CHAPTER 8

Atoms on Display

Chapter Overview

Chapter Challenge

Based on the effectiveness of a science museum to entertain and educate people about science, students are challenged to develop an exhibit that explains the structure of an atom in a way that captures the audience's interest within 30 seconds. In their exhibit, they have to include the distinct parts of an atom, provide information on how the atom is held together, and explain the role of models in developing an atom. In addition, students must show the strengths and limitations of various atomic models, educate visitors on why indirect methods of measuring the size of an atom are important, and include safety features.

The *Chapter Challenge* evaluates how skillfully the exhibit is presented—whether it is interactive, has safety features, and explains concepts thoroughly in writing. The exhibit should also include posters that present an overview of what visitors will be seeing and a review of what they have seen as they conclude their visit. Students' creativity is further tested when they are required to construct a poster, a booklet, or a toy that can be sold at the museum store.

As you discuss the *Chapter Challenge*, point out that their exhibit is meant to encapsulate the essential physics content presented in this chapter in an engaging and informative manner. Students might find some aspects of the challenge difficult and may need to be reassured that once they have completed all the sections they will have the necessary knowledge and confidence to develop their exhibit. Let students know that they will be graded using criteria that will be decided by them as a class.

Chapter Summary

Atoms on Display investigates the structure of an atom and its size, explaining how models were used by scientists to develop an understanding of an atom. Students

- investigate static electricity and Coulomb's law to prepare them to understand the forces holding the atom together.
- use inquiry to find the number of coins enclosed in a film canister. They then learn how related techniques were used to determine that electric charge is quantized.
- use statistical measurements to estimate the size of a penny. They compare their statistical approach with direct measurement. Finally, they compare their experiment with Rutherford's experiment to explain the size of the nucleus in relation to the atom.
- observe the spectral lines from several gases using a spectrometer and develop the Bohr model of a hydrogen atom. They calculate the wavelengths of light as electrons jump from one orbit to another in the Bohr atom.
- describe the wave-particle duality of light and electrons and solve problems based on photoelectric effect.
- learn that a force called the strong force is needed to overcome the Coulomb force of repulsion and holds nuclear particles together. Students are then introduced to Feynman diagrams to understand how forces are transmitted.
- use the concept of probability to understand radioactive decay and learn that the rate of decay is defined by half-life to determine the age of objects. They then complete nuclear equations for alpha, beta, and gamma decays.

- calculate the mass defect and binding energies of nuclei by using Einstein's famous equation, $E = mc^2$.
- graph the average binding energy per nucleon versus the atomic mass for selected elements of the periodic table, infer the relative stability of different elements, and explore how nuclear fission and fusion reactions release energy.

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