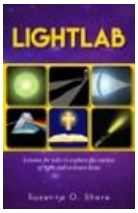
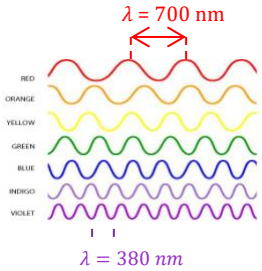


LIGHTLAB EXTRA ACTIVITY 9: DIFFRACTION GRATINGS

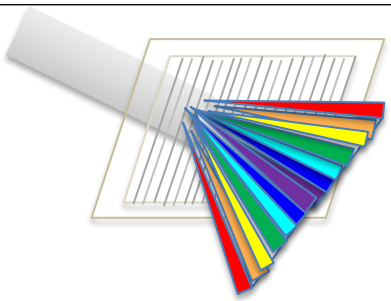


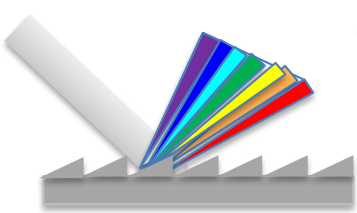
PURPOSE: Learn how light beams split into rainbow colors through a diffraction grating, the heart of a spectroscope.

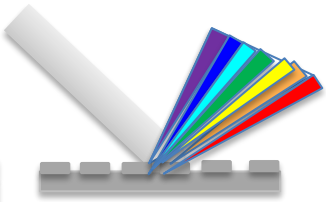
BACKGROUND: In Lightlab chapter 9, we explain how a rainbow spectrum forms through the refraction of light, incident on water drops and prisms. A rainbow pattern can also be observed through another process called diffraction, when a light beam is separated into the many colors due to tiny grooves that can only be seen through a microscope. Their size is comparable to the range of wavelengths of visible light: from 380nm to 700nm (1nm = 1 billionth a m). To give you an idea, the width of your hair strand is close to 500 times thicker than light's wavelength.

Whether transmissive or reflective, a diffraction grating will separate a light beam into the rainbow color beams because they bend at different angles. Since Red light has a longer wavelength, it will bend more than violet.

A transmissive diffraction grating is usually a transparent sheet of plastic with straight opaque lines scratched on it. There can be as many as 1000lines/mm	A reflective diffraction grating is usually made with adding a reflective coating on a plastic material that has about 1000 grooves/mm which are angled edges or spaced wells.

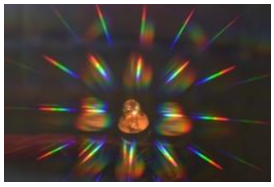






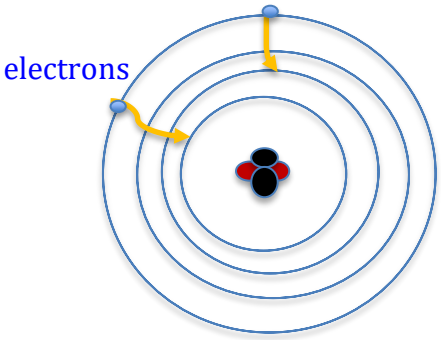
TEST DIFFRACTION GRATINGS AROUND THE HOUSE:
Materials: a pair of diffraction glasses, a CD, light source.

These popular diffraction glasses are transmissive and they have opaque lines in 2 directions! Wear them or shine light through them, and watch the rainbow spectrum spread all around the light source.



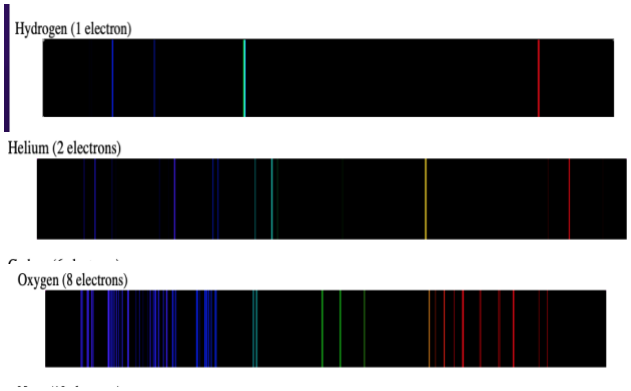
CD's and DVD's have grooves dug all throughout the reflective surface and split light incident on them into the rainbow spectrum. Shine light directly on a CD, watch the spectrum form on its surface as well reflections on the walls and ceiling.

While their displays are fun and cool, many important scientific facts can be concluded from diffraction gratings, often used in spectroscopes. Sunlight and incandescent bulbs reflect a continuous color spectrum of rainbow colors like we showed so far. This is not the case of light sources from a glowing gas which emit bright lines with dark bands in between.



The spectrum emitted by a gas is characteristic of its atomic structure, and is the result of electrons jumping from high energy levels to lower ones. In the diagram on the left, the energy levels that an electron can occupy are marked by the circles. The larger the circle, the higher the energy of the electrons residing there.
The # of levels that an electron falls corresponds to the energy it can emit through radiation which is emitted by a particular wavelength, whether visible to the eye or not.

For example, the spectra emitted by Hydrogen, Helium and Oxygen have certain spectral lines spaced by dark bands. These images are produced by a spectrometer that uses either a diffraction grating or a prism. Scientists can study the light emitted by stars and other objects in space, or heated substances here on Earth, to identify the kinds of elements that are present.



Spectrometers come in all types and sophistication, and you can also build your own homemade spectrometer. Below aree references that show how to build a spectrometer with:

a. a CD: https://buggyandbuddy.com/homemade-spectroscope/
b. a transmissive diffraction grating: Light Optics NASA guide pages 29-33.

GOD'S LIGHT: In Lightlab Chapter 9, we do a scripture study on the meaning of God's rainbow as a covenant with Noah, followed by covenants with other Godly men of the old testament until the final one about Messiah's redemptive work. Further research led me to find another teaching of the subject, for your review.

http://greenbaggins.wordpress.com/2006/05/16/god's-rainbow-covenant-with-noah-2/

Lightlabetc Remarks: We would love to hear from you regarding any questions you may still have on this subject. Just email us at lightlabetc@gmail.com or contact us from the website: lightlabetc.com. For many cool postings on science and faith, join us @lightlabetc on Instagram, Facebook, and Pinterest.