

# Atomic and Electron Structure—Preface

The 20<sup>th</sup> century was known as the atomic age. The discovery of the nuclear and electronic structure of the atom revolutionized not only science but history as well. In chemistry, our knowledge of atomic structure provides a central, unifying principle for understanding the composition and properties of matter. The purpose of *Atomic and Electron Structure*, Volume 3 in the Flinn ChemTopic™ Labs series, is to provide high school chemistry teachers with laboratory activities that will allow students to share in some of the remarkable discoveries of the atomic age. The powerful lessons embedded in these experiments and demonstrations will build a strong foundation for all students as they begin their study of chemistry.

## The Nuclear Atom

The discovery of radioactivity at the end of the 19<sup>th</sup> century provided scientists with the tools to study the internal structure of atoms. One of the first lessons to emerge from the study of radioactivity was that not all atoms of the same element have the same mass. The existence of isotopes is an essential property of matter that determines the atomic mass of an element. In “Bean Bag Isotopes,” students investigate the mass properties and relative abundance of isotopes for a “bean bag” element and calculate its atomic mass.

Radioactive particles also played a central role in the discovery of the nucleus. In “Atomic Target Practice,” students confront a “black-box” problem similar to the one Rutherford faced when he proposed the existence and properties of the nucleus. Rutherford shot alpha particles at atoms in a piece of gold foil and observed the scattering angles. Students shoot marbles at an unknown, unseen object. By tracing the apparent path a marble takes after striking the unknown target from a variety of angles, students can estimate the general size and shape of the target. “The Think Tube” is an alternative black-box demonstration activity that may be used to develop students’ power of observation and deduction.

## Light, Energy, and Electron Structure

All students begin their study of chemistry with prior knowledge of the atom and models or pictures based on that knowledge. One of the most popular “pictures” of the atom is the atomic symbol itself, which shows electrons orbiting the nucleus in fixed paths. This picture is wrong! Unless students have an opportunity to form a new picture of the atom, all they will remember after the new lessons are complete is the old, wrong picture. In the “Quantum Leap Lab,” students drop marbles from specified distances onto a target to simulate the properties of electrons and the electronic structure of atoms. A new picture emerges—a picture that shows only

the probability of finding an electron, not the exact location of any electron.

As students learn more about the electronic structure of the atom, the picture grows to include the idea of quantized energy levels. Two demonstrations, “Energy in Photons” and “The Photoelectric Effect,” illustrate the quantum nature of light and the relationship between light and energy that attests to the existence of quantized energy levels. In the experiment “Atomic Spectra,” students observe and measure the emission spectra of different elements in a variety of light sources. The pattern of electron energy levels reveals itself in the bright line patterns of the atomic spectra. Finally, colorful flame tests provide qualitative evidence for the electronic structure of atoms. Two versions of this classic activity are included in this book. See the “Flame Tests” experiment and the “Oooh! Aaah! Flame Tests” demonstration.

## Atomic Dimensions

Building an accurate model of atomic and electron structure requires some appreciation for the relative size of the nucleus and the electron “cloud” and the overall dimensions of atoms and molecules. In “Mapping Atomic Structure,” students use a basketball and a map of their city to draw a scale model of nuclear and atomic structure. In “Atomic Coatings,” students measure the mass of the zinc coating on a piece of galvanized iron and determine the thickness of the coating. Given the diameter of a zinc atom, students can then “count” the number of layers of zinc atoms in the invisible coating.

## Creativity and Safety in the Lab

*Atomic and Electron Structure* offers the high school chemistry teacher a wide selection of creative simulations and safe adaptations of classic experiments in the history of atomic structure. The hands-on and “minds-on” activities in this book—combined with complete sample data and teachers notes—give you the opportunity to engage your students and increase their knowledge and understanding of atomic structure. All of the experiments and demonstrations in *Atomic and Electron Structure* have been thoroughly tested and retested. You know they will work! Use the experiment summaries and concepts on the following pages to locate the concepts you want to teach and to choose activities that will help you meet your goals.

