15615 SPECTROSCOPE, SET OF 2

Purpose:

To investigate bright line and continuous spectra from a variety of light sources as well as from chemicals burned in a flame.

Additional Required Materials:

Light sources, such as classroom fluorescent lights, incandescent lights, mercury vapor and sodium vapor street lights, and neon signs. Chemicals and burner flame.
Tweezers

Assembly:

1. Select a card of press-out slit disks. These die cut disks are circular with a rectangular slit punched across the diameter. Remove one of these disks and press out the rectangular center piece.

2. Insert the slit disk into one spectrum tube cap. This is a friction fit and it will fit tightly. Be careful not to bend the slit disk as it is being inserted.

3. Select a card of diffraction grating holders. One die cut holder appears on the card as two circles that touch. Remove one diffraction grating holder from the card being careful not to tear the two halves apart. Push out the circular center of each half.

4. Using tweezers, remove one piece of diffraction grating from the envelope and insert it between the folded halves of the grating holder. ***AVOID*** **getting fingerprints on the diffraction grating.** Press fit the grating holder into one end cap.

5. Blow or shake out any dust or particles that may be in the spectrum tube and mount the prepared end caps on opposite ends of the tube.

6. With the grating end of the assembled spectrum tube nearest your eye, look at a fluorescent or incandescent bulb.

7. Turn the spectrum tube so that the slit in the end is vertical. Turn the grating cap so that the colored spectrum appears on each side of the tube and at right angles to the slit. You will need to look straight ahead down the tube to make sure the slit is brightly illuminated, and then without changing position, look to one side or the other through the diffraction grating to see the spectrum. Check often that the cap holding the grating has not be rotated out of proper position.

What is a spectrum and how to make one:

When an electron in an atom drops from one energy level to a lower energy level, it loses energy. Where does this energy go? It shows up as a single photon of light. A photon's energy is described by its frequency or color. Light that is blue in color is made up of photons with higher energy than light that is red in color.

Materials can be made to give off light by a number of methods such as heating in a flame, sparking from electrodes, or passing an electric current through a low pressure gas. Heating a compound in a flame is the simplest method of exciting atoms. The electrons in the compound will absorb energy from the heat of the flame, then as the electrons fall back to their

low energy “ground” state photons are emitted with energies that are characteristic to that compound.

How can we tell what colors are in the light coming from the chemical in the flame? Recall that sunlight shining through a prism creates a small “rainbow”. This rainbow is the spectrum of sunlight with the lower energy (red) light on one side and higher energy (blue) light on the other. We can use the same prism to separate the colors of the flame we are testing or we can use a diffraction grating. A diffraction grating behaves in a fashion similar to the Young’s double slit experiment where two narrow slits were used to spread light of different wavelength through different angles. The grating repeats the slit spacing for a brighter image.

Observing Spectra:

After you’ve assembled your spectroscope, you can use it to look at a variety of light sources; fluorescent lights, ordinary incandescent bulbs, mercury vapor and sodium vapor street lamps, and neon signs. **DO NOT look at the sun.** It is far too bright and will damage your eyes. Record your observations and compare the similarities and differences between these light sources. The classroom fluorescent lights are particularly useful because one can see the mercury bright lines from the excited vapor inside superimposed on a continuous reference spectrum provided by the coating that seems to glow white.

To flame test a chemical, (such as our product #32340, Flame Spectra Salts) place a few crystals of a chemical on a wire loop and hold it in the flame of a Bunsen burner. The flame color will change and when viewed through a spectroscope, colored lines characteristic of that chemical will be visible. It is best to work in pairs for this experiment. Have someone hold the chemical in the flame while you observe its spectrum. Record your observations, then trade places. After you've observed different chemical spectra, see if you can identify a chemical by viewing its spectra alone. Have someone select a chemical without telling you what it is and place it in the flame. Compare the spectra you observe with the notes you've taken. Can you tell which chemical was chosen?

Time Allocation:

To prepare this product for an initial experimental trial should take less than ten minutes. Actual experiments will vary with needs of students and the method of instruction, but are easily concluded within one class period.

Feedback:

If you have a question, a comment, or a suggestion that would improve this product, you may call our toll free number.