerve cells which sends messages to the brain through the optic nerve. The fovea is where the image is focused the sharpest.

PROCEDURE:

1. Have the students label the retina, fovea, optic nerve, cornea, lens, and iris after you discuss what each of them.

2. Look at the worksheet and have students trace the path of light through the lens of our eyes. The optic nerve transmits the information to the retina; and the brain inverts the inverted image, so we see the image the way it actually is.

3. Answers:



APPLIED SCIENCE - TECHNOLOGY (5B) POST LAB

HOW THE EYE SEES IMAGES