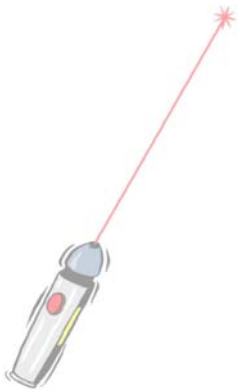
Laser Light: An Activity

Overview
This simple activity will help students visualize the difference between laser light and normal light. By walking in different patterns, students will simulate light of different wavelengths as well as the difference between coherent and incoherent light.



Students Will Learn…
- That all colors of light travel at the same speed.
- Different colors of light have different wavelengths.
- White light is made up of all colors of light.
- Filters let through light of only certain wavelengths.
- The difference between coherent and incoherent light.

What You Need
- A large open space
- Pieces of different colors of construction paper (optional)

Getting Ready
If you wish to assign students a color, have several pieces of different colored construction paper ready for the students. The traditional colors of the rainbow (red, orange, yellow, green, blue, indigo, violet) work best.

GO: Laser Light
1. Tell the students they are going to pretend to be white light. Have the students stand in a straight line. Have them arrange themselves so they are in the same order as the colors of the rainbow (ROY G. BIV) based on the color of their shirt (if you have uniforms in your school or a poor variety of shirt colors present, you can give each student a sheet of colored construction paper and have them line up by the color of their paper).

2. Tell the students that all colors of light travel at the same speed. Therefore, when they start walking, they all must walk at the same speed.

3. Tell the students that light can be thought of as a wave and that different colors of light have different wavelengths. Therefore, they will all take different step lengths.

4. Tell the students that the students representing blue light will take small steps since blue has a short wavelength. Students wearing green will take medium-sized steps and students wearing red will take long steps. Other colors should be adjusted accordingly.

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5. Have all the students walk toward you at the same speed. Tell them to observe the other "colors" as they walk. Tell them that white light is made up of all the colors, so they are pretending to be white light.

6. Have the students return to the starting point. Stand 10 feet or so from the students. Tell them you are a filter and you are only going to let through a certain color of light (you might wish to choose the color that is most popular that day). Have the students walk toward you. Everyone who is not the same color as the filter has to stop when they reach you. Tell the students this is what a colored filter does. It stops all colors of light except one. NOTE: If you are, for example, a red filter and two students are wearing slightly different shades of red shirts, let them both pass. Tell the students that filters usually let though a small range of colors and not just one color.

7. Now tell the students they are going to learn the difference between laser light and normal light. Tell the students that they will now all be the same color so they will take the same size steps and walk at the same speed. Have the students stand in a line and start walking toward you at the same speed taking the same size steps. Tell them not to worry about being in step with the person next to them. This exercise simulates monochromatic (single color) light that is not coherent.

8. Next, tell the students to line up and walk toward you taking steps of the same size. This time, however, tell them they all have to be in step. Tell the students this simulates laser light and is called coherent. All the light is "in step." Scientists would say the light has a constant phase relationship. In coherent light, all the individual photons act as one wave.

What's Really Happening Here…

Students are seeing many properties of light in this activity. The first thing students should realize is that light can be thought of as a wave, much like a water wave. Different colors of light have different wavelengths. Blue light is around 400 nanometers (1 nanometer is one billionth of a meter) and red light is around 700 nanometers. The students taking short steps represent the blue light and the students taking long steps represent red light. The steps they are taking a many orders of magnitude greater than the wavelength of visible light.

Filters usually let through a selected range of wavelengths. This range is called a bandpass. The bandpass can be very large or very small. Typically, a red filter that is similar to a theater gel probably lets through some orange and yellow light as well. You can specify how close to the color a student's shirt must be to pass through the filter. You can even specify a very broad bandpass by letting students with green and yellow shirts pass, for example.

White light contains all colors of light. By having students take steps of different length depending on their shirt color, you are simulating white light. Telling all students to walk at the same speed illustrates another important property of light. All colors of light travel



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at the same speed in a vacuum. (Many substances slow down some colors of light more than others, a process called dispersion. We will assume the light is in a vacuum for this activity.) This property of light is one of Einstein's Postulates of Special Relativity.

Coherent light is a very difficult concept to get across to students. It is true that all the photons in coherent light are in phase. The students simulate in phase by being in step with each other.

Going Further

You can also play with the concept of colored filters. Filters let through only certain colors of light. Have the students walk toward you as white light. Tell them you are a green filter and ask them to walk past you if their color will make it past and stop if they think their color won't.

You can get more advanced and download filter curves from the web. These curves tell you what colors make it through each filter. You can find them at web sites such as http://www.rosco.com/us/filters/roscolux.asp, a company that sells filters.

Many companies will give you a sample book of their filters as well. The theater department at your school may have a set of samples already.



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