Spectral Fingerprints

Overview:

A spectroscope is a device used to produce the spectral lines of elements. Spectral lines of chemical elements produce unique patterns. By studying the spectra produced by the sun and reflected light from planets or moons, scientists can determine what elements are present in the planets' atmospheres. In this activity, students learn how spectral lines can be used to identify elements present on unknown planets.

Objectives:

The student will:

- discover that elements produce unique spectral lines; and
- use known spectral lines to determine unknown elements.

Materials:

- VISUAL AID: "Spectral Lines"
- STUDENT INFORMATION SHEET: "Spectral Lines"
- STUDENT WORKSHEET: "Challenge #1: Name the Gas"
- STUDENT WORKSHEET: "Challenge #2: Gases on Fictitious Planets"

Spectral Fingerprints

Activity Procedure:

1. Show the VISUAL AID: "Spectral Lines". Five different gases are listed: hydrogen, oxygen, nitrogen, helium, and neon. Explain how these spectral lines can be used to analyze unknown gases on Earth or on other planets.
2. Hand out the STUDENT INFORMATION SHEET: "Spectral Lines" and read through the introduction. Explain the spectral lines of gases represented on this sheet are rough approximations of the actual spectral emissions shown on the VISUAL AID.
3. Hand out the STUDENT WORKSHEET: "Challenge #1: Name the Gas." Ask students to use the STUDENT INFORMATION SHEET: "Spectral Lines" to figure out which gases are represented in Challenge #1. They can accomplish this task by comparing the spectral lines on the INFORMATION SHEET with the spectral lines on the worksheet.
4. Hand out the STUDENT WORKSHEET: "Challenge #2: Gases on Fictitious Planets." Ask students to use the STUDENT INFORMATION SHEET: "Spectral Lines" to find all the gases represented in the atmospheres of the fictitious planets listed in Challenge #2. Remind students that some of the fictitious planets may have more than one gas represented in their spectral lines.

Answers to Student Worksheets:

Challenge #1

A. Helium

B. Oxygen

C. Nitrogen

Challenge #2

1A. Oxygen

1B. Neon and Helium

1C Nitrogen and Oxygen

2. Irving would be a logical choice. It has oxygen and nitrogen in its atmosphere and is most like Earth.

Teacher Note: *Helium was discovered on the sun before it was discovered on Earth. In 1868, Pierre-Jules-Cesar Janssen first observed an unusual yellow line in the spectral emission from the sun during a solar eclipse. Norman Lockyer also observed this bright yellow line, but was unable to find an element that could produce it in the lab. He named the new element helium after the Greek sun god Helios.*

For years, it was thought that the element Helium might only exist on the sun. In 1895, Sir William Ramsey isolated helium from cleveite, a uranium mineral, and confirmed the existence of helium on Earth.

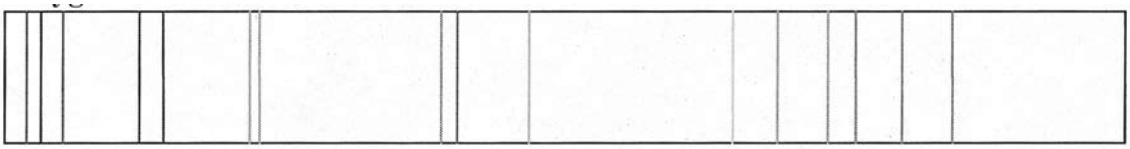
Spectral Lines

Remember how Anders Jonas Angstrom used a prism to compare the spectrum of light produced by the aurora with the spectrum of sunlight? With that experiment, Angstrom proved the aurora was caused by particles crashing into elements in the atmosphere. Do a similar comparison to figure out what gases may be present in the atmospheres of other planets.

Below are some rough examples of spectral lines given off by different gases. (These drawings are not exact.)

Hydrogen

Oxygen



Nitrogen

Helium

Neon

Name:_____ **Student Worksheet**

Challenge #1: Name the Gas

Directions: Identify the gases in the following samples. To solve this problem, do a careful comparison among these samples and those on the STUDENT INFORMATION SHEET: "Spectral Lines."

A. Sample #1 This gas is _____

B. Sample #2 This gas is _____

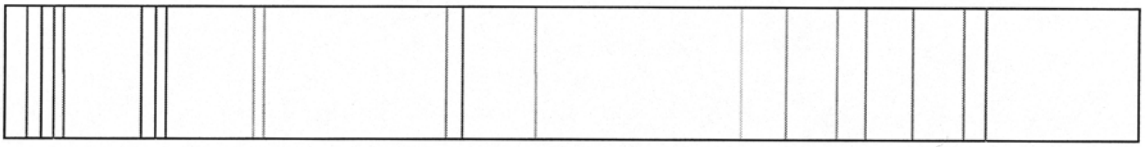
C. Sample #3 This gas is _____

Name:_____ **Student Worksheet**

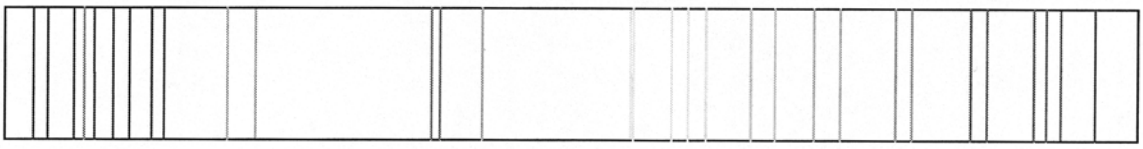
Challenge #2: Gases on Fictitious Planets

1. The atmospheres of most planets are made up of a mixture of several gases. Below are the spectral lines for each of the various planets in your newly discovered solar system. Examine each to determine what gases are in the atmosphere of these unknown planets.

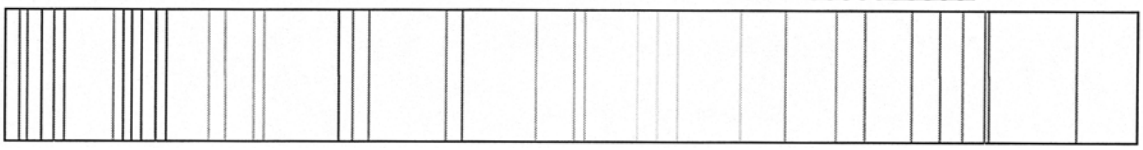
A. Gruening Gases Present: _____



B. Bunnell Gases Present: _____



C. Irving Gases Present: _____



2. Which planet would you recommend as the one most likely to be able to support life as we know it on Earth? Explain your choice._____

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