Name _____ Date _____ Class _____

The Properties of Water

This section describes the structure and properties of water. It also describes the way water changes state, or form.

Use Target Reading Skills

After reading the passages that contain key terms, use all the information you have learned to write a definition of each key term in your own words.

polar molecule:

_____

_____

capillary action:

_____

_____

surface tension:

_____

_____

solution:

_____

_____

solvent:

_____

_____

specific heat:

_____

_____

evaporation:

_____

_____

condensation:

_____

_____

The Properties of Water *(continued)*

The Structure of Water

1. Circle the letter of each sentence that is true about water's structure.

a. Water is made up of atoms bonded to form molecules.
b. Water contains half as many hydrogen atoms as oxygen atoms.
c. Water molecules tend to push away from each other.
d. The chemical formula for water is H_2O.

Key Properties of Water

2. A molecule that has electrically charged areas is called a(n) _____ molecule.

3. Circle the letter of each sentence that is true about capillary action.

a. It explains how water moves against the force of gravity.
b. It is due to the attraction among molecules of water and surrounding materials.
c. It prevents water from moving through materials with pores.
d. It causes clothing to stay dry.

4. How does capillary action allow water to climb up the sides of a straw?

_____

_____

5. Circle the letter of each sentence that is true about water's surface tension.

a. It helps some insects "skate" across the surface of the water.
b. It refers to the tightness across the surface of the water.
c. It is caused by polar molecules repelling each other.
d. It causes raindrops to form round beads.

6. How does surface tension force the surface of water to curve?

_____

_____

_____

7. A mixture that forms when one substance dissolves another is called a(n) _____. The substance that does the dissolving is called a(n) _____.

8. Why can water dissolve many substances?

_____

_____

_____

_____

9. Circle the letter of each substance that dissolves in water.

a. salt
b. oil
c. oxygen
d. wax

10. The amount of heat needed to increase the temperature of a certain mass of a substance by 1°C is its _____.

11. Is the following sentence true or false? Compared with other substances, water requires a lot of heat to increase its temperature.

_____

12. Circle the letter of each sentence that is true about water's specific heat.

a. It is due to the many attractions among water molecules.
b. It makes large bodies of water heat up more quickly than nearby land.
c. It makes large bodies of water cool off more slowly than nearby land.
d. It leads to warmer air over land than over water on summer days.

Changing State

13. List the three states of matter.

a. _____ **b.** _____

c. _____

14. Solid water is called _____.

15. Complete this compare/contrast table.

How Water Changes State

Type of Change	Starting State	Ending State
Melting	Solid	Liquid
Boiling	**a.**	**b.**
Evaporation	**c.**	**d.**
Condensation	**e.**	**f.**
Freezing	**g.**	**h.**

Match the state of water with the statement that is true about it.

	State of Water	Statement
____	**16.** ice	**a.** It is invisible.
____	**17.** liquid water	**b.** It takes the shape of its container.
____	**18.** water vapor	**c.** It has a temperature less than 0°C.

19. Circle the letter of each sentence that is true about evaporation.

- **a.** It occurs as water molecules absorb energy.
- **b.** It occurs as water molecules slow down.
- **c.** It occurs at the surface of a liquid.
- **d.** An example of it is air drying your hair after swimming.

20. Circle the letter of each sentence that is true about condensation.

- **a.** It occurs as water molecules slow down.
- **b.** It occurs as the temperature of water molecules reaches the boiling point.
- **c.** It turns water from a visible state to an invisible state.
- **d.** An example of it is clouding up a cold window with your breath.

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The Properties of Water

Guide for Reading

- How does the chemical structure of water molecules cause them to stick together?
- What are some of water's unusual properties?
- What are the three states in which water exists on Earth?

A water molecule is made up of two hydrogen atoms bonded to an oxygen atom. Each end of a water molecule has a slight electric charge. A molecule that has electrically charged areas is called a **polar molecule. The positive hydrogen ends of one water molecule attract the negative oxygen ends of nearby water molecules. As a result, the water molecules tend to stick together.**

Many of water's unusual properties occur because of the attraction among its polar molecules. **The properties of water include capillary action, surface tension, the ability to dissolve many substances, and high specific heat. Capillary action** is the combined force of attraction among water molecules and with the molecules of surrounding materials. **Surface tension** is the tightness across the surface of water that is caused by polar molecules pulling on each other.

A **solution** is a mixture that forms when one substance dissolves another. The substance that does the dissolving is called the **solvent.** Many substances dissolve in water because water is polar. The charged ends of the water molecule attract the molecules of other polar substances.

Specific heat is the amount of heat needed to increase the temperature of a certain amount of a substance. Compared to other substances, water requires a lot of heat to increase its temperature.

Water exists in three **states,** or forms: solid, liquid, and gas. **Ice is a solid, the familiar form of water is a liquid, and water vapor in the air is a gas.** Change of state is related to temperature, which is a measurement of the average speed of molecules. When the temperature reaches 0°C, the solid ice melts and becomes liquid water. At 100°C, liquid water boils and the molecules have enough energy to escape the liquid and become water vapor. Liquid water also becomes a gas through **evaporation,** which is the process by which molecules at the surface of a liquid absorb enough energy to change to the gaseous state.

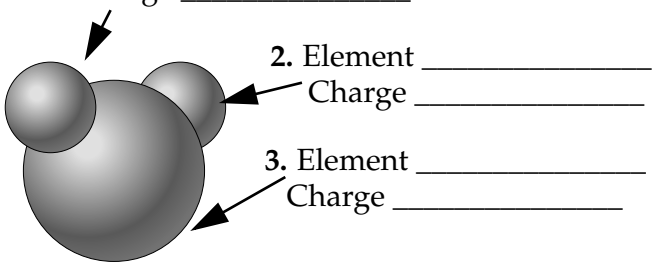
The process by which a gas changes to a liquid is called **condensation**. As the temperature of the gas cools down to 100°C, the molecules slow down and begin to change back to the liquid state. When water cools below 4°C, the molecules line up in a crystal structure. Water molecules take up more space in this crystal structure than as a liquid. This means that ice is less dense than liquid water, and thus floats on liquid water.

Name _____ Date _____ Class _____

The Properties of Water

Understanding Main Ideas

Label the parts of this water molecule by writing the name of the element and the electrical charge in items 1 through 3.



Answer the following questions on a separate sheet of paper.

4. Why is water considered a polar substance?
5. Which state of water allows fish to remain in a lake when winter temperatures are below 0°C? Explain.
6. What happens to the molecules of water vapor when the temperature of the gas cools to 100°C?
7. Why is water often called the "universal solvent"?

Building Vocabulary

Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

____ **8.** capillary action

____ **9.** condensation

____ **10.** evaporation

____ **11.** specific heat

____ **12.** solution

____ **13.** solvent

____ **14.** state

____ **15.** surface tension

a. a mixture that forms when one substance dissolves another

b. form of a substance, including solid, liquid, or gas

c. the tightness across the surface of water caused by the polar molecules pulling on each other

d. the process by which molecules at the surface of a liquid absorb enough energy to change to the gaseous state

e. the combined force of attraction among water molecules and with the molecules of surrounding materials

f. the process by which a gas changes to a liquid

g. a substance that dissolves another substance

h. the amount of heat needed to increase the temperature of a certain amount of a substance by 1°C

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The Ends Make the Difference

If you get grease on a piece of clothing, what do you do? You wash it in water with a detergent. The reason detergent helps clean the cloth has to do with the structure of detergent molecules and how they mix with water. As you can see in Figure 1, a detergent molecule has two very different ends. The rounded end has a positive charge. This charged end of the detergent molecule is attracted to the polar water molecules. The other end of the detergent molecule has no charge. Instead of being attracted to polar water molecules, the end without a charge is attracted to the nonpolar grease and dirt molecules.

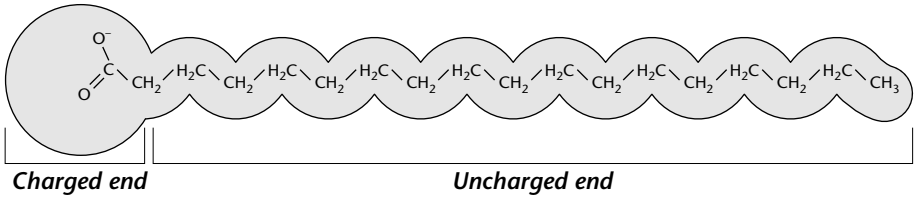

Figure 1

When you add detergent to the water in a washing machine, the nonpolar ends of detergent molecules dissolve into the grease on the cloth and break the grease apart into tiny droplets. The action of the washing machine helps dislodge the grease droplets from the cloth. The detergent molecules surround the grease droplets, with their polar ends sticking out from the droplet. These polar ends dissolve in water. When the water flows out of the washing machine, the grease droplets are carried along with it.

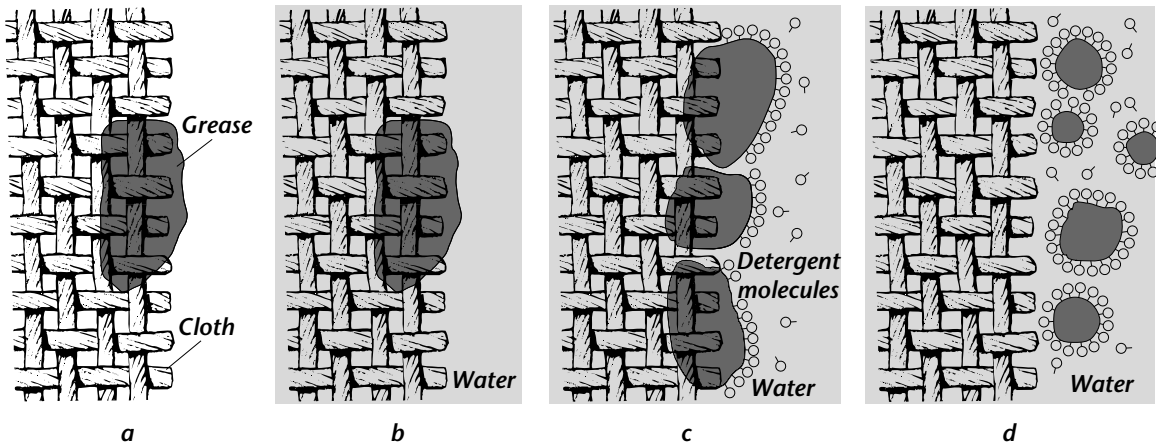

Figure 2

Answer the following questions on a separate sheet of paper.

1. Write a caption for each of the illustrations in Figure 2, using what you have learned about how a detergent works.
2. In your own words, describe how a greasy pair of pants gets clean by being washed in a washing machine.