

LESSON 1**Pacing Guide:** Days 1–2**AP Topics:** I.A.1, I.A.2, I.A.3, II.A.2.b

Atomic Structure and Atomic Theory

INTRODUCE THE LESSON**Learning Objectives:****Students will**

1. describe Dalton's theory of atoms and show the significance of Gay-Lussac's experiment.
2. summarize the experiments that characterized the structure of the atom.
3. describe features of subatomic particles.

INSTRUCT Topic 1**Dalton's Atomic Theory, PE pp. 46–48 (AP Topics I.A.1, I.A.2, II.A.2.b)****Lecture/Discussion Topics**

Dalton's theory of the atom consists of four basic principles:

- elements are composed of tiny particles called atoms;
- atoms of different elements are different;
- chemical compounds are formed when atoms combine with each other; and
- chemical reactions involve reorganization of the atoms.

Despite errors Dalton may have made in assigning the masses of compounds, his principles were correct. Dalton's ideas on atomic mass were later corrected by Gay-Lussac and Avogadro. Gay-Lussac performed experiments to determine the absolute formulas for many compounds, and Avogadro assumed that the number of molecules in gases at the same temperature, pressure, and volume were the same.

In-class Discussion Questions, PE p. 74, #2, 7, 9, 10

Instructor's Resource Guide, pp. 64–66

React, *Interactive Course Guide,* p. 4 #2

Instructor's Resource Guide, p. 127

INSTRUCT Topic 2**Early Experiments to Characterize the Atom, PE pp. 49–53 (AP Topic I.A.1)****Lecture/Discussion Topics**

The first experiment that led to an understanding of the atom was carried out by J. J. Thomson, who found that when high voltage electricity was applied to a cathode ray tube, a stream of negatively-charged particles called electrons was produced. Thomson was able to determine the charge-to-mass ratio of the electron, and postulated that since many different types of metals were able to produce these electrons at high voltages, electrons must be fundamental to all metals or atoms. Thomson assumed that the atom was made of a cloud of positive

charges with electrons embedded in it. This became known as the plum pudding model. Robert Milikan later determined the magnitude of the electron charge, and eventually, the mass of the electron using Thomson's charge-to-mass ratio.

Henri Becquerel discovered that uranium emitted radiation in the absence of light, and called this phenomenon radioactivity. Three types of radioactivity have been identified: alpha, beta, and gamma particles. Alpha particles are positively-charged helium atoms, beta particles are high speed electrons, and gamma particles are high energy photons.

Ernest Rutherford performed experiments to test Thomson's plum pudding model. From his gold foil experiment in which he shot alpha particles at the foil, he deduced Thomson's model could not be correct. The atom was not made of positively-charged particles with negatively-charged electrons embedded randomly, but was well organized with a definite nucleus and electrons surrounding this nucleus.

In-class Discussion Questions, PE p. 31, #4

Instructor's Resource Guide, p. 65

INSTRUCT Topic 3

The Modern View of Atomic Structure, PE pp. 53–56 (AP Topics I.A.1, I.A.3)

Lecture/Discussion Topics

All atoms contain the three particles – protons, neutrons, and electrons – but each atom differs in the number and arrangement of these particles. Because of this, the atoms of different elements, with different numbers of protons and electrons, show different chemical behavior. Elements that contain the same number of protons, but different numbers of neutrons and mass, are called isotopes.

In-class Discussion Questions, PE p. 74, #5

Instructor's Resource Guide, p. 65

INTEGRATE TECHNOLOGY

Transparencies: 11, 12, 13, 14, 15

HM ClassPrep™

Videos: A-2: Electron Beam; A-9: Stoichiometry: Gay-Lussac's Law of Combining Volumes; C-2: Cathode Ray Tube

Video and Animations DVD: Cathode Ray Tube; Milikan Oil Drop Experiment

Go to

<http://college.hmco.com/chemistry/general/zumdahl/chemistry/6e/instructors/index.html>

<http://college.hmco.com/chemistry/general/zumdahl/chemistry/6e/students/index.html>

for web links related to Zumdahl, Chemistry, 6th edition textbook. The student web site includes The Ace Practice Tests (password protected).

REVIEW

Challenge Problems, PE pp. 78–79, #83, 87

Complete Solutions Guide, pp. 27–29

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STUDENT SELF-CHECK

Topic 1: Examples and Exercises, *Study Guide*, pp. 23–25
Questions and Exercises, PE pp. 75–77, #15, 16, 27, 28, 87
Complete Solutions Guide, pp. 18–28

Topic 2: Examples and Exercises, *Study Guide*, p. 26
Questions and Exercises, PE pp. 75–76, #17, 18, 19, 20, 33, 34
Complete Solutions Guide, pp. 18–28

Topic 3: Examples and Exercises, *Study Guide*, pp. 26–27, p. 38, #5–9
Questions and Exercises, PE pp. 75–78, #19, 21, 30, 73, 74
Complete Solutions Guide, pp. 18–28

ASSESS

HM Testing v6.1 Test Item File #3, 4, 10–16, 18–23, 25–30, 32, 33, 44, 57–59