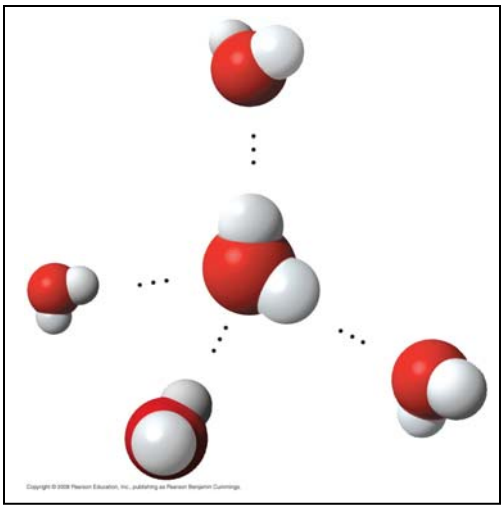
Name_____**Period**_____

Chapter 3: Water and the Fitness of the Environment

Concept 3.1 The polarity of water molecules results in hydrogen bonding



1. Study the water molecules at the right. On the central molecule, label oxygen (O) and hydrogen (H).

2. What is a *polar molecule*? Why is water considered polar?

3. Now, add + and – signs to indicate the charged regions of *each* molecule. Then, indicate the hydrogen bonds.

4. Explain *hydrogen bonding*. How many hydrogen bonds can a single water molecule form?

Concept 3.2 Four emergent properties of water contribute to Earth's fitness for life

Hydrogen bonding accounts for the unique properties of water. Let's look at several.

Cohesion

5. Distinguish between *cohesion* and *adhesion*.

6. What is demonstrated when you see beads of water on a waxed car hood?

7. Which property explains the ability of a water strider to walk on water?

Moderation of Temperature

8. The calorie is a unit of heat. Define *calorie*.

9. Water has high *specific heat*. What does this mean? How does water's specific heat compare to alcohol's?

10. Explain how hydrogen bonding contributes to water's high specific heat.

11. Summarize how water's high specific heat contributes to the moderation of temperature. How is this property important to life?

12. Define *evaporation*. What is *heat of vaporization*? Explain at least three effects of this property on living organisms.

Expansion upon Freezing

13. Ice floats! So what? Consider what would happen if ponds and other bodies of water accumulated ice at the bottom. Describe why this property of water is important.

14. Now, explain *why* ice floats. Why is 4°C the critical temperature in this story?

Solvent of Life

15. Review and define these terms:
    solvent

    solution

    solute

16. Consider coffee to which you have added sugar. Which is the solvent? The solute?

17. Explain why water is such a fine solvent.

18. Define *hydrophobic* and *hydrophilic*.

19. You already know that some materials, such as olive oil, will not dissolve in water. In fact, oil will float on top of water. Explain this property in terms of hydrogen bonding.

20. Now, let's do a little work that will enable you to prepare solutions. Read the section on solute concentrations carefully, and show the calculations here for preparing a 1-molar solution of sucrose. Steps to help you do this follow. The first step is done for you. Fill in the rest.

Steps to prepare a solution:

a. Write the molecular formula. $C_{12}H_{22}O_{11}$

b. Use your periodic table to calculate the mass of each element. Multiply by the number of atoms of the element. (For example, O has a mass of 16. Therefore one mole of O has a mass of 16 x 11 = 176 g/mole.)

c. Add the masses of each element in the molecule.

d. Add this mass of the compound to water to bring it to a volume of 1 liter. This makes 1 liter of a 1-M (1 molar) solution.

21. Can you prepare 1 liter of a 0.5-molar *glucose* solution? Show your work here.

22. Define *molarity.*

Concept 3.3 Acidic and basic conditions affect living organisms

23. What two ions form when water dissociates?

You should have answered "hydronium (H_3O+) and hydroxide ions (OH–)" in the preceding question. However, by convention, we will represent the hydronium ion as H+.

24. What is the concentration of each ion in pure water at 25°C?

25. Water has a pH of 7. *pH* is defined as the negative log of the hydrogen ion concentration [H+]. Can you now see how water is assigned a pH of 7?

26. To go a step further, the product of H+ and OH– concentrations is constant at 10^{-14}.

$$[H+\}[OH-\} = 10^{-14.}$$

Water, which is neutral with a pH of 7, has an equal number of H+ and OH– ions. Now, define

acid

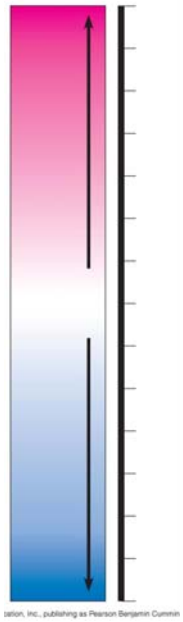
base

27. Because the pH scale is logarithmic, each numerical change represents a 10X change in ion concentration.

    a. So, how many times more acidic is a pH of 3 compared to a pH of 5?

    b. How many times more basic is a pH of 12 compared to a pH of 8?

    c. Explain difference between a pH of 8 and a pH of 12 in terms of H+ concentration.



28. On the pH chart, label pH 1–14. Label *neutral, acid, base*. Indicate the locations of pure water, urine, gastric juice, and bleach.

29. Even a slight change in pH can be harmful! How do *buffers* moderate pH change?

30. Exercise will result in the production of CO_2, which will acidify the blood. Explain the buffering system that minimizes blood pH changes.

31. *Acid precipitation* is increasing. Explain its sources.

32. Discuss how CO_2 emissions affect marine life and ecosystems.

Testing Your Knowledge: Self-Quiz Answers
Now you should be ready to test your knowledge. Place your answers here:

1._____ 2._____ 3._____ 4._____ 5._____ 6._____ 7._____ 8._____