Oak Meadow
YOUR TRUSTED PARTNER IN JOYFUL LEARNING

Chemistry with Lab

Chemistry is the study of matter through observation and experimentation. In this course, students get a rigorous hands-on introduction to the tools, terms, and practices of the study of Chemistry. The course syllabus includes 36 engaging and thought-provoking lessons, affording students a chance to read, write, and reflect on chemistry principles and their real-world applications. The course features 32 laboratory activities, ranging from simple calculations and graphs to full-featured experiments with solutions, gases, and electrochemical cells. These activities employ standard household items, while more specialized tools and substances are included in the Oak Meadow Lab Kit. This course fulfills all the standards of a college preparatory Chemistry course.

The following materials are needed for this course:

Oak Meadow Chemistry Coursebook

MicroChem Lab Kit (includes Lab Manual)

Chemistry (Prentice Hall)

The Joy of Chemistry (Prometheus Book)

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Chemistry

Oak Meadow
Coursebook

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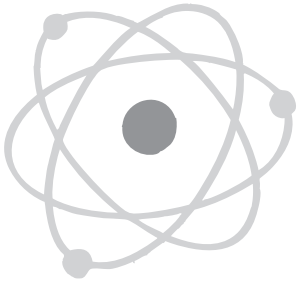

Contents

LESSON

4 Atomic Structure

The color-enhanced image of the iron atoms on page 100 in your textbook is processed data from a scanning tunneling microscope. We can't really see atoms as we see other things. They're too small! Is that picture of iron atoms real? Actually, scientists are able to move these atoms around and arrange them in patterns. Using instruments like the scanning tunneling microscope, you can watch "videos" of atoms jumping from one configuration to another. In Lesson 4, we will look more closely at the structures of these small building blocks of the world, which scientists call *atoms*.

Section 4.1

Learning Objectives:

- You will be able to describe Dalton's ideas about atoms.
- You will be able to explain Dalton's atomic theory.
- You will be able to identify the instrument that is used to observe individual atoms.

Assignments:

1. **Read Section 4.1 on pp. 100-103 in your textbook.**

2. **Answer the odd-numbered questions in the "4.1 Section Assessment" on pg. 103 in your textbook.**

Section 4.2

In this section, particularly, notice how atoms used to be characterized strictly by experimental evidence of other, seemingly unrelated, data. Would you be able to imagine that the glowing beam produced in Thompson's experiment was a stream of tiny negatively charged particles? These experiments were conducted only a bit more than 100 years ago!

Learning Objectives:

- You will be able to identify three kinds of subatomic particles.
- You will be able to describe the structure of atoms according to the Rutherford atomic model.

Assignments:

1. **Read Section 4.2 on pp. 104-108 in your textbook.**

2. **Look at all the questions in the "4.2 Section Assessment" on pg. 108 in your textbook, but answer only questions 10 and 11.**

3. **Writing assignment: Rutherford was quoted saying: "It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you." Explain what is meant by this quote, in terms of Rutherford's famous experiment and what it meant for our understanding of atomic structure. Can you think of a time when something really surprised you, and affected the way you felt about something in your own life? Alternatively, you can make up a fictional account of a discovery that caused a shift in someone's way of thinking.** Ruth Lewin Sime, Journal of Chemical Education 66 (1989): 373

Section 4.3

This section introduces you to the elements and how they are arranged on the periodic table. You should have enough understanding of chemistry vocabulary and chemical concepts to take a first look at the elements with a proper appreciation for what the periodic table is and what it represents. This section explains what all materials are made of and how they are different.

Learning Objectives:

- You will be able to explain what makes elements and isotopes different from each other.
- You will be able to calculate the number of neutrons in an atom.
- You will be able to calculate the atomic mass of an element.
- You will be able to explain why chemists use the periodic table.

Assignments:

1. **Read Section 4.3 on pp. 110-119 in your textbook.**

2. **Complete Practice Problems 17-24 on pp. 112-113 and 116-117 in your textbook.**

3. **Answer all of the questions in the "4.3 Section Assessment" on pg. 119 in your textbook.**

Chapter 4 Assessment

Optional

- **Answer Questions 35, 39, 41, 43, 47, 51, and 55 under "Reviewing Content" on pg. 122 in your textbook.**

- **Answer Questions 61 and 65 under "Understanding Concepts" on pg. 123 in your textbook.**

- **Answer Question 77 under "Critical Thinking" and Question 81 under "Concept Challenge" on pg. 124 in your textbook.**

Lesson 4 Test

Complete the Lesson 4 Test, located on pg. 125 in your textbook.

Lesson 4 Summary

In Lesson 4 we were introduced to the elements, and to the atoms of those elements, in a way that allows us to study and understand them on an entirely different level. Carbon is still carbon: It's the stuff charcoal is made of; but now we have a better understanding of carbon's relationship to other elements, and we know that more than one type of carbon atom exists.

The atom is below our level of ordinary perception, yet we must find a way to "visualize" and make sense of it. A model for the atom has been presented for our consideration and use. Perhaps it represents a new viewpoint that may not be exactly our own, but we can make it our own. This atomic model, like language, can help us discuss different materials, predict their behavior, describe their conditions, and, hopefully, control them in directions that are optimum for us.

Your completed work should be maintained in your homeschooling portfolio or, if you are enrolled, sent to your Oak Meadow teacher at this time for feedback and evaluation. Please be sure to organize and label each assignment clearly.

LESSON

5 Models of the Atom

We are fortunate today to have pictures of atoms that have been obtained by direct measurements. At the beginning of the last chapter, we mentioned the color-enhanced image of iron atoms on page 100 in your textbook. These atoms were arranged on a copper surface and scanned with a sensitive and sharp tip that could be delicately adjusted extremely close to the sample surface. Iron atoms don't really "look" like that. We can't "see" them. Nevertheless, we can get a pretty good idea of what they would look like if we could make ourselves, and the light we use to see, really small and "spray paint" their "surfaces" with orange paint! The ripples in the picture are electrons "trapped" within the surrounding 48 iron atoms.

This might help you visualize real atoms, even though real atoms would not actually appear this way. The importance is that we might be very close, indeed, to more workable models of atoms than ever before.

Section 5.1

Learning Objectives:

- You will be able to identify the inadequacies of the Rutherford model of the atom.
- You will be able to explain the fundamental contributions of Bohr's concept of the atom.
- You will be able to describe the energies and positions of electrons according to the quantum mechanical model.
- You will be able to describe how the shapes of orbitals differ.

Assignments:

1. **Read Section 5.1 on pp. 126-132 in your textbook.**

2. **Answer the odd-numbered questions in the "5.1 Section Assessment" on pg. 132 in your textbook.**

3. **Complete investigation 4, "Atomic Orbital Models," in your MicroChem lab manual. Take pictures or make drawings of your models and answer all questions.**

Section 5.2

Learning Objectives:

- You will be able to describe how to write the electron configuration for an atom.
- You will be able to explain why the actual electron configurations for some elements differ from those predicted by the aufbau principle.

At this point, we're fast approaching the very heart of how and why matter behaves as it does. Remember, this is still partly theory, but it is highly workable. If you can understand how electrons are actually arranged in atoms, you've got most of chemistry figured out. The explanations for why water is wet and how matches burn are all based on these concepts.

Assignments:

1. **Read Section 5.2 on pp. 133-136 in your textbook.**

2. **Complete Practice Problems 8 and 9 on pg. 135 in your textbook.**

3. **Look at all the questions in the "5.2 Section Assessment" on pg. 136 in your textbook, and answer Questions 11 and 13.**

Section 5.3

Learning Objectives:

- You will be able to describe the relationship between the wavelength and frequency of light.
- You will identify the source of atomic emission spectra.
- You will explain how the frequencies of emitted light are related to changes in electron energies.
- You will be able to distinguish between quantum mechanics and classical mechanics.

Assignments:

1. **Read Section 5.3 on pp. 138-146 in your textbook.**

2. **Writing Assignment:** Not everyone has the same ability to see visible light. *Color blindness* is a condition where people have difficulty distinguishing certain colors. Still, nature has provided most of us with the ability to see what is called "visible light." **Why do you think nature has given us the ability to see only the visible light section of the electromagnetic spectrum pictured on page 139? Wouldn't it be better if we could see radar waves and infrared waves as well? Please write one paragraph expressing your opinion.**

3. **Complete Practice Problems 14 and 15 on pg. 140 in your textbook.**

4. **Answer Questions 17, 19, and 21 in the "5.3 Section Assessment" on pg. 146 in your textbook.**

Chapter 5 Assessment

Optional

- **Answer the odd-numbered questions up to Question 39 under "Reviewing Content" on pg. 149 in your textbook. Answer Question 49 as well.**

- **Answer Questions 51, 53, and 57 under "Understanding Concepts" on pg. 150 in your textbook.**

- **Consider the questions under "Critical Thinking" and "Concept Challenge" on pg. 151 in your textbook.**

  Note: For Question 75 under "Concept Challenge," the authors have given the answers in moles. This is how chemists usually report ionization energies. The answers per atom are H = 2.18 × 10^{-22}J/atom and so on. The answer given is the energy required to ionize one mole of H atoms.

Lesson 5 Test

Complete the Lesson 5 Test, found on pg. 153 in your textbook.

Lesson 5 Summary

Lesson 5 focuses on the models of the atom presented in Chapter 5 in your textbook. This lesson brings you up-to-date on current views and research about the electronic structure of atoms. This means that you are looking at the same basic view of atoms that professional chemists consider in their research and calculations. This is no small matter, no pun intended. In addition, the laboratory included in this lesson parallels the actual experiments and observations made by the scientists who developed these models. Much of this theory is based on very careful observation of the "colors" exhibited by emission spectra.