Chapter 11 Study Guide

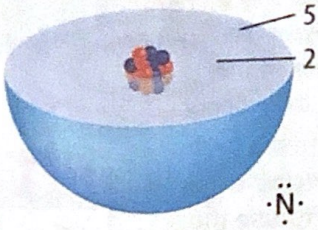
WebQuest

THE BIG IDEA Elements can join together by sharing, transferring, or pooling electrons to make chemical compounds.

Key Concepts Summary

Lesson 1: Electrons and Energy Levels

- Electrons with more energy are farther from the atom's nucleus and are in a higher energy level.
- Atoms with fewer than eight **valence electrons** gain, lose, or share valence electrons and form stable compounds. Atoms in stable compounds have the same electron arrangement as a noble gas.



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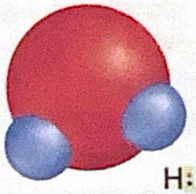
Lesson 2: Compounds, Chemical Formulas, and Covalent Bonds

- A compound and the elements it is made from have different chemical and physical properties.
- A **covalent bond** forms when two nonmetal atoms share valence electrons. Common properties of covalent compounds include low melting points and low boiling points. They are usually gas or liquid at room temperature and poor conductors of electricity.

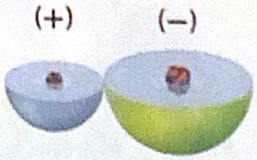


H:Ö:H

- Water is a polar compound because the oxygen atom pulls more strongly on the shared valence electrons than the hydrogen atoms do.

Lesson 3: Ionic and Metallic Bonds

- **Ionic bonds** form when valence electrons move from a metal atom to a nonmetal atom.
- An ionic compound is held together by ionic bonds, which are attractions between positively and negatively charged **ions.**
- A **metallic bond** forms when valence electrons are pooled among many metal atoms.



Na^+ $:\ddot{Cl}:^-$

Vocabulary

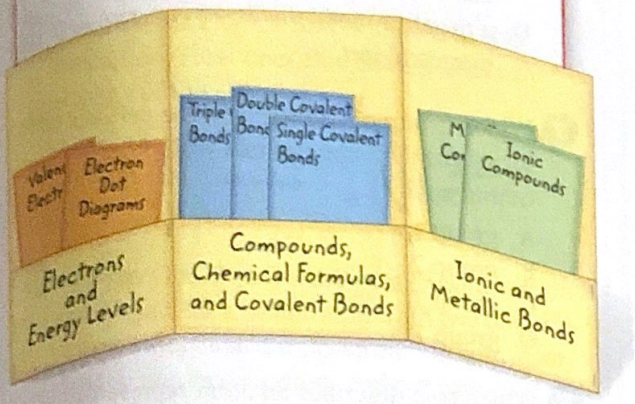
chemical bond p. 382
valence electron p. 384
electron dot diagram p. 385
covalent bond p. 391
molecule p. 392
polar molecule p. 393
chemical formula p. 394
ion p. 398
ionic bond p. 400
metallic bond p. 401

Study Guide

Vocabulary eFlashcards
Vocabulary eGames
Personal Tutor

FOLDABLES Chapter Project

Assemble your lesson Foldables as shown to make a Chapter Project. Use the project to review what you have learned in this chapter.



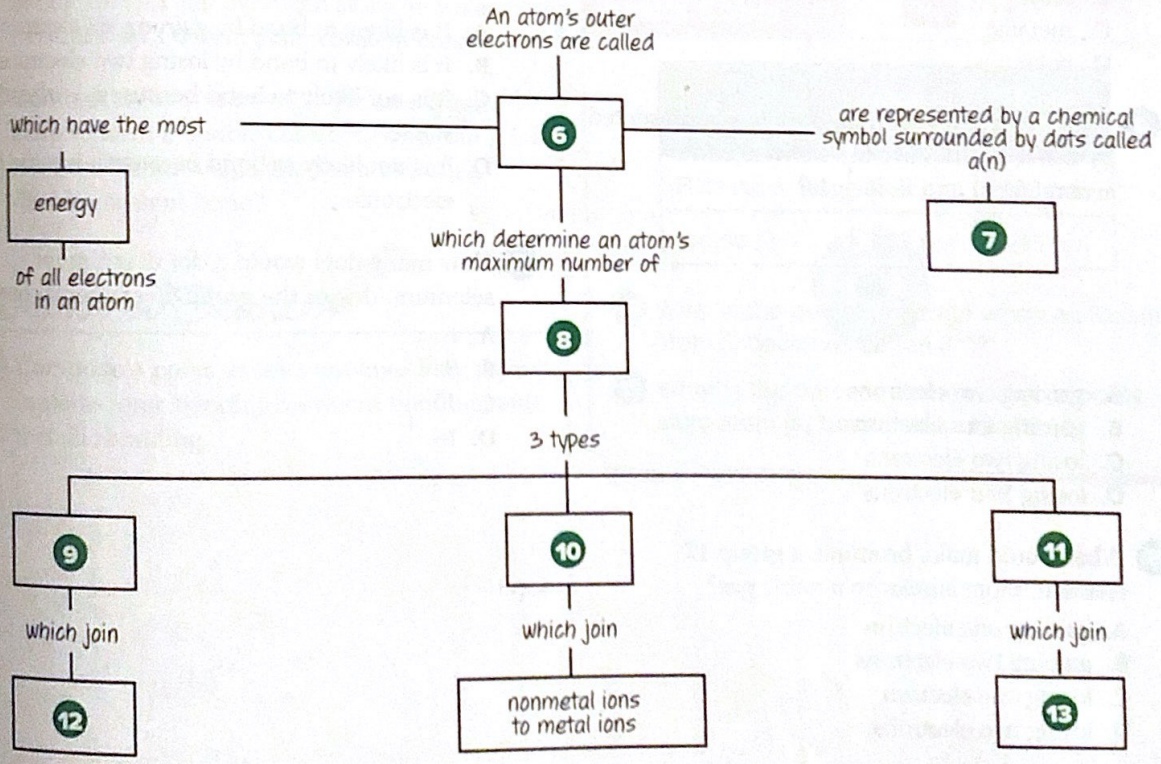
Use Vocabulary

1. The force that holds atoms together is called a(n) _____.
2. You can predict the number of bonds an atom can form by drawing its _____.
3. The nitrogen and hydrogen atoms that make up ammonia (NH_3) are held together by a(n) _____ because the atoms are both nonmetals.
4. Two hydrogen atoms and one oxygen atom together are a _____ of water.
5. A positively charged sodium ion and a negatively charged chlorine ion are joined by a(n) _____ to form the compound sodium chloride.

Link Vocabulary and Key Concepts

Interactive Concept Map

Copy this concept map, and then use vocabulary terms from the previous page and other terms from the chapter to complete the concept map.



Understand Key Concepts

1. Atoms lose, gain, or share electrons and become as chemically stable as
   A. an electron.
   B. an ion.
   C. a metal.
   D. a noble gas.

2. Which is the correct electron dot diagram for boron, one of the group 13 elements?
   A. $\dot{B}\cdot$
   B. $\cdot\ddot{B}:$
   C. $:\ddot{B}:$
   D. $\cdot\ddot{B}\cdot$

3. If an electron transfers from one atom to another atom, what type of bond will most likely form?
   A. covalent
   B. ionic
   C. metallic
   D. polar

4. What change would make an atom represented by this diagram have the same electron arrangement as a noble gas?

   A. gaining two electrons
   B. gaining four electrons
   C. losing two electrons
   D. losing four electrons

5. What would make bromine, a group 17 element, more similar to a noble gas?
   A. gaining one electron
   B. gaining two electrons
   C. losing one electron
   D. losing two electrons

6. Which would most likely be joined by an ionic bond?
   A. a positive metal ion and a positive nonmetal ion
   B. a positive metal ion and a negative nonmetal ion
   C. a negative metal ion and a positive nonmetal ion
   D. a negative metal ion and a negative nonmetal ion

7. Which group of elements on the periodic table forms covalent compounds with other nonmetals?
   A. group 1
   B. group 2
   C. group 17
   D. group 18

8. Which best describes an atom represented by this diagram?

   A. It is likely to bond by gaining six electrons.
   B. It is likely to bond by losing two electrons.
   C. It is not likely to bond because it is already stable.
   D. It is not likely to bond because it has too few electrons.

9. How many dots would a dot diagram for selenium, one of the group 16 elements, have?
   A. 6
   B. 8
   C. 10
   D. 16

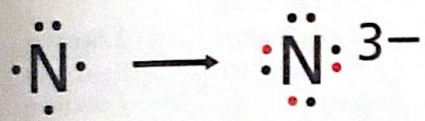
Online Test Practice

Critical Thinking

10 **Classify** Use the periodic table to classify the elements potassium (K), bromine (Br), and argon (Ar) according to how likely their atoms are to do the following.

a. lose electrons to form positive ions
b. gain electrons to form negative ions
c. neither gain nor lose electrons

11 **Describe** the change that is shown in this illustration. How does this change affect the stability of the atom?



12 **Analyze** One of your classmates draws an electron dot diagram for a helium atom with two dots. He tells you that these dots mean each helium atom has two unpaired electrons and can gain, lose, or share electrons to have four pairs of valence electrons and become stable. What is wrong with your classmate's argument?

13 **Explain** why the hydrogen atoms in a hydrogen gas molecule (H_2) form nonpolar covalent bonds but the oxygen and hydrogen atoms in water molecules (H_2O) form polar covalent bonds.

14 **Contrast** Why is it possible for an oxygen atom to form a double covalent bond, but it is not possible for a chlorine atom to form a double covalent bond?

Writing in Science

15 **Compose** a poem at least ten lines long that explains ionic bonding, covalent bonding, and metallic bonding.

REVIEW THE BIG IDEA

16 Which types of atoms pool their valence electrons to form a "sea of electrons"?

17 Describe a way in which elements joining together to form chemical compounds is similar to the way the letters on a computer keyboard join together to form words.

Math Skills

Math Practice

Element	Atomic Radius	Ionic Radius
Potassium (K)	227 pm	133 pm
Iodine (I)	133 pm	216 pm

18 What is the percent change when an iodine atom (I) becomes an ion (I^-)?

19 What is the percent change when a potassium atom (K) becomes an ion (K^+)?

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

Multiple Choice

1 Which information does the chemical formula CO_2 NOT give you?

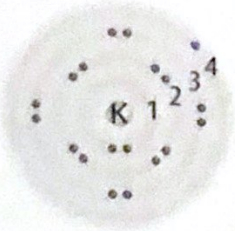
A number of valence electrons in each atom

B ratio of atoms in the compound

C total number of atoms in one molecule of the compound

D type of elements in the compound

Use the diagram below to answer question 2.



2 The diagram above shows a potassium atom. Which is the second-highest energy level?

A 1

B 2

C 3

D 4

3 What is shared in a metallic bond?

A negatively charged ions

B neutrons

C pooled valence electrons

D protons

4 Which is a characteristic of most nonpolar compounds?

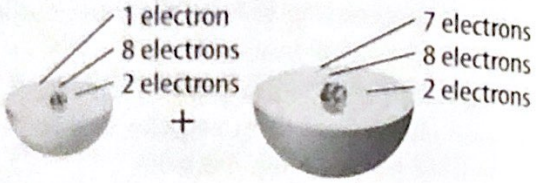
A conduct electricity poorly

B dissolve easily in water

C solid crystals

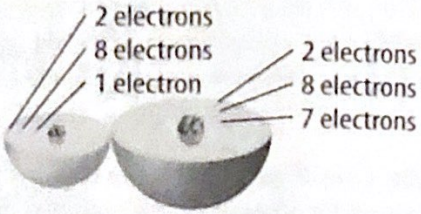
D shiny surfaces

Use the diagram below to answer question 5.

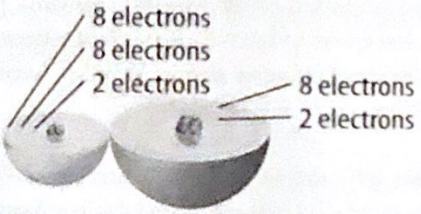


5 The atoms in the diagram above are forming a bond. Which represents that bond?

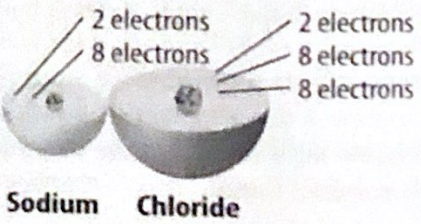
A



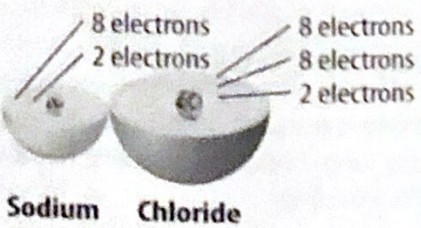
B



C



D



6 Covalent bonds typically form between the atoms of elements that share

A nuclei.

B oppositely charged ions.

C protons.

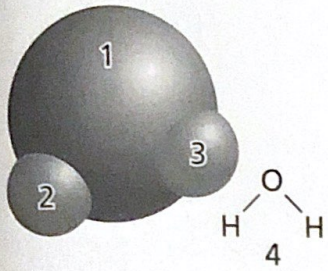
D valence electrons.

Standardized Test Practice

Online Standardized Test Practice

Use the diagram below to answer question 7.

Water Molecule



7 In the diagram above, which shows an atom with a partial negative charge?

A 1

B 2

C 3

D 4

8 Which compound is formed by the attraction between negatively and positively charged ions?

A covalent

B ionic

C nonpolar

D polar

9 The atoms of noble gases do NOT bond easily with other atoms because their valence electrons are

A absent.

B moving.

C neutral.

D stable.

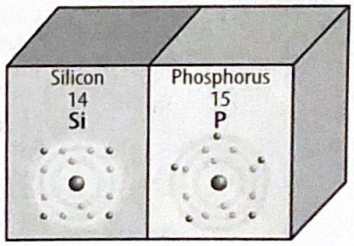
Constructed Response

Use the table below to answer question 10.

Property	Rust	Iron	Oxygen
Color			Clear
Solid, liquid, or gas			
Strength		Strong	Does NOT apply
Usefulness			

10 Rust is a compound of iron and oxygen. Compare the properties of rust, iron, and oxygen by filling in the missing cells in the table above. What can you conclude about the properties of compounds and their elements?

Use the diagram below to answer questions 11 and 12.

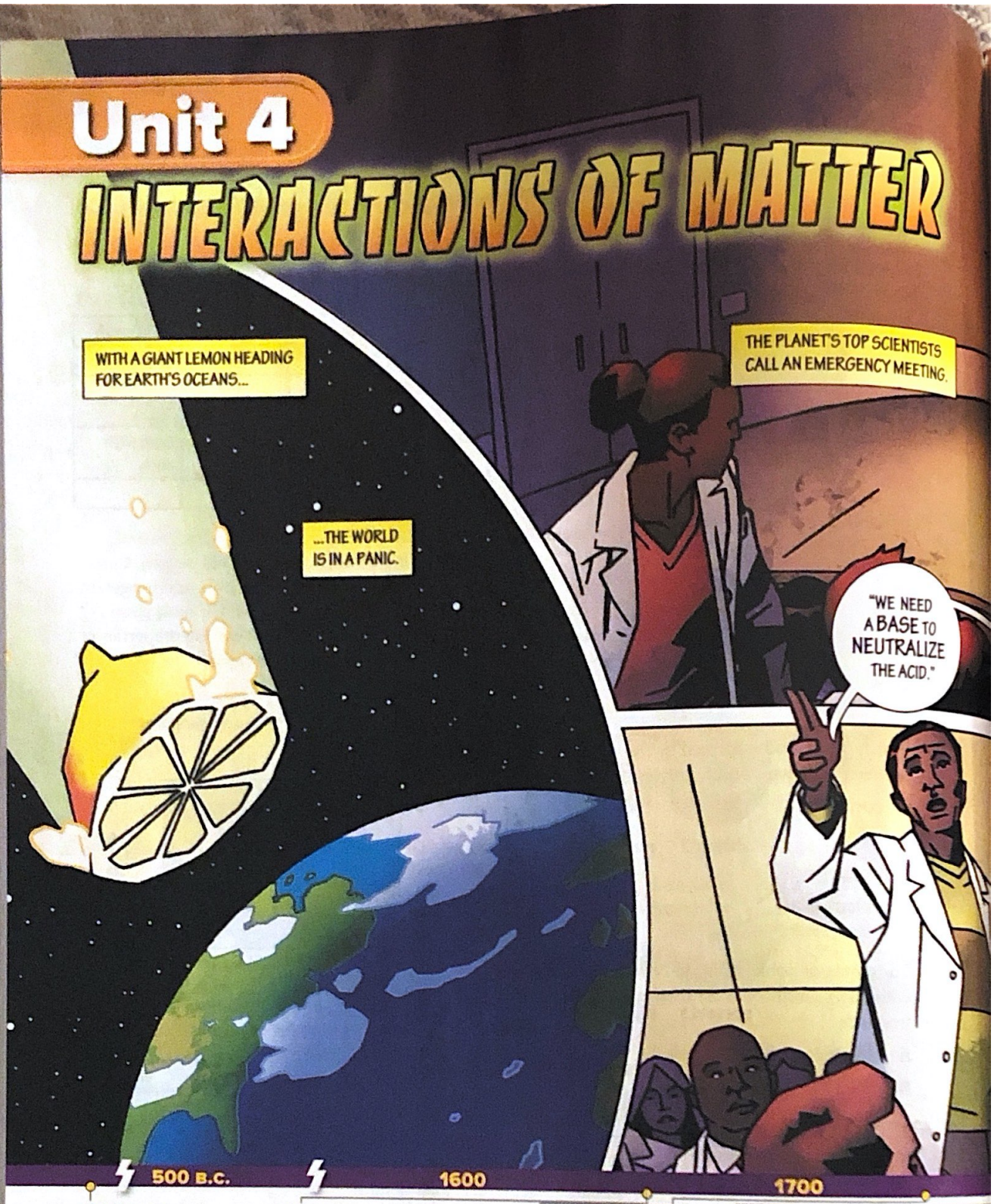


11 In the diagram, how are valence electrons illustrated? How many valence electrons does each element have?

12 Describe a stable electron configuration. For each element above, how many electrons are needed to make a stable electron configuration?

NEED EXTRA HELP?												
If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12
Go to Lesson...	2	1	3	3	3	2	2	3	1	2	1	1

Unit 4
INTERACTIONS OF MATTER



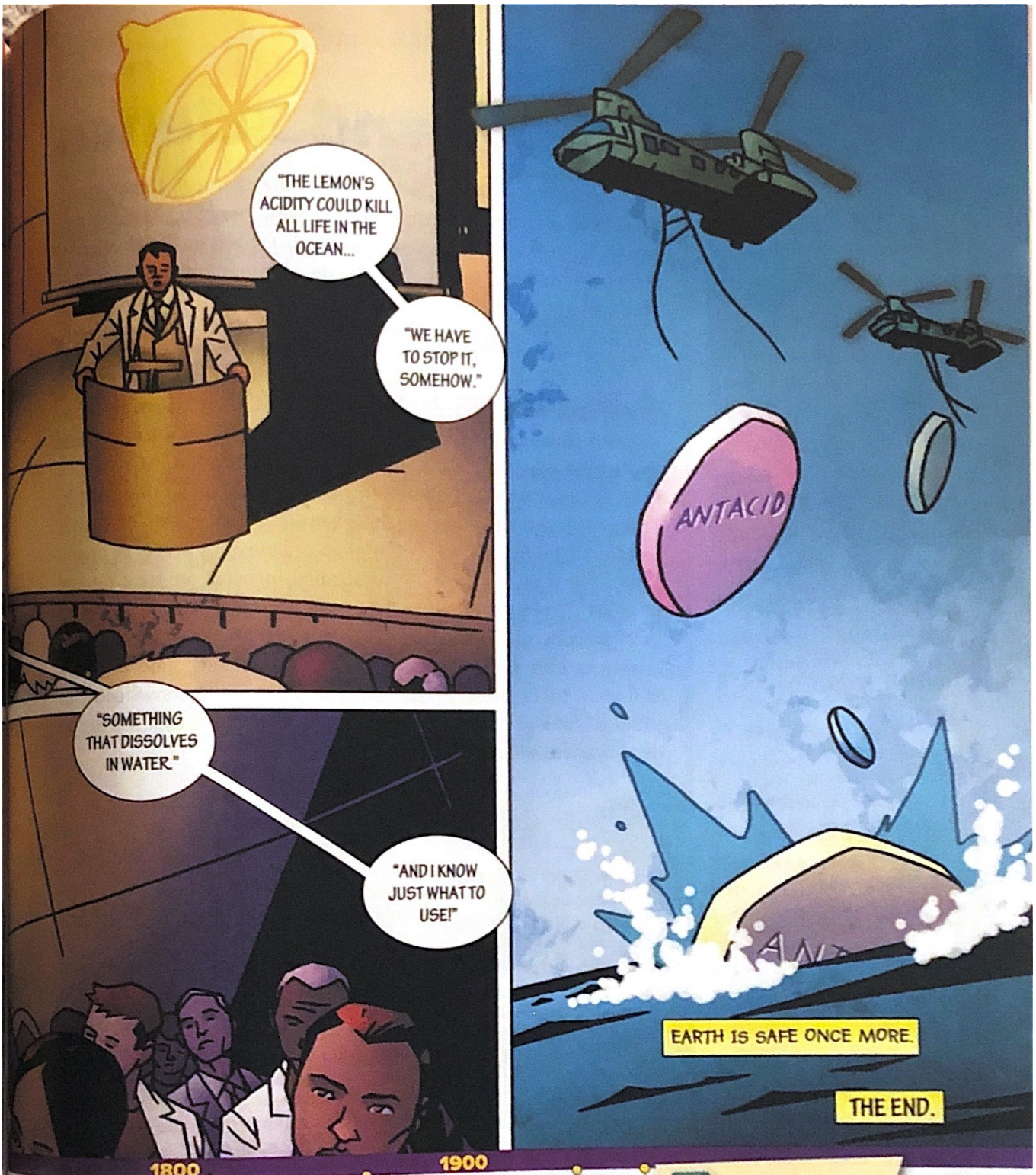
500 B.C. 1600 1700

1000 B.C.
Chemistry is considered more of an art than a science. Chemical arts include the smelting of metals and the making of drugs, dyes, iron, and bronze.

1661
A clear distinction is made between chemistry and alchemy when *The Sceptical Chymist* is published by Robert Boyle. Modern chemistry begins to emerge.

1789
Antoine Lavoisier, the "father of modern chemistry," clearly outlines the law of conservation of mass.

1803
John Dalton publishes his atomic theory, which states that all matter is composed of atoms, which are small and indivisible and can join together to form chemical compounds. Dalton is considered the originator of modern atomic theory.



1800 1900

1869
The first periodic table is published by Dmitri Mendeleev. The table arranges elements into vertical columns and horizontal rows and is arranged by atomic number.

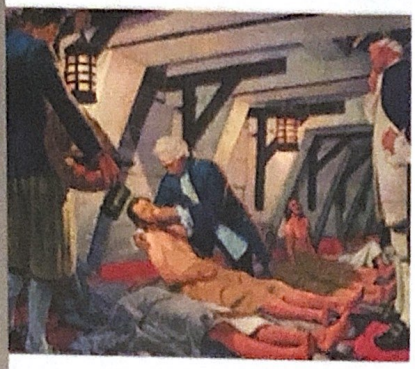
1953
James Watson and Francis Crick develop the double-helix model of DNA. This discovery leads to a spike in research of the biochemistry of life.

1983
Kary Mullis devises the polymerase chain reaction (PCR), a technique for copying a small portion of DNA in a lab environment. PCR can be used to synthesize specific pieces of DNA and makes the sequencing of DNA of organisms possible.

Visit ConnectED for this unit's STEM activity.

Health and Science

Have an upset stomach? Chew on some charcoal. Have a headache? Rub a little peppermint oil on your temples. As shown in Figure 1, people have used chemicals to fix physical ailments for thousands of years, long before the development of the first medicines. Many cures were discovered by accident. People did not understand why the cures worked, only that they did work.



▲ **Figure 1** Thousands of years ago, people believed that evil spirits caused illness. Herbs or other natural materials treated symptoms.

Asking Questions About Health

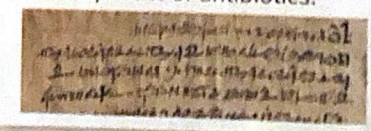
Over time, people asked questions about which cures worked and which cures did not work. They made observations, recorded their findings, and had discussions about cures with other people. This process was the start of the scientific investigation of health. **Health** is the overall condition of an organism or group of organisms at any given time. Early studies focused on treating the physical parts of the body. The study of how chemicals interact in organisms did not come until much later. Recognizing that chemicals can affect health opened a whole new field of study known as biochemistry. The time line in Figure 2 shows some of the medical and chemical discoveries people made that led to the development of medicines that save lives.

Figure 2 The time line shows several significant discoveries and developments in the history of medicine. ▼

4,200 years ago Clay tablets describe using sesame oil on wounds to treat infection.

3,500 years ago An ancient papyrus described how Egyptians applied moldy bread to wounds to prevent infection.

More than 3,300 years later, scientists found that a chemical in mold broke down the cell membranes of bacteria, killing them. Similar discoveries led to the development of antibiotics.



2,500 years ago Hippocrates, known as the "Father of Medicine," is the first physician known to separate medical knowledge from myth and superstition.

Year 900 The first pharmacy opened in Persia, which is now Iraq.

1740s A doctor found that the disease called scurvy was caused by a lack of Vitamin C.

Early explorers on long sea voyages often lost their teeth or developed deadly sores. Ships could not carry many fruits and vegetables, which contain Vitamin C, because they spoil quickly. Scientists suspect that many early explorers might have died because their diets did not include the proper vitamins.

Benefits and Risks of Medicines

Scientists might recognize that a person's body is missing a necessary chemical, but that does not mean they can always fix the problem. For example, people used to get necessary vitamins and minerals by eating natural, whole foods. Today, food processing destroys many nutrients. Foods last longer, but they do not provide all the nutrients the body needs.

Researchers still do not understand the role of many chemicals in the body. Taking a medicine to fix one problem sometimes causes others, called side effects. Some side effects can be worse than the original problem. For example, antibiotics kill some disease-causing bacteria. However, widespread use of antibiotics has resulted in "super bugs"–bacteria that are resistant to treatment.

Histamines are chemicals that have many functions in the body, including regulating sleep and decreasing sensitivity to allergens. However, low levels of histamines have been linked to some serious illnesses. Many medicines have long-term effects on health. Before you take a medicine, you should recognize that you are adding a chemical to your body. You should be as informed as possible about any possible side effects.

MiniLab
15 minutes

Is everyone's chemistry the same?

Each person's body is a unique "chemical factory." Why might using the same medicine to treat illness not work exactly the same way in everyone?

1. Read and complete a lab safety form.
2. Place a strip of **pH paper** on your tongue. Immediately place the paper in a **self-sealing plastic bag.**
3. Compare the color of your paper to the **color guide.** Record the pH in your Science Journal.
4. Record your pH on a class chart for comparison.

Analyze and Conclude

1. **Organize Data** What was the range of pH values among your classmates?
2. **Predict** How might differences in pH affect how well a medicine works in different people?

Scientists studying digestion in dogs noticed that ants were attracted to the urine of a dog whose pancreas had been removed. They determined the dog's urine contained sugar, which attracted ants. Eventually, scientists discovered that diabetes resulted from a lack of insulin, a chemical produced in the pancreas that regulates blood sugar. Today, some people with diabetes wear an insulin pump that monitors their blood sugar and delivers insulin to their bodies.

1770s The first vaccination is developed and administered.

1800s Nitrous oxide is first used as an anesthetic by dentists.

1920s Insulin is identified as the missing hormone in people with diabetes.

1920s Penicillin is discovered, but not developed for treatment of disease until the mid-1940s.

2000s First vaccine to target a cause of cancer