BIOL 1301-01 Introduction to Biology

Instructor: Professor Raja Abhilash Punagoti

Name: Ryohei Hayashi

Learning Journal 1

**1. What makes ionic bonds different from covalent bonds? Explain your answer and add sources/citations to support your answer.**

The main difference between ionic and covalent bonds lies in the way electrons are shared. In ionic bonding, one atom donates an electron to another atom, resulting in the formation of positively and negatively charged ions that attract each other through electrostatic forces. This is commonly seen between metals and nonmetals, where electrons are completely transferred from one atom to another, creating an imbalance of charge (Chemistry LibreTexts, n.d.).

In contrast, covalent bonding forms between two nonmetal atoms through the sharing of electrons. These atoms form a stable outer shell by sharing electrons, and no charge imbalance occurs. If the sharing is completely equal, it is called a nonpolar covalent bond, and if there is a slight difference in electronegativity, a polar covalent bond forms (Chemistry LibreTexts, n.d.).

Thus, ionic bonding is characterized by the complete transfer of electrons, while covalent bonding involves equal or unequal sharing of electrons. Ionic bonds usually form a crystalline lattice in the solid state and have high melting and boiling points. Substances with covalent bonds typically exist in a liquid or gaseous state and have lower melting and boiling points (Chemistry LibreTexts, n.d.). These characteristics are important for understanding how substances react and their properties.

**2. Why are hydrogen bonds and van der Waals interactions necessary for cells? Explain your answer and add sources/citations to support your answer.**

Hydrogen bonds and van der Waals forces are very important for cells. Both are relatively weak bonds and play essential roles in maintaining biological structures and functions.

Hydrogen bonds frequently occur between water molecules but also contribute to the stabilization of proteins and DNA structures. For example, hydrogen bonds stabilize the double helix structure of DNA, enabling accurate copying and transmission of genetic information. They also play a role in forming and maintaining the unique three-dimensional structure of proteins, allowing proteins to perform their specific functions (Biology LibreTexts, n.d.).

Van der Waals forces are particularly important in protein folding. These forces help stabilize the hydrophobic amino acid side chains inside the protein, forming a stable core. Additionally, these forces arise from temporary polarizations between different molecules as they come close to each other, helping achieve precise molecular arrangements and functions (JoVE, n.d.).

Although these bonds are not as strong as covalent or ionic bonds, they are indispensable for maintaining the correct structure and function of biomolecules. Thus, hydrogen bonds and van der Waals forces act complementarily to achieve the delicate balance and precision required in biological processes (Biology LibreTexts, n.d.).

**3. Describe the significance of carbon and the three essential elements required for life on Earth.**

The three essential elements for life on Earth are carbon, hydrogen, and oxygen. These elements form the basic structure of all major biochemical molecules. For example, carbon is fundamental to all organic molecules and serves as the chemical basis of life (Biology LibreTexts, n.d.).

The importance of carbon is particularly notable; it plays a central role in the carbon cycle, which stabilizes Earth's climate and carbon balance by moving carbon between various natural reservoirs (National Geographic, 2023). Carbon is a crucial element in photosynthesis for plants and in respiration for animals. Thus, carbon affects the flow of energy and the cycle of nutrients, playing a central role in the life-supporting cycles (Biology LibreTexts, n.d.).

For these reasons, carbon is an especially important element for life on Earth, and its chemical properties provide the foundation for biodiversity and ecosystem health. Without these elements, life on Earth as we know it would not exist.

Word-Count: 601

References

1. LibreTexts. (n.d.). *General Biology* https://bio.libretexts.org/Bookshelves/Introductory\_and\_General\_Biology/Book%3A\_General\_Biology\_(Boundless)
2. JoVE. (n.d.). *Protein folding: Hydrogen bonds, Van der Waals interactions & disulphide bridges*. Retrieved from https://www.jove.com/science-education/10716/protein-folding-hydrogen-bonds-van-der-waals-interactions-disulphide
3. LibreTexts. (n.d.). *Chemistry* Retrieved from https://chem.libretexts.org/