

# Atomic and Electron Structure— Experiment Summaries and Concepts



## ***Bean Bag Isotopes—Relative Abundance and Atomic Mass***

Atoms of the same element that have different masses are called isotopes. How are isotopes distinguished from one another? What is the relationship between the atomic mass of an element and the mass of its isotopes? In this activity, students investigate the mass properties and relative abundance of isotopes for a “bean bag” element and calculate its atomic mass.

## ***Atomic Target Practice—Rutherford Scattering and the Nuclear Atom***

Rutherford’s discovery of the nucleus has been described as a “black box” experiment. In order to explain the results, Rutherford had to unlock the black box—he had to solve the structure of the atom. The purpose of this activity is to discover by indirect means the size and shape of an unknown object which is hidden inside its own “black box.” By tracing the apparent path a marble takes after striking the unseen target from a variety of angles, students can estimate the general size and shape of the target.

## ***Quantum Leap Lab—Probability and Electron Structure***

The popular image of electrons in an atom shows electrons orbiting the nucleus in fixed paths. The image is wrong! How can we dispel this image from students’ minds and help them build an accurate model of the atom and its electrons? In this activity, students drop marbles onto a target and investigate by analogy the relationship between probability and electron structure. The pattern of marble drops on the target sheets simulates the three-dimensional properties of atomic orbitals.

## ***Flame Tests—Atomic Emission and Electron Energy Levels***

Just as a fingerprint is unique to each person, the color of light emitted by an element when it is heated in a flame is also unique to each element. In this experiment, students observe the characteristic colors of light emitted by different metal compounds and use their observations to identify an unknown metal ion.

## ***Atomic Spectra—Light, Energy, and Electron Structure***

The pattern of lines in the atomic emission spectrum of an element provides evidence for the quantization of energy—the most difficult topic in understanding atomic structure. The purpose of this experiment is to study the emission spectra of different light sources, such as fluorescent lights, gas discharge tubes, neon signs, and novelty lamps. The pattern of electron energy levels in atoms literally comes to light as students observe the bright line spectra.

## ***Atomic Coatings—The Size of an Atom***

Counting the number of atoms in a microscopic amount of material might take a billion years—an almost impossible task. How can students truly comprehend the size of an atom? In this experiment, students measure the mass of the zinc coating on a piece of galvanized iron and determine the thickness of the zinc coating. Given the diameter of a zinc atom, students can then “count” the number of layers of atoms in the invisible coating.

## **Concepts**

- Isotope
- Percent abundance
- Mass number
- Atomic mass
- Atomic structure
- Nucleus
- Atomic mass
- Nuclear charge
- Quantum mechanics
- Electron energy levels
- Heisenberg uncertainty principle
- Atomic orbitals
- Atomic emission
- Wavelength and energy of light
- Excited vs. ground states
- Emission spectrum
- Quantization of energy
- Electron energy levels
- Electron transitions
- Atomic size
- Density, mass, and volume