

Science Works DIY: Spectroscope

Objective:

Would you like to hold a rainbow in your hand? With a spectroscope, you can! You can make this device from simple materials you have at home. Then you can use it to learn more about light emitted around you.

Difficulty Level:

Easy (ages 8-14)/Easy with help (ages 3-8)

Materials:

A CD
Aluminum foil
A cereal box or cracker box
Spare piece of thin cardboard
Scotch tape
Scissors
Ruler

Procedure:

1. Make two diagonal one inch cuts on each side of an upright box at a 45 degree angle. If you use a cereal box or a cracker box, make your cuts just below the nutritional information. Connect these two diagonal cuts with a horizontal cut along the edge of the box. This slot will hold your CD.
2. Make a viewing window on the top of the box, above the CD. An easy way to make a viewing window is to cut about 2" off the flaps on top of the box, if you are using a cereal box. This opening will allow you to see the spectra of light reflected off the CD.
3. Now, on the opposite end of the box, you need to make a thin slit, or horizontal cut, in the cardboard, to allow light to pass through to the CD. This slit should be positioned slightly higher than the horizontal CD holder you made on the opposite side.

Safety Note:

Never look directly at the sun through your spectroscope! You can severely damage your eyes.

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4. The slit will allow light into the box, and must be very thin. If your slit is too wide, tape two pieces of aluminium foil over it, one above and one below, so they are very close together, but not overlapping.

5. To use your spectrometer, point the slit towards a light source and look through the viewing window at the top of the box. You will see bands of color reflected on your CD. Try pointing the slit at different light sources, and see what you notice about the bands of color.

Some light sources to try:

A computer screen

A TV screen

A fluorescent light bulb

Sodium or mercury street lights

(sodium lights have a yellow glow, and are often in parking lots)

A candle

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What do you notice?

Which colors appear lighter or darker at each source?

All the light sources were white light! **Why did they make different patterns on the CD?**

What's the Science?

A CD contains information encoded on its surface in tiny grooves. If you tilt a CD and examine it, you can see concentric rings on its surface. You also will notice that the light reflects off the CD like a rainbow. This is because the grooves make light spread out, or diffract, when it hits the CD.

Because your aluminum foil slit is so narrow, the light that passes through it splits into different colors, similarly to light passing through a prism. When the colors are split, you are able to see the spectrum of light.

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Depending on the source of the light (halogen globe, fluorescent globe, daylight, etc.), some colors will appear brighter or darker than others. When we point the CD spectrometer at a halogen globe, the image on the CD shows a continuous, rainbow pattern. The chemicals composing white light from this source emit almost every color in the spectrum, so you will see a rainbow of colors reflected.

The chemicals in a fluorescent light will emit only a handful of colors. So, when you look at a fluorescent light through your spectroscope, you will only see bands of color, with areas of shadow between.

Astronomers use spectrometry to split the light from space. They can examine the bands of light and color in the spectrum, and the dark bands splitting them, to learn which chemical compounds are being emitted or absorbed. Astronomers can learn a lot about the sources of this emitted or absorbed light, as well as the density and temperature, the magnetic field strength in the environment, and even how far away the light source is, and whether it is moving toward us or away from us. We used spectroscopy to learn that stars are mostly made of hydrogen and that comets contain lots of water, and used it to discover the first extrasolar planets!

Take a picture and share it with us, so we can see what you made!

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