Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ AP Biology Mrs. Javon

Chapter 2 Active Reading Guide

The Chemical Context of Life

**Section 1**

1. Define and give an example of the following terms:

|  |  |
| --- | --- |
| **Term** | **Definition** |
| matter |  |
| element |  |
| compound |  |

1. What four elements make up 96% of all living matter?
2. What is the difference between an *essential element* and a *trace element?*

**Section 2**

1. Sketch a model of an atom of helium. Show electrons, protons, neutrons and atomic nucleus.
2. What is the atomic number of helium? \_\_\_\_\_\_ Its atomic mass? \_\_\_\_\_
3. Here are some more terms you should fully grasp. Define each term.

|  |  |
| --- | --- |
| **Term** | **Definition** |
| neutron |  |
| proton |  |
| electron |  |
| atomic number |  |
| atomic mass |  |
| isotope |  |
| electron shells |  |
| energy |  |

1. Consider the entry in the Periodic Table for carbon.

What is the atomic mass? \_\_\_\_\_ What is the atomic number? \_\_\_\_\_

How many electrons does carbon have? \_\_\_\_ How many neutrons? \_\_\_\_\_

1. What are *isotopes*? Explain using carbon as an example.
2. Explain radioactive isotopes and one medical application that uses them
3. What is the only subatomic particle that is directly involved in the chemical reactions between atoms?
4. What is *potential energy?*
5. Explain which has more potential energy in each pair:
   1. Boy at the top of a slide/Boy at the bottom of a slide
   2. Electron in the first energy shell/Electron in third energy shell
   3. Water/Glucose
6. What determines the chemical behavior of an atom?
7. Sketch an electron distribution diagram of sodium.
   1. How many valence electrons does it have? \_\_\_\_\_ Circle the valence electrons.
   2. How many protons does it have?

**Section 3**

1. Define *molecule.*
2. Now refer back to your definition of a compound and complete the chart.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Molecule?**  **(y or n)** | **Compound?**  **(y or n)** | **Molecular**  **Formula** | **Structural**  **Formula** |
| Water |  |  |  |  |
| Carbon  dioxide |  |  |  |  |
| Methane |  |  |  |  |
| Oxygen |  |  |  |  |

1. What type of bond is seen in O2? Explain what this means.
2. What is meant by *electronegativity*?
3. Explain the difference between a *nonpolar covalent bond* and a *polar covalent bond*.
4. Make an electron distribution diagram of water. Which element is most electronegative? Why is water considered a *polar* molecule? Label the regions that are more positive or negative.
5. Another bond type is an *ionic bond*. Explain what is happening in Figure 2.10.
6. Define *anion* and *cation*. In #21, which is the anion?
7. What is a *hydrogen bond*? Indicate where the hydrogen bond occurs in Figure 2.12.
8. Explain *Van der Waals Interactions*. Though they represent very weak attractions, when these interactions are numerous, they can stick a gecko to the ceiling!
9. Here is a list of the types of bonds and interactions in the section: hydrogen bonds, covalent bonds, ionic bonds, Van der Waals interactions Place them in order from the strongest to the weakest.

strong weak

1. Use morphine and endorphins as examples to explain why molecular shape is important in biology.

**Section 4**

1. Write the chemical equation for photosynthesis. Label the *reactants* and the *products*.
2. For the equation you just wrote:
   1. How many molecules of carbon dioxide are there? \_\_\_\_\_
   2. How many molecules of glucose are there? \_\_\_\_\_
   3. How many elements in a molecule of glucose? \_\_\_\_\_
3. What is meant by *dynamic equilibrium*? Does this imply equal concentrations of each reactant and product?

**Section 5**

1. Again, what is a polar molecule? Why is water considered polar?
2. How many hydrogen bonds can a single water molecule form?
3. Distinguish between *cohesion* and *adhesion*.
4. Which is demonstrated when water beads on a waxed car hood?
5. Which property explains the ability of a water strider to walk on water?
6. The calorie is a unit of heat. Define *calorie.*
7. Water has a high *specific heat*. What does this mean?
8. Explain how hydrogen bonding contributes to water’s high specific heat.
9. Summarize how water’s high specific heat contributes to the moderation of temperature. How is this property important to life?
10. Define *evaporation*. What is *heat of vaporization*? Explain at least three effects this property has on living organisms.
11. Ice floats! So what? Consider what would happen if ponds and other bodies of water accumulated ice at the bottom. Explain why this property is important to life.
12. Now explain *why* ice floats. Why is 4°C the critical temperature?
13. Review and define these terms.

|  |  |
| --- | --- |
| **Term** | **Definition** |
| solvent |  |
| solution |  |
| solute |  |

1. Consider coffee, to which you have added sugar. Which is the solute? The solvent?
2. Explain why water is such a fine solvent.
3. Distinguish between *hydrophobic* and *hydrophilic* substances. Give an example of each.
4. You already know that some materials, like oil, will not dissolve in water. In fact, oil will float on top of water. Explain this property in terms of hydrogen bonding.
5. 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 1M solution of sucrose. Steps to help you do this follow. Step 1 has been done for you.
   1. Write the molecular formula C12H22O11
   2. Use the periodic table (page B1 in appendix) to calculate the mass of each element. Multiply by the number of atoms of the element (for example, O has a mass of 16. 16 x 11 = 176 g/mol)
   3. Add the masses of each element in the molecule
   4. Add this mass of the compound to water to bring it to a volume of 1 liter. This makes 1 L of a 1M solution
6. Show your work to prepare 1 L of 0.5 M glucose solution.
7. Define *molarity*.
8. What two ions form when water dissociates?
9. What is the concentration of each ion in pure water at 25°C?
10. pH is defined as the negative log of the hydrogen ion concentration [H+]. Explain how water is assigned a pH of 7.
11. 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, has an equal number of H+ and OH-. Now define:

**Acid-**

**Base-**

1. Because the pH scale is logarithmic, each numeric change represents a 10 X change in ion concentration.
   1. How many time more acidic is a pH of 3 compared to a pH of 5? \_\_\_\_\_\_\_\_\_\_
   2. How many time more basic is a pH of 12 compared to a pH of 8? \_\_\_\_\_\_\_\_\_\_
   3. Explain the difference between a pH of 8 and a pH of 12 in terms of H+ concentration.
2. Even a slight change in pH can be harmful. How do *buffers* moderate pH change?
3. Exercise will result in the production of CO2, which will acidify the blood. Explain the buffering system that minimizes blood pH changes.
4. How is increased CO2 in the atmosphere linked to *ocean acidification?*
5. Why does ocean acidification cause carbonate ion concentration to decrease?
6. Which organisms would be most directly affected? Which ecosystem is most negatively impacted?