



Spectral Analysis

Amount of time Demo takes: 5-6 minutes

Try this in the classroom!

Lesson's Big Idea

- Every gas gives off a characteristic light when placed across a high electric field.
- A pure gas is contained in a tube. Electric current is then sent through it causing the gas to illuminate.

Materials

- [Spectrum Tube Power Supply](#)
- [Spectrum Tubes \(15\) \(Arbor Scientific\)](#): Air, Argon Gas, Carbon Dioxide, Chlorine Gas, Helium Gas, Hydrogen Gas, Iodine, Krypton Gas, Mercury Vapor, Neon Gas, Nitrogen Gas, Oxygen Gas, Water Vapor, Xenon
- [Handheld Spectroscope - Educational Innovations](#)
- **Needs electricity**

SAFETY!

- DO NOT TOUCH SOCKETS WITH POWER ON!
- Be sure power supply is **off** when plugging it in. To ensure glass tubes do not break, use protruding glass handle. See picture below.



Background Information

- Noble gas: group of chemical elements that are colorless, odorless and stable.
 - Visible spectrum: portion of the electromagnetic spectrum that is visible to the human eye.
- Electric field: a field of force surrounding a charged particle
- When a gas is excited by the high voltage, an electron will be excited to a higher energy level. When the electron returns to a lower energy level, it emits a photon of light. The photon of light is always the same energy since the energy change is always the same. Therefore, each excited element emits characteristic wavelengths determined by energy level differences present in that element.
 - When the spectrum tube is turned on, it may appear to be a particular color with the unaided eye. However, analysis of the spectrum with a spectrometer will reveal a series of sharp emission lines. Spectrum tubes use research grade gases and vapors to provide bright-lines of high clarity. They are designed for optimum intensity and line resolution when examined in a student grade spectrometer equipped with a 200 line/mm diffraction grating.

Setup Instructions

1. Plug power cord into power supply, then into extension cord.

Instructional Procedure

1. Make sure the power switch is **off** and unplug the power supply from the outlet when inserting the spectrum.
2. Slide the spectrum tube into the top socket. Very carefully push the tube up and then insert the other end into the bottom socket.
3. Plug the spectrum tube power supply into power outlet.
4. Turn the power switch to the ON position. The power supply and spectrum tube should now be glowing.
5. The life of a spectrum tube is extended if it is not used for more than 30 seconds continuously. Cycle the power supply on for 30 seconds then off for 30 seconds to prevent the spectrum from overheating. This will greatly increase the usable life of the spectrum tube.
6. ALWAYS TURN OFF THE POWER SWITCH AND UNPLUG POWER SUPPLY

BEFORE INSERTING OR REMOVING SPECTRUM TUBE. DO NOT TOUCH SOCKETS WHEN THE POWER SWITCH IS ON OR PLUGGED IN.

Tips & Tricks

- Keep tubes organized, getting them confused will make explaining the different characteristics difficult.

Assessment Questions

- What makes noble gases very unreactive with other elements?
 - There are 8 electrons in the outer valence shell of the element, this makes the element unreactive with other elements because its outer valence shell is full.

Careers & Real-World Applications

- Careers
 - Chemical Engineer
 - Lighting Technician
 - Astronomer
 - The study of stars' light spectra is used to identify compositional elements of stars.
- Neon lights and signs are illuminated from what is shown in this experiment

Clean Up

- If there are particular cleanup instructions, example disposal for chemical waste etc, it needs to be included here.
- Include how to store the items (i.e. dry off wet items, put things back in particular locations)

Related Next Generation Science Standards

- K-5
 - 4-PS3 Energy
 - 4-PS4 Waves and their Applications in Technologies for Information Transfer
 - 5-PS1 Matter and Its Interactions
- 6-8
 - MS-PS1 Matter and Its Interactions
 - MS-PS4 Waves and Their Applications in Technologies for

Information Transfer

- 9-12
 - HS-PS1 Matter and Its Interactions
 - HS-PS3 Energy
 - HS-PS4 Waves and Their Applications in Technologies for Information Transfer
 - HS-ESS1 Earth's Place in the Universe