

## **Make a Spectroscope**

Follow the instructions below to make your own spectroscope, a tool that can split any light source into a rainbow of colors.

### **Materials Needed:**

Cardboard tube (e.g. paper towel tube)

CD or DVD (will be cut up!)

Scissors

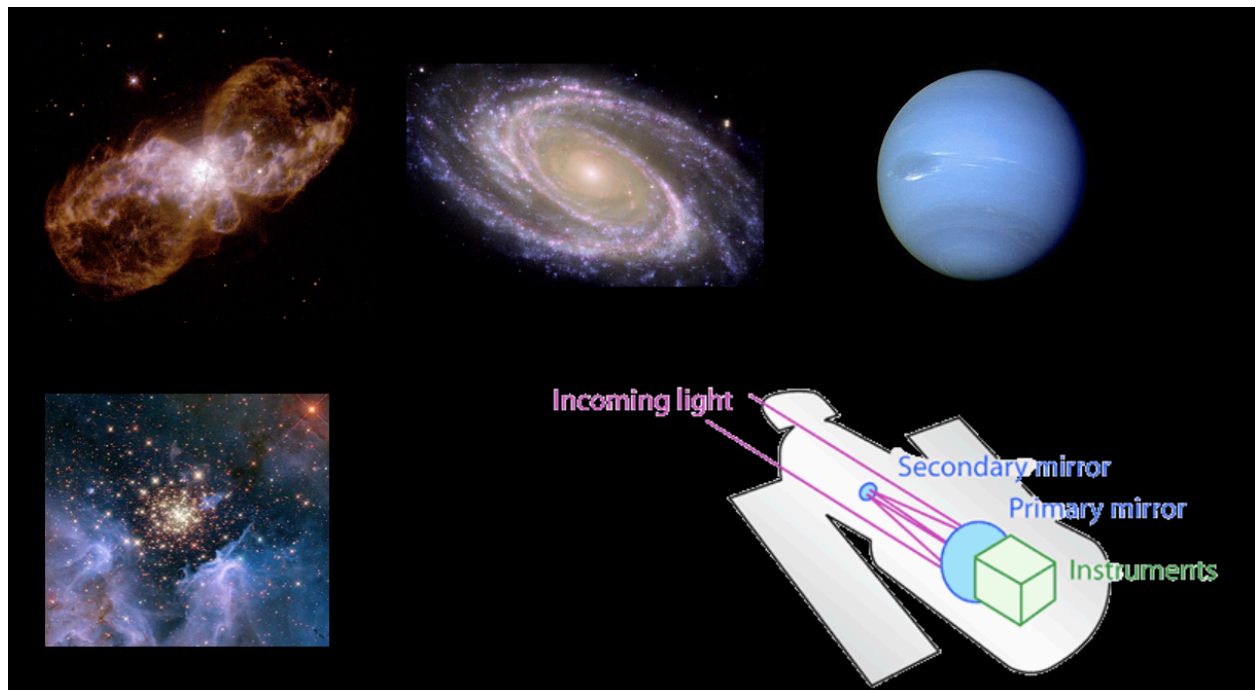
Tape

Paper (or duct tape, or masking tape)

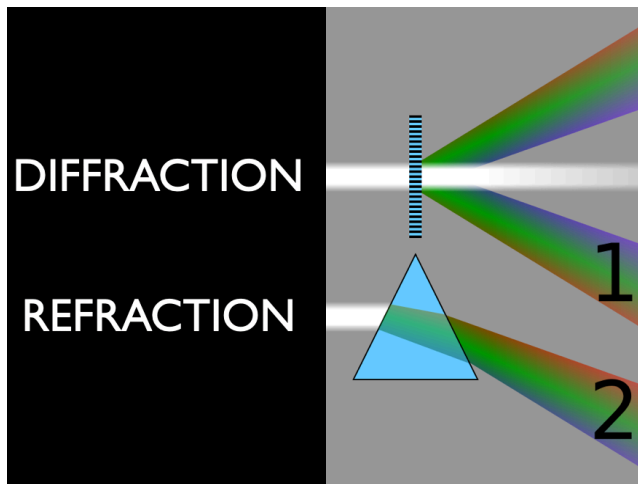
## **Introduction**

Astronomers use light to study the Universe in many different ways.

Because objects in space are very distant, in most cases too distant for even spacecraft to visit, we rely on the light from those distant objects to understand them. Astronomers use telescopes to collect light from distant objects from our solar system to the edge of the observable Universe.

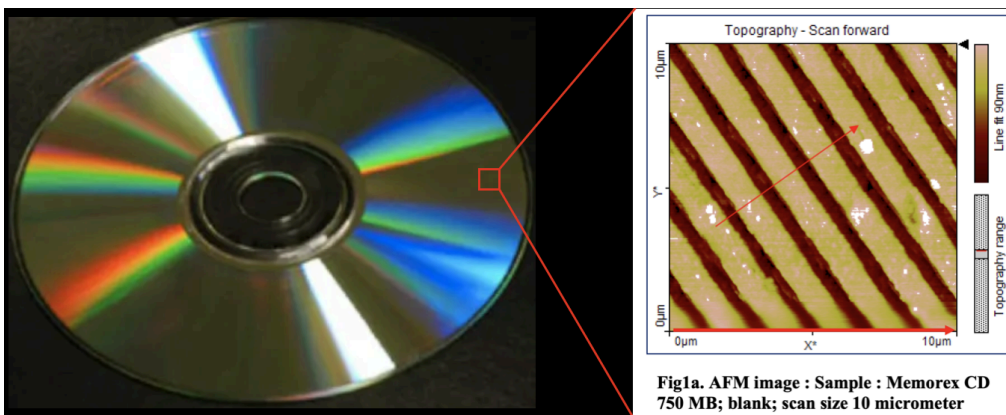


Light can be split into a rainbow using different techniques. Astronomers call these rainbows “spectra” or “spectrum” for a single rainbow. The spectrum of a distant planet, star, nebula, or galaxy can be used to measure many things including chemical composition, temperature, density, speed, etc.



A spectrum can be created using two different methods to split light: diffraction and refraction. Diffraction happens when light encounters a slit or obstacle, bending different colors different amounts as light behaves like a wave. Refraction happens when light passes through prism, different colors are bent different amounts resulting in a rainbow.

These instructions will show you how to build a spectroscope that splits light using diffraction. To split light you can use a CD or DVD. Either one has a surface with many, many lines close together that cause diffraction.



(nnin.org)

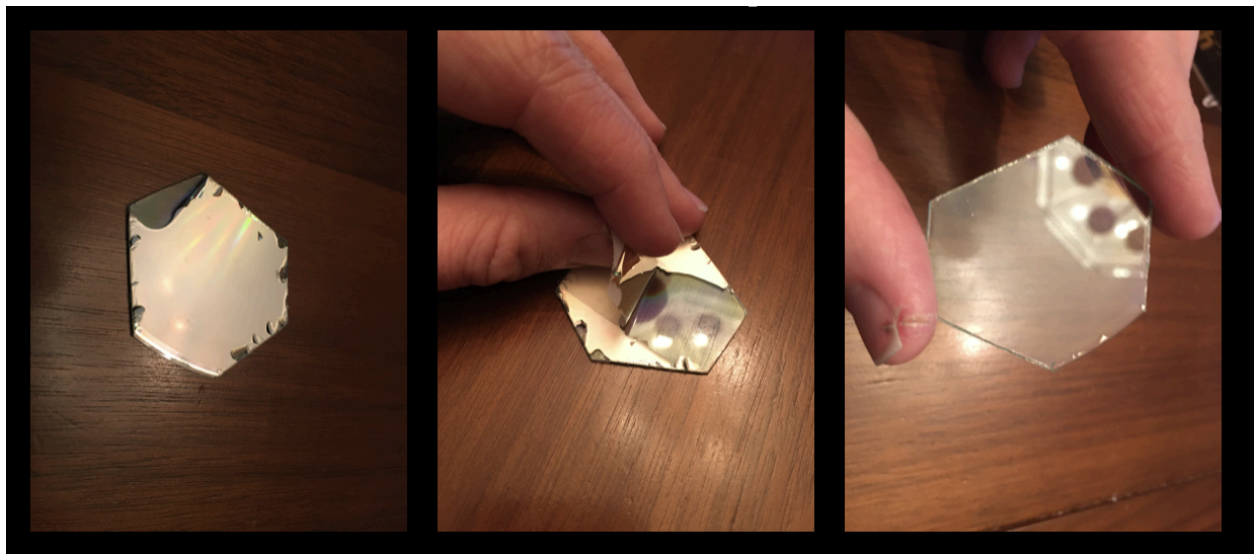


## **Instructions**

**Step 1:** Acquire your materials, including a CD or DVD that is OK to cut up. If you have any old unused CD-R or DVD-R they work great!

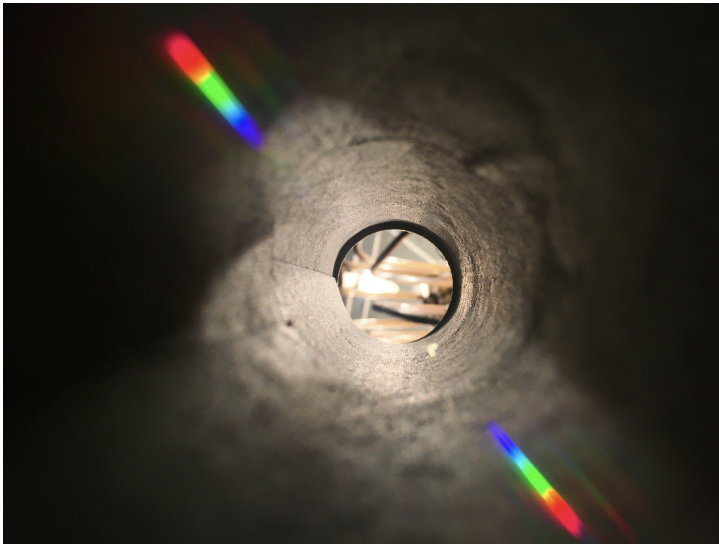
**Step 2:** You will need to cut a piece of CD that can cover the end of your tube. One method is to cut the CD in half, then cut in half again so you have four pieces. Take one of these pieces and carefully cut the edges and corners so they are not sharp or pointy.

**Step 3:** Remove the reflective coating from your piece of CD, it helps to use tape for this step. The small piece should be clear now.



**Step 4:** Hold the transparent piece of CD to your eye and look at different lights, you should see rainbows slightly to the side through the piece. This is diffraction in action.





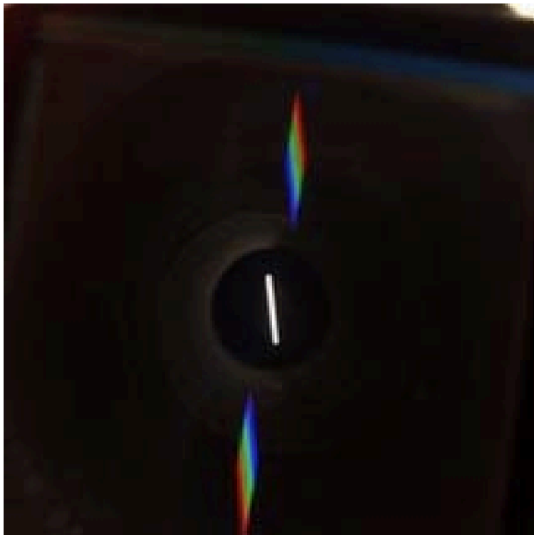
**Step 5:** Hold the transparent piece of CD to the end of your tube. You should be able to look through the piece into the tube, check by holding the end of the tube with the piece of CD to your eye and looking through. You'll see something like the picture to the left.

**Step 6:** At one end of your tube, create a narrow slit through which light can pass. You can do this using two pieces of solid tape to cover all but a narrow part of the end, or you can cut two pieces of paper and tape them to the end of the tube so that only a small slit is left. An example using tape is in the picture below.



**Step 7:** Hold the CD piece up to the end opposite the slit and look at a light through the tube, with your eye against the piece of CD. There should be rainbows again, and you can rotate the CD piece until they are to the left and right of the slit as shown in the example below:

**Incorrect Alignment**



**Correct Alignment**



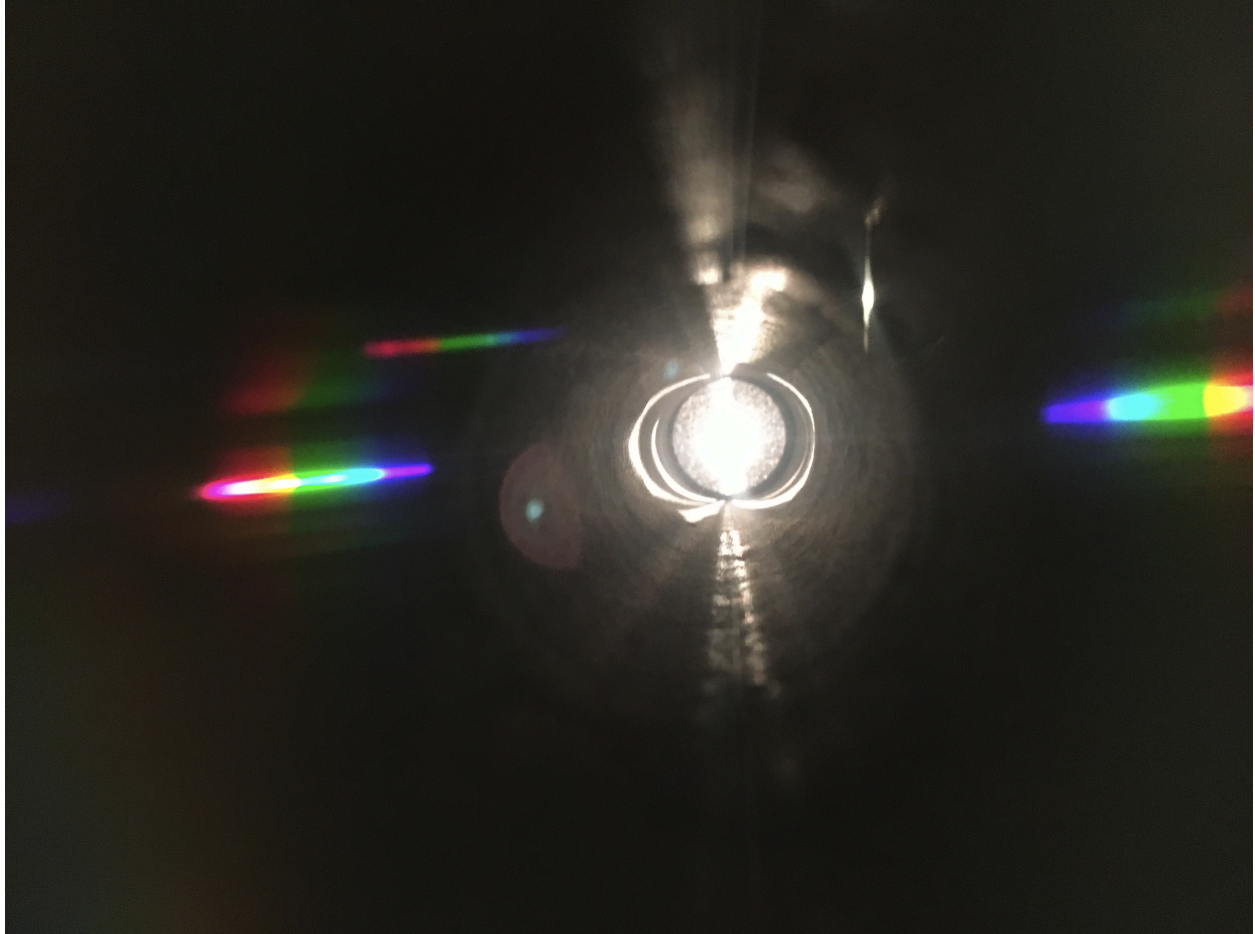
(euhou.net)

**Step 8:** Once you have rotated the CD piece so that the rainbows are aligned to the left and right of the slit, tape the piece to the end of the tube.





**Step 8:** Once you have rotated the CD piece so that the rainbows are aligned to the left and right of the slit, tape the piece to the end of the tube. Your spectroscope is complete! Use it to look at different light sources and observe the spectrum created, but **DO NOT POINT IT AT THE SUN!!**



These instructions were adapted from the following activity created by Angela Turricchia and Ariel Majcher:

<http://www.euhou.net/index.php/exercises-mainmenu-13/classroom-experiments-and-activities-mainmenu-186/178-a-home-made-spectroscope>

For more information about Astronomical spectroscopy check out:

<https://imagine.gsfc.nasa.gov/science/toolbox/spectra1.html>

<https://www.eso.org/public/teles-instr/technology/spectroscopy/>

[https://www.youtube.com/watch?v=jjy-eqWM38g&ab\\_channel=CrashCourse](https://www.youtube.com/watch?v=jjy-eqWM38g&ab_channel=CrashCourse)