Study Guide

Interactive Textbook

- Complete student edition
- Section and chapter self-assessments
- Assessment reports for teachers

Help Students Read

L2

Building Vocabulary

Word/Part Analysis Tell students that they can use what they know about word parts to figure out the meaning of words. Instruct students to separate the word parts from *nonmetal* and *metalloid*. Suggest that they look at the word *metal* if they have difficulty. Then, have them look up each word part and write the definitions of these words using the definitions they found for the word parts. (Non- *means "not" and* -oid *means "having the appearance of" or "resembles."*)

Paraphrasing By writing the definitions of key terms in their own words, students can relate meaning to their own experiences. You might have students paraphrase all the key terms, or allow them to choose the terms that are most troublesome. Then have them read the text associated with the terms and find the terms in a dictionary or encyclopedia. From these definitions, challenge students to write another definition in their own words.

Connecting Concepts

Concept Maps Help students develop one way to show how the information in this chapter is related. Elements are organized in the periodic table according to their properties. These properties result from the properties of atoms. Have students brainstorm to identify the key concepts, key terms, details, and examples. Then write each item on a self-stick note and attach it at random to chart paper or to the board.

Tell students that this concept map will be organized in hierarchical order and to begin at the top with the key concepts. Ask students these questions to guide them to categorize the information on the self-stick notes: **What are atoms? How are elements organized? What are the properties of metals, nonmetals, and metalloids? How do stars form elements?**

Prompt students by using connecting words or phrases, such as "include," "are made up of," and "have properties of," to indicate the basis for the organization of the map. The phrases should form a sentence between or among a set of concepts.

Answer

Accept logical presentations by students.

All in One Teaching Resources

- Key Terms Review: *Elements and the Periodic Table*
- Connecting Concepts: *Elements and the Periodic Table*

Chapter

Study Guide

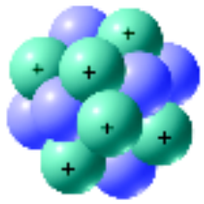
1 Introduction to Atoms

Key Concepts

- Atoms are made of even smaller particles called protons, neutrons, and electrons.
- An element can be identified by the number of protons in the nucleus of its atoms.
- Because atoms are so small, scientists create models to describe them.

Key Terms

nucleus
proton
neutron
electron
atomic number
isotope
mass number
model



2 Organizing the Elements

Key Concepts

- Mendeleev noticed that a pattern of properties appeared when he arranged the elements in order of increasing atomic mass.
- Each square in the periodic table includes the element's atomic number, chemical symbol, name, and atomic mass.
- The properties of an element can be predicted from its location in the periodic table.

Key Terms

atomic mass
periodic table
chemical symbol
period
group

3 Metals

Key Concepts

- The physical properties of metals include shininess, malleability, ductility, and conductivity.
- The reactivity of metals tends to decrease as you move from left to right across the periodic table.
- Elements that follow uranium in the periodic table are made—or synthesized—when nuclear particles are forced to crash into one another.

Key Terms

metal
malleable
ductile
conductivity
reactivity
corrosion
alkali metal
alkaline earth metal
transition metal
alloy
particle accelerator

4 Nonmetals and Metalloids

Key Concepts

- Most nonmetals are poor conductors of heat and electricity and are reactive with other elements. Solid nonmetals are dull and brittle.
- The most useful property of the metalloids is their varying ability to conduct electricity.

Key Terms

nonmetal
diatomic molecule
halogen
noble gas
metalloid
semiconductor

5 Elements From Stardust

Key Concepts

- Nuclear fusion, which occurs in stars on a huge scale, combines smaller nuclei into larger nuclei, creating heavier elements.
- A supernova provides enough energy for the nuclear fusion reactions that create the heaviest elements.

Key Terms

plasma
nuclear fusion
nebula
supernova

Review and Assessment

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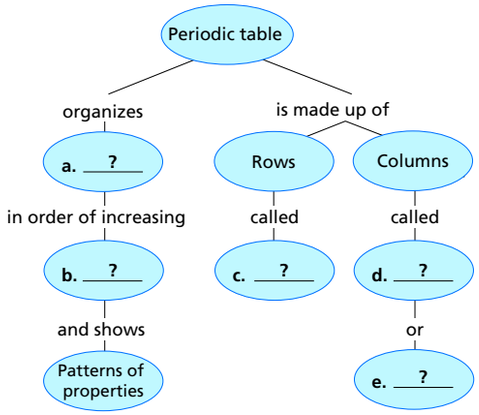
Organizing Information

Concept Mapping Copy the concept map about the periodic table onto a sheet of paper. Then complete it and add a title. (For more on Concept Mapping, see the Skills Handbook.)



Reviewing Key Terms

Choose the letter of the best answer.

1. The atomic number of an atom is determined by the number of
   a. protons. **b.** electrons.
   c. neutrons. **d.** isotopes.
2. In the modern periodic table, elements are arranged
   a. according to atomic mass.
   b. according to atomic number.
   c. in alphabetical order.
   d. according to the number of neutrons in their nuclei.
3. Of the following, the group that contains elements that are the most reactive is the
   a. alkali metals.
   b. alkaline earth metals.
   c. carbon family.
   d. noble gases.
4. Unlike metals, many nonmetals are
   a. good conductors of heat and electricity.
   b. malleable and ductile.
   c. gases at room temperature.
   d. shiny.
5. At the hot temperatures of stars, electrons are stripped away from nuclei. This process forms a state of matter called
   a. a heavy element. **b.** liquid.
   c. plasma. **d.** supernova.
6. Inside the sun, nuclear fusion creates helium nuclei from
   a. oxygen nuclei.
   b. beryllium nuclei.
   c. carbon nuclei.
   d. hydrogen nuclei.

Writing in Science

News Report Imagine you are writing an article for a space magazine about the life cycle of a star. Which elements are produced in a star at different stages? How are these elements distributed into space?

Discovery Channel SCHOOL
Elements and the Periodic Table
Video Preview
Video Field Trip
Video Assessment

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All in One Teaching Resources

- Transparency K31
- Chapter Test
- Performance Assessment Teacher Notes
- Performance Assessment Student Worksheet
- Performance Assessment Scoring Rubric

ExamView® Computer Test Bank CD-ROM

Review and Assessment

Organizing Information

Sample title: Organization of the Periodic Table
a. Elements
b. Atomic number
c. Periods
d. Families (or Groups)
e. Groups (or Families)

Reviewing Key Terms

1. a **2.** b **3.** a **4.** c **5.** c **6.** d

Writing in Science

Writing Mode Description

Scoring Rubric

4 Exceeds criteria; includes a highly detailed and accurate description of the life cycle of a star, including what elements are formed and how they are dispersed
3 Meets criteria
2 Includes a brief description that contains a few errors and/or omissions
1 Includes a sketchy description that contains serious errors and/or omissions

Elements and the Periodic Table

Show the Video Assessment to review chapter content and as a prompt for the writing assignment. Discussion questions: **What must happen to a star in order for the heaviest elements to be created?** *(The star must explode.)* **How do elements from the stars continue to reach Earth?** *(From cosmic bodies such as meteorites striking Earth's surface)*

Checking Concepts

7. Two isotopes of an element have different numbers of neutrons in the nuclei of their atoms.

8. Phosphorus has an average atomic mass nearest to 31.

9. Sample answer: Fluorine and bromine have properties similar to those of chlorine.

10. Tin and lead are the two elements in Group 14 that are most likely to be malleable and good conductors of electricity.

11. Iodine is most likely to be a poor conductor of electricity and a brittle solid at room temperature.

12. Stars like the sun do not contain enough energy to produce elements heavier than oxygen.

Thinking Critically

13. Proton: mass—about one amu, location—nucleus; neutron: mass—about one amu, location—nucleus; electron: mass—about 1/2000 amu, location—outside the nucleus

14. (**A**) 28—atomic number; (**B**) Ni—chemical symbol; (**C**) Nickel—name; (**D**) 58.71—atomic mass

15. Particle accelerators cause nuclei to crash into the nuclei of other elements with enough energy to combine into nuclei of new elements.

16. The materials used in computer chips are semiconductors, which have the property of conducting electricity under some conditions and not under other conditions.

17. Because of their like (positive) charges, atomic nuclei repel one another strongly. The extremely high pressures found in stars squeeze the nuclei together.

Review and Assessment

Checking Concepts

7. How do two isotopes of an element differ from one another?

8. What element has an average atomic mass nearest to 31?

9. Use the periodic table to name two elements that have properties similar to those of chlorine (Cl).

10. Which two elements in Group 14 on the periodic table are most likely to be malleable and good conductors of electricity?

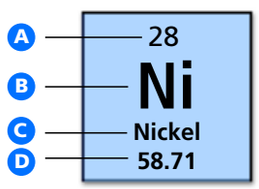
11. Of the elements oxygen (O), zinc (Zn), and iodine (I), which one would you predict to be a poor conductor of electricity and a brittle solid at room temperature?

12. Why are elements heavier than oxygen *not* produced in stars like the sun?

Thinking Critically

13. **Comparing and Contrasting** List the three kinds of particles that make up atoms, and compare their masses and their locations in an atom.

14. **Applying Concepts** Below is a square taken from the periodic table. Identify the type of information given by each labeled item.



15. **Applying Concepts** Explain how particle accelerators are used to synthesize elements with atomic numbers above 95.

16. **Inferring** What property of the materials used in computer chips makes them useful as switches that turn electricity on and off?

17. **Relating Cause and Effect** Why is extremely high pressure required to cause atomic nuclei to crash into one another in stars?

Applying Skills

Use the table to answer Questions 18–22.

The table below list properties of five elements.

Element	Appearance	Atomic Mass	Conducts Electricity
A	Invisible gas	14.007	No
B	Invisible gas	39.948	No
C	Hard, silvery solid	40.08	Yes
D	Silvery liquid	200.59	Yes
E	Shiny, bluish-white solid	207.2	Slightly

18. **Classifying** Classify each element in the table as a metal or a nonmetal. Explain your answers.

19. **Inferring** Both elements B and C have an atomic mass close to 40. How is this similarity possible?

20. **Drawing Conclusions** Use the periodic table to identify the five elements.

21. **Predicting** Would you expect elements A and B to have similar chemical properties? Why or why not?

22. **Predicting** Would you expect to find element C uncombined in nature? Explain.

Lab zone Chapter Project

Performance Assessment Display the chart showing the metals you studied. Be ready to discuss which properties are common to all metals. Describe other properties of metals you could not test. List all the properties that could be used to find out whether an unknown element is a metal.

Lab zone Chapter Project

L3

Performance Assessment In their class presentations, students should note any differences between expected and observed results and hypothesize reasons for these differences. Promote a cooperative spirit during presentations. Stress that there are many different properties to test, several ways to test each property, and properties (such as reactivities with many other elements) that could not be tested. Ask students to keep notes on the presentations, noting differences between experimental designs. Once all presentations have been made, lead a class discussion about which properties are common to all metals. One such property is electrical conductivity.

Standardized Test Prep

Test-Taking Tip

Reading All the Answer Choices

In answering a multiple-choice question, always read *every* answer choice before selecting the answer you think is correct. In some cases, all of the responses may be true statements, but only one answers the question correctly. In the sample question below, for example, you are asked why a carbon atom is heavier than the total mass of its protons and electrons. Each answer choice is a statement. If you look at each answer choice by itself, it expresses something that is correct. However, only one of the answer choices explains why a carbon atom is heavier than the total mass of its protons and electrons.

Sample Question

Why is the mass of a carbon atom greater than the total mass of its protons and electrons?

A The mass of a proton is greater than the mass of an electron.
B A proton is positively charged and an electron is negatively charged.
C Most of the atom's volume is the sphere-shaped cloud of electrons.
D One or more neutrons in the nucleus add mass to the atom.

Answer

The correct answer is **D**. With the exception of some hydrogen atoms, every atom contains one or more neutrons. The mass of a neutron is about the same as that of a proton. Choices **A, B,** and **C** are true statements about the subatomic particles that make up every atom. However, none of the statements answers the question.

Choose the letter of the best answer.

1. Elements that are gases at room temperature are likely to be classified as which of the following?
A metals
B nonmetals
C metalloids
D unreactive

2. Which property of aluminum makes it a suitable metal for soft drink cans?
F It has good electrical conductivity.
G It can be hammered into a thin sheet (malleability).
H It can be drawn into long wires (ductility).
J It can reflect light (shininess).

Use the table below to answer Questions 3–5.

8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **Ne** Neon 20.179
16 **S** Sulfur 32.06	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948

3. Which element has an atomic number of 18?
A hydrogen
B oxygen
C fluorine
D argon

4. An atom of fluorine has 10 neutrons. What is the total number of other subatomic particles in this atom?
F 9 protons and 9 electrons
G 9 protons and 19 electrons
H 10 protons and 10 electrons
J 19 protons and 19 electrons

5. Which combination of elements represents part of a group, or family, of the periodic table?
A oxygen, fluorine, and neon
B sulfur, chlorine, and argon
C fluorine and chlorine
D oxygen and chlorine

Constructed Response

6. Describe the modern model of the atom. Your discussion should include the three main types of particles that make up an atom and the charge and location of each. Include an explanation of the overall charge on an atom.

Applying Skills

18. Elements A and B are most likely nonmetals because they are gases that do not conduct electricity. Elements C and D are most likely metals because they are silvery and conduct electricity. Element E is a weak conductor, but it is most likely a metal because of its appearance.

19. Almost all of the mass of an atom comes from its protons and neutrons. Although each element has a characteristic number of protons, the number of neutrons can vary and may cause two different elements to have similar atomic masses.

20. A: nitrogen; B: argon; C: calcium; D: mercury; E: lead

21. No. Element A (nitrogen) and element B (argon) are in different groups, or families.

22. No. Element C (calcium) is an alkaline earth metal. Elements in this group are not found as elements in nature.

Standardized Test Prep

1. B **2.** G **3.** D **4.** F **5.** C

6. The modern model of an atom includes three main types of atomic particles called protons, neutrons, and electrons. The protons and neutrons are clustered together in an atom's central core, or nucleus. Electrons move rapidly in the space outside the nucleus. Protons are positively charged, electrons are negatively charged, and neutrons have no charge. An atom has an equal number of protons and electrons, so its overall charge is neutral.