Activities with Light
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Focus: Phys Sci

Description: In this session we will present a number of hands on activities involving an understanding of phenomena of light. There will be both short activities demonstrations as well as longer activities suitable for laboratory work. Come and enjoy learning about the properties of light as well as humans' perception of it along with a number of fun way to teach about light.

Human Perception of Light

A) Is White White?

Take two index cards, Punch or cut a small hole in the center.
Hold the card with a hole front of the second index card so that you can see the second card through the hole. If you turn one of the cards up or down, the two cards seem to change color. One gets whiter and one gets grayer as different amounts of light fall on them.

B) Retinal Fatigue

Our eyes detect light when the light causes chemical reactions to occur in the cones of our eyes. Our eyes have three different kinds of cones to detect three different colors (RED, BLUE, GREEN). If you stare at a red picture for a few moments, the cones in our eyes that respond to red light are all actuated and it will take a short time before they are ready to detect red light again. If you then quickly look at a white background the red cones will not react but the blue and green detectors will and your brain will register a cyan color even though you are looking at a white background. The short time before the cones can again detect light after they have reacted is called persistence of vision. This also accounts for our seeing "moving pictures" even though they are just a series of still pictures projected on a screen. Click on the link below.

Retinal Fatigue

The Rainbow

A) Diffraction Gratings

It is common to use diffraction gratings in a class to show students rainbows and spectral lines. It is common for teachers to buy the diffraction gratings in 35mm slides. These slides cause a problem because they are square and they must be properly aligned to show the spectrum. An easier and cheaper alternative is to cut a rectangle out of card stock (about 1” by 2”) and punch a hole in one end. Then cut a small portion of diffraction grating just big enough to cover the hole and tape it in place alining the diffraction grating along the length of the rectangle. Thus, in class the teacher only has to say “hold the rectangle vertically” and all the students should be able to see the spectrum. While modern diffraction film is quite good it has many lines to the inch (about 1000 lines per mm) and tends to spread the spectrum quite wide so that the students still do not notice the spectrum far off to the side. Flinn Scientific sells “Flinn C-Spectra™” in 8”x10” sheets that is a bit more sturdy than common diffraction grating so it doesn't have to be mounted in anything and only has about 225 lines per mm so the spectrum is not spread as wide and students can easily see it. Cut into 1”x 2” pieces you can get 40 pieces per sheet but mounted in card stock as described above will give several hundred pieces.

B) Colored Shadows

It is possible to buy "party bulbs" from the grocery store in all three primary colors. If only one bulb projects light upon a white screen or wall then you will only see that color and a black shadow. If you shine any two bulbs on a white screen then they will add together to produce a new color of light (red + blue = magenta, red + green = yellow, blue + green = cyan), black shadows and shadows of the original two colors. It is very interesting to shine all three colors on a white screen. They will produce white light with black shadows and shadows of the three complementary colors.

3. Inverse square nature of light

The following activity is one that can be easily performed by students and can be used to discover the inverse nature of light at least two different ways. Click on the link below.

Light Lab

4. Reflection

A) Corner Mirror

Most people think that mirrors transpose the left and right sides of images. Actually, it is precisely because they DO NOT that things look funny in a mirror. A mirror actually changes the front and back of the image. For example when you look into a mirror, the image faces you so you see your the face in the mirror rather than the back of your head which is what you would see if the image was facing the same direction as you are. All other things (up and down, side to side) are the same. It is possible to make a mirror that actually shows an image of what you actually look like to other people. It is simply constructed by placing two mirrors at right angles to one another. However, if people look into such a mirror they will think things look strange since people are so used to looking into real mirrors. You can make a pair of glasses which have different colored frames. Have a student put on the glasses (without seeing the frames), look into the corner mirror and ask them to point to the “red” frame. They will undoubtedly point to wrong frame.

B) Flying

When we look into a regular mirror the image is not on the mirror but on the other side, equally far behind the mirror that the object is in front. This can give rise to some very interesting illusions. Try straddling a large vertical mirror. Then gradually lift your leg on the mirror side while standing on the other leg. To anyone in front of the mirror it will give a very convincing illusion that you are flying! This is because the image is equally far behind the screen as the image is in front. And the front and back of the image has been reversed to the image looks like the other leg.

C) This demonstration also makes use of the fact that images are as far behind the mirror as the object is in front. Have one student stand a few feet in front of a tall mirror that does not quite reach their head. Have a second student stand equally far behind the mirror. It is possible to observe some very interesting people this way. A girl with a football player's physique or a tough boy in a pretty dress.

5. Science Fiction Klingon Cloaking!

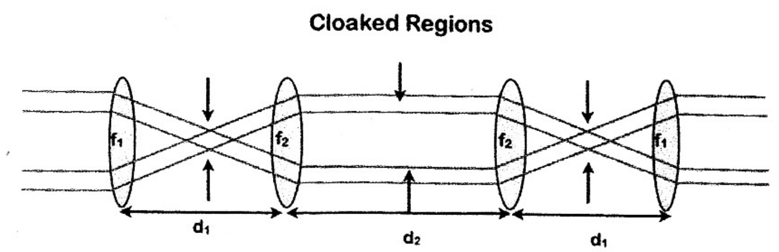
Anyone familiar with Star Trek know that the Klingon's have a special device to make their ships invisible. While we still haven't invented a true cloking device the properties of light can be used to make it appear as if one has been invented.

A) Disappearing Penny

This will demonstrate the principles of refraction and total internal reflection. Put a penny underneath a clear plastic tumbler (6 to 8 oz low rise). Show that the penny can be seen from the side even when a piece of cardboard covers the top of the tumbler. Then fill the tumbler with water to the very top and again cover the top with a piece of cardboard. The penny will have seemed to have disappeared. Explain that the light from the penny is being refracted as it enters the bottom of the tumbler. When it hits the side of the tumbler, it strikes at such an angle that it undergoes total internal reflection and can only exit the water at the top surface. This is really the principle of fiber optics. Light enters one end of the fiber and can only exit at the other end.

B) Optical bench cloaking

Start with two pair of lenses, one pair (f_1) with a longer focal length (about 15 cm) and one pair (f_2)with a shorter focal length (about 5 cm). Arrange them as shown below with d_1 equal to the sum of the focal lengths and d_2 about 1 to 2 times d_1. Objects can be placed in the outer areas near the focal point of d_1 or above the long cylinder of d_2 and when viewed along the axis the object will dissappear.



More complete instructions and an inexpensive kit are available on line at Laser Classroom.
http://laserclassroom.com/products/invisibility-kit-2/