UNIVERSITY of WASHINGTON
CLEAN ENERGY INSTITUTE

DIY SPECTROSCOPE

UNDERSTANDING HOW LIGHT INTERACTS WITH MATERIALS IS A FUNDAMENTAL PILLAR OF CLEAN ENERGY RESEARCH; DEVELOPMENT OF STATE-OF-THE-ART SOLAR TECHNOLOGY STARTS WITH FULLY UNDERSTANDING AND MAXIMIZING THE SOLAR SPECTRUM.

Have you ever noticed how black asphalt gets hotter than the white sidewalk on a sunny day? Or observed how water twinkles in the sunshine? Have you ever seen a rainbow? Light interacts with everything around us, and clean energy researchers are very interested in understanding these interactions. One of the most important tools we use to do this is called a spectroscope. Can you help us build a spectroscope and learn more about light?

OVERVIEW & RESEARCH CONNECTION

At the University of Washington, researchers in the Clean Energy Institute investigate a variety of materials with applications in solar energy and energy storage. Some of the most fundamental and important characterization techniques probe how light interacts with these materials. Researchers use spectroscopes to help them answer clean-energy questions. Can you help us build a spectroscope and learn more about the properties of sunlight?

This is a demonstration geared toward elementary school students to introduce the concepts of instrumentation and the visible spectrum. Students will assemble a very easy, fun, and inexpensive spectroscope out of arts and crafts materials.

Through this demonstration, students will learn that sunlight is made up of different wavelengths of light. The DVD in the spectroscope has 1350 grooves/mm that diffract sunlight into its constituent wavelengths. Looking through the viewing port, students will be able to see all the different colors of light that make up sunlight. Students can also experiment with other light sources and observe any differences.

SAFETY CONSIDERATIONS FOR THE SPECTROSCOPE

> Be careful while using the scissors and/or knife

> Don't look directly at the sun (or other light source)

REQUIRED MATERIALS

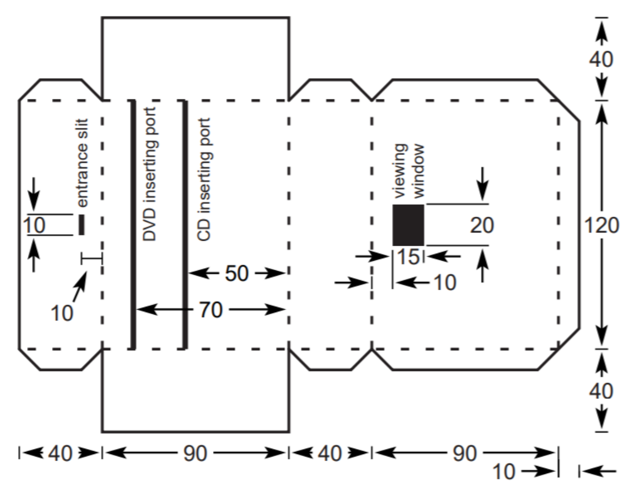
All listed materials can be easily found at craft stores or from an online retailer.

- Thin cardboard sheet (12 x 12 in)
- Ruler
- Scissors or X-Acto knife
- Pencil
- Tape
- DVD
- Light source
- Decorations (markers, stickers, etc.)

MATERIALS PREPARATION

It is recommended that volunteers prepare materials ahead of time or prepare materials themselves to limit the potential for students to injure themselves with the scissors or knife. The schematic below gives an outline for the relative dimensions of each component.

1. Trace spectroscope outline on piece of cardboard as shown in the diagram below. Measurements are in mm.
2. Cut the cardboard box along the solid black lines.



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SPECTROSCOPE ASSEMBLY

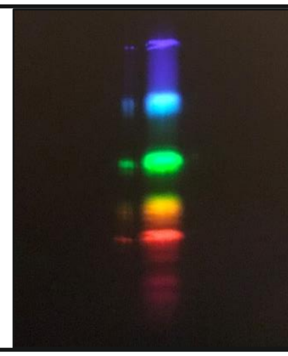
Once the materials are prepared, the spectroscope can be assembled. Students may help fold the cardboard, place the DVD, and decorate the spectroscope. The following pictures demonstrate how the spectroscope should look after assembly.

1. Fold the spectroscope box along the dotted lines.
2. Tape the edges of the box.
3. Insert the DVD at a 60-degree angle through the slit.

USING THE SPECTROSCOPE

Students should take an active role in using the spectroscope and making observations.

1. Hold the spectroscope entrance slit to the sunlight.
2. Look through the viewing port.
3. Make observations.
4. Try holding the spectroscope at different angles to change the amount of light that enters.



LEADING QUESTIONS FOR STUDENTS

> What did you see when you looked through the viewing port? What do you think is happening?

> Can you think of two roles that the DVD plays in making the spectroscope work?

> Try holding a flashlight to the entrance port. Is it different than when you held it to sunlight? Why?

> Can you hold the spectroscope so what you see gets brighter? What difference do you think it makes?

References & Additional Resources:

1. Wakabayashi; Hamada "A DVD Spectroscope: A Simple, High-Resolution Classroom Spectroscope" *J. Chem. Educ.* **2006**, *83*, 56—58.
2. Kovarik; Clapis; Romano-Pringle "Review of Student-Built Spectroscopy Instrumentation Projects" *J. Chem. Educ.* **2020**, *97*, 2185—2195.
3. Wahab "Fluorescence Spectroscopy in a Shoebox" *J. Chem. Educ.* **2007**, *84*, 1308—1312.