



Identifying Metals Using Atomic Emission

Middle School Earth Science | Fall Module 1 | Environmental Laboratory

NGSSS Big Idea: Big Idea 1—The Practice of Science

Benchmark Code & Description:

SC.7.N.1.1—Define a problem from your curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

NGSSS Big Idea: Big Idea 11—Energy Transfer and Transformation

Benchmark Code & Description:

SC.7.P.11.1—Recognize that adding heat to or removing heat from a system may result in a temperature change and possibly a change of state.

SC.7.P.11.2—Investigate and describe the transformation of energy from one form to another.

SC.7.P.11.3—Cite evidence to explain that energy cannot be created nor destroyed, only changed from one form to another.



LEARNING GOAL/OBJECTIVE

Students will learn how applying a flame to a metal solution can produce a distinct color of light. Chemists use this technique to determine the quantity of various metals contained in a sample.



PREREQUISITES

Review:

- Applicable Textbook Sections
- Laboratory Safety (see Support Materials)
- Vocabulary List



VOCABULARY

Absorbance—a measure of the quantity of light absorbed by a sample.

Atomic Absorption Spectroscopy (AAS)—a procedure to determine the quantity of chemical elements using the absorption of optical radiation (light) by free atoms in the gaseous state. This is used to test for metals.

Atomic Emission Spectroscopy (AES)—a method of chemical analysis that uses the intensity of light emitted from a flame, plasma, arc, or spark at a particular wavelength to determine the quantity of an element in a sample. The wavelength of the atomic spectral line gives the identity of the element while the intensity of the emitted light is proportional to the number of atoms of the element.

Atomization—molecule are dissociated into free atoms.

Calibrants—a set of graduations to indicate values or concentrations.

Compliance—conforming to environmental laws, regulations, standards and other requirements.

Compound—a chemical substance formed when two or more elements combine.

Concentration—the amount of a substance per defined space. It usually is expressed in terms of mass per unit volume.

Diluent—in Chemistry it is the component added to lessen concentration.

Dilution—the process of lessening the concentration of a solution.

Element—the basic substance formed by a specific number of atoms.

Hollow Cathode Lamps—the most common radiation source in AAS. Inside the sealed lamp, filled with argon or neon gas at low pressure, is a cylindrical metal cathode containing the element of interest and an anode. A high voltage is applied across the anode and cathode, resulting in an ionization of the fill gas. The gas ions are accelerated towards the cathode and, upon impact on the cathode, sputter cathode material that is excited in the glow discharge to emit the radiation of the sputtered material (i.e., the element of interest).

Ionization—atoms are converted to gaseous ions.

Solvent—a liquid substance capable of dissolving or dispersing one or more other substances.

Spectrophotometer—a device which measures light intensity as a function of its wavelength.

Vaporization—solid particles are converted into gaseous molecules.

Wavelength—the distance measured in the direction of propagation between two points of the same phase in consecutive cycles of a wave.



HANDS-ON ACTIVITY

Task(s): Students use atomic emission to identify metals in different solutions and interpret data to identify and unknown solution.

Provided Materials:

- Clipboard/Pencil
- Lab Coat
- Gloves
- Atomic Emission Worksheet
- Safety Goggles

Career Options: Chemist (BS Degree), Scientist (BS Degree), Microbiologist (BS Degree)

Lesson Steps:

1. Students are provided lab coats and safety goggles to wear.
2. As students are suiting up, a safety presentation will play.
3. The instructor will demonstrate and explain the use of an atomic absorption spectrophotometer.
4. Students will separate into five groups and perform an Atomic Emission test to determine an unknown metal solution.
5. Student will learn how this relates to work done in the lab.
6. Staff will discuss responsibilities, job description and educational requirements of lab personnel.

Introduction: The electrons in an atom occupy different energy levels. At the lowest possible energy level, they are at ground state. When heated, electrons gain energy and are at an excited state. When electrons lose energy and return to ground state, they emit light in a spectrum unique to each metal. Some of these colors can be observed by the naked eye using flame emission.

Procedure: Identify metals by observing the color emitted from a flame.

1. Student 1 take the Lithium loop, place it in the flame and record the color below.
2. Student 2 take the Sodium loop, place it in the flame and record the color below.
3. Student 3 take the Potassium loop, place it in the flame and record the color below.
4. Student 4 take the Barium loop, place it in the flame and record the color below.
5. Student 5 take the unknown loop, place it in the flame and record the color below.
6. Identify the unknown metal.

Metal	Lithium	Sodium	Potassium	Barium	
Color					

Did You Know?

The ability of atoms to produce these colors is put to use by practitioners of the art of fireworks manufacturing. By including different combinations of metal salts in the exploding shell, these artists can produce beautiful displays in nearly all the colors of the rainbow.

