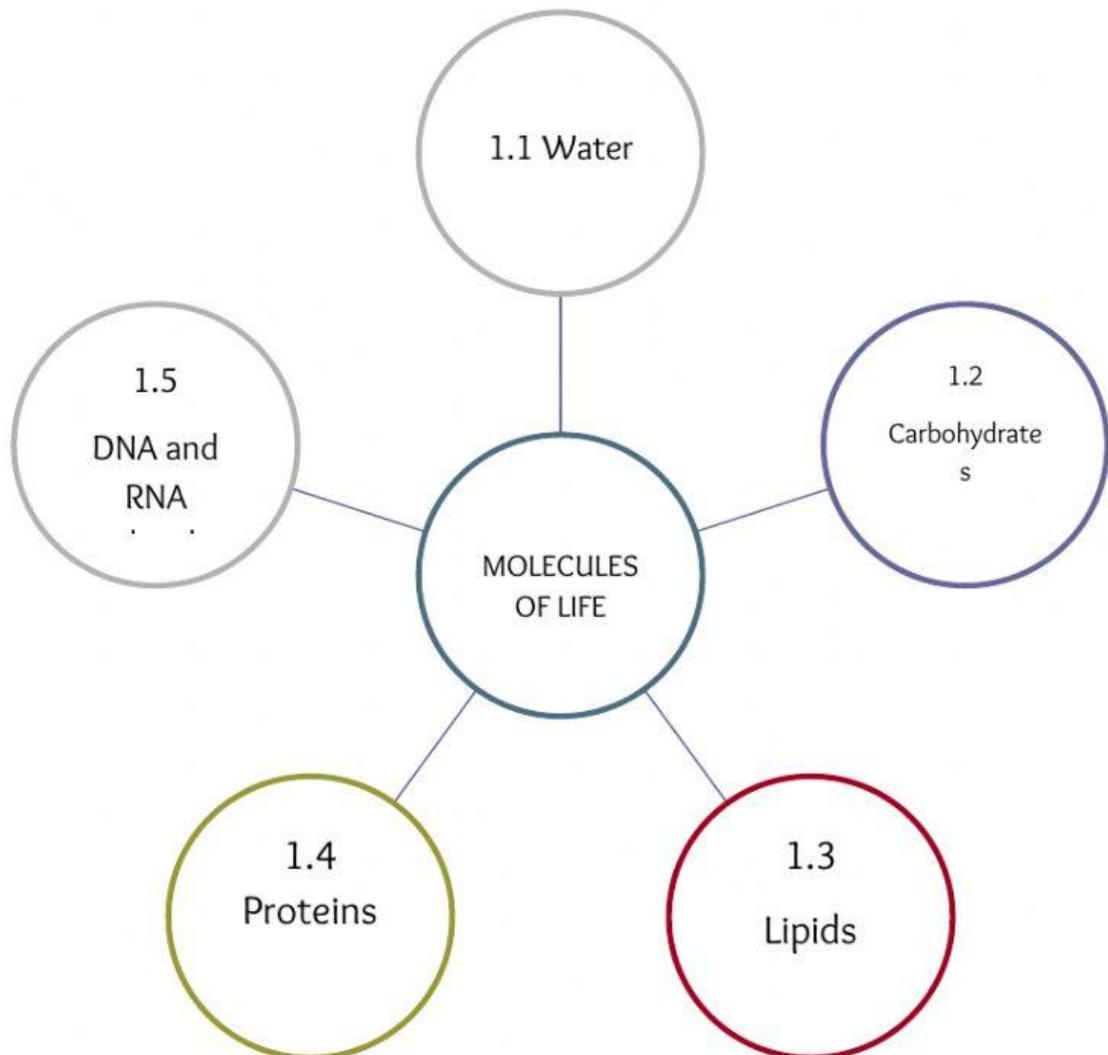

CHAPTER 1 :

MOLECULES OF LIFE



1.1 WATER

LEARNING OUTCOMES:

At the end of this topic, students should be able to:

- Illustrate the structure of water molecule.
- State the properties of water.

Exercise 1.1 (a): Draw the structure of water molecules. Use the information given to label and complete the structure of a water molecule.

Exercise 1.1 (b): Fill in the blanks below to complete the explanation of water structure.



Key:

Covalent bond

104.5 °

δ^+

δ^+

2 δ^-

Oxygen atom

Hydrogen atom

STRUCTURE OF WATER

Consists of _____ oxygen atom and two hydrogen atoms.

The three atoms of water molecule form wide _____ shaped structure.

Two hydrogen atoms joined to the oxygen atom by _____ bond. Thus, one water molecule, has two covalent bonds.

The bond angle in water molecule between two covalent bonds is 104.5 °.

Water is **polar molecule**.

Universal Solvent

Defined as a molecule that carry an _____ distribution of electrical charge such as the opposite ends of the molecule have opposite charge.

The oxygen region of molecule has a _____ (δ^-) and each hydrogen has a partial positive charge (δ^+).

This unequal sharing of electrons occurs where oxygen atom is more electronegative than hydrogen.

The polarity of the water molecule can attract other _____ molecules (hydrophilic or water-loving substances e.g. sugar, salt) but

it _____ non-polar molecules (hydrophobic or water-hating substances) e.g. oil.

Polarity of water molecule allows it to form hydrogen bonds with each other.

One water molecule able to form _____ hydrogen bonds with another four water molecules.

b) State the properties of water.

Properties of Water

1. Universal solvent

2. **LOW** viscosity

3. High specific **HEAT CAPACITY**

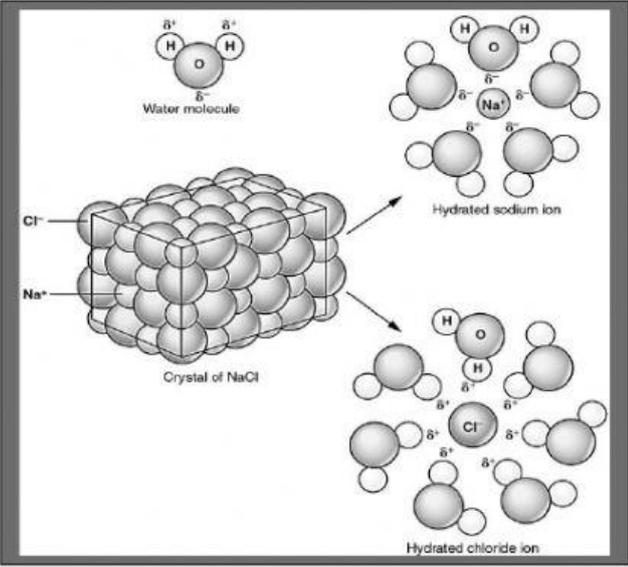
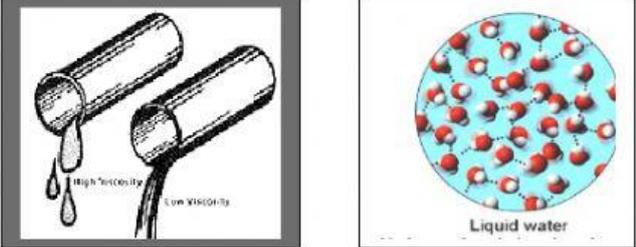
4. High latent heat of vaporization

5. High **SURFACE TENSION**

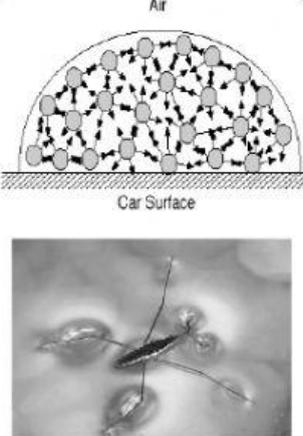
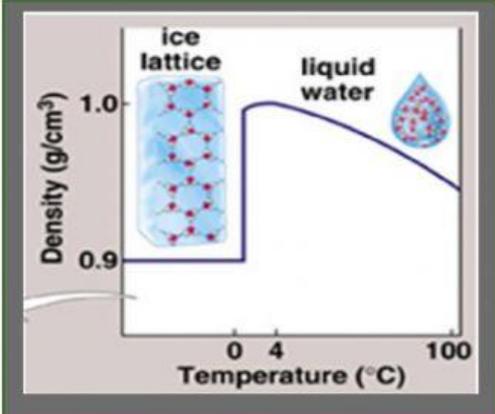
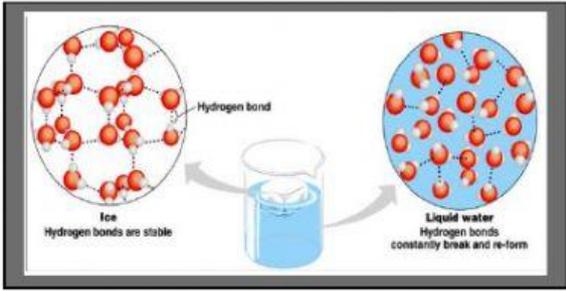
6. Maximum density at 4°C

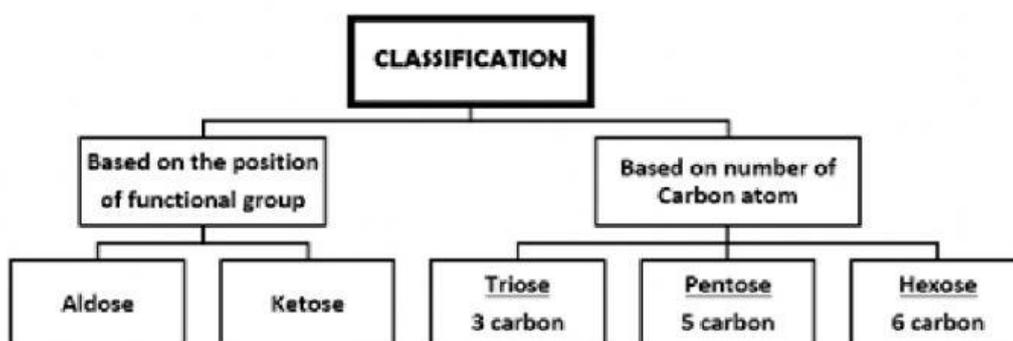
➤ Describe the properties of water and its importance.

No.	Properties of Water	Description
1.		<p>➤ Solvent is dissolving agent of a solution.</p> <p>➤ Water is a _____ molecule;</p> <p>➤ that makes it suitable as universal solvent for ions (e.g. Na^+ and Cl^-) and polar molecules.</p> <p>➤ Example : NaCl can dissolve in water</p> <p>➤ Oxygen atoms of water are attracted to the positively charged _____ ions while,</p> <p>➤ Hydrogen atoms of water are attracted to the negatively charged chloride ions.</p> <div data-bbox="726 1496 1401 1780" style="text-align: center;"> <p>Copyright © The McGraw-Hill Companies, Inc. Permission is granted to reproduce this diagram.</p> <p>The salt NaCl dissolves in water.</p> </div> <p>➤ Water molecules gather around the Na^+ and Cl^- to form _____ separating them from one another.</p>

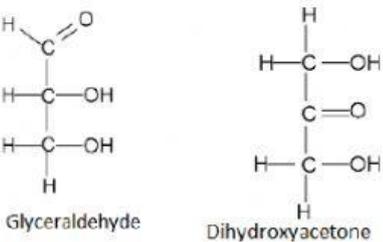
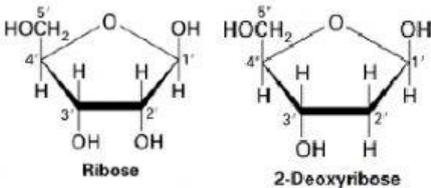
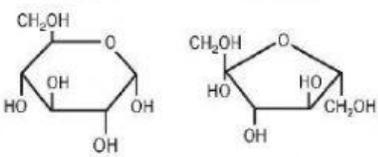
		<p>➤ Pulling these ions away from the salt crystal</p> <p>➤ Causes these ions to separate & dissolve.</p>  <p>Importance of universal solvent:</p> <ol style="list-style-type: none"> _____ for most solutes Provides an aqueous medium for biochemical reactions. Serves as the body's major transport medium e.g. in blood capillaries and xylem.
2.	<p>_____</p> <p>EMBED PBrush</p>	<p>➤ Viscosity is a measure of _____ to flow.</p> <p>➤ Water has low viscosity because hydrogen bonds between water molecules are being continually broken & reformed.</p> <p>➤ The less viscous of the fluid the greater its movement (fluidity).</p>  <p>Importance of low viscosity:</p> <ul style="list-style-type: none"> _____ Foods could move easily down the alimentary canal. Synovial fluid within the joints reduces _____ between bone surfaces, thus enables free easy movement.

3.	<hr/> <hr/>	<p>Blood and lymph flow easily in the circulatory system.</p> <p>Definition: The amount of heat must be _____, to raise the temperature of 1g of water, by 1°C, per calorie (cal) or 1 cal/g/°C.</p> <p>➤ Large amount of _____ is needed to increase the temperature of 1g of water by 1°C.</p> <div data-bbox="746 495 1348 772" style="border: 1px solid black; padding: 5px;"> <p>Definition</p> <ul style="list-style-type: none"> • Specific Heat Capacity is the amount of heat energy needed to raise the temperature of one kilogram of any material by 1 degree Celsius (or 1 Kelvin – doesn't matter – thank you metric system!). • For example it takes 4180 J of heat energy to raise the temperature of 1 kg of water by 1 °C.  </div> <p>➤ As water absorb heat, _____ bonds between water molecules are broken.</p> <p>➤ Only after hydrogen bonds are broken does heat absorption increase the motion of water molecules, thus the temperature of water increase.</p> <p>Importance of high specific heat capacity:</p> <ul style="list-style-type: none"> • Acts as _____ buffer to prevent sudden body temperature changes in cells of organisms. • Allow ocean to _____ relatively constant temperature.
4.	<hr/> <hr/> 	<p>Definition: Quantity of heat must be _____ for 1g of water to vaporize liquid to _____.</p> <p>➤ Large amount of heat/energy is used to _____ the hydrogen bonds that link individual water molecule.</p> <p>Importance of high latent heat of vaporization:</p> <p>💧 _____ effect;</p> <p>✓ _____ of water in sweat on skin or in transpiration from green leaves or panting in animals e.g. dog.</p>
5.	<hr/> <hr/>	<p>Definition: A measure of how _____ it is to break the surface of a liquid.</p> <p>➤ The stronger the bonds between the molecules in liquid, the _____ the surface tension.</p> <p>➤ Surface tension is related to _____ forces between water molecules.</p>

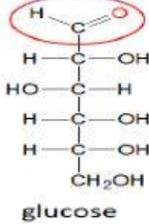
		<p>➤ In the body of water, water molecules within are attracted _____ by cohesion.</p> <p>➤ At the air-water interface, cohesive force only from interior.</p> <p>➤ Thus, the _____ attraction causes the inwardly forces that cause high surface tension at the surface of water.</p> <p>Importance of high surface tension:</p> <ul style="list-style-type: none"> • Many small organisms rely on surface tension to settle on water. E.g.: _____ • Helps in _____ of water in plants.
6.	<div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p><i>How do aquatic organisms in ponds and lakes can survive in liquid water during the winter</i></p> </div> <p>○ Water achieves its highest density at _____.</p> <p>○ Therefore, ice (0°C) is less dense than water and floats on top of water.</p> <p>○ Water _____ on top of lakes and insulates the layers below from further cooling and freezing.</p> <p>○ Thus allowing life forms to thrive in the water beneath the ice.</p>	<p>➤ Water achieves its highest density at 4°C.</p>  <p>➤ Therefore, ice (0°C) is _____ than water and floats on top of water.</p> <p>➤ Water is the only substances whose solid form is less dense than its liquid form.</p> 



a) Classification of Monosaccharide based on the **number of carbon atom**:

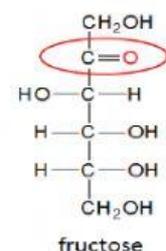
<p>3 classes:</p> <p>1. _____ sugar (3C sugar) Eg: glyceraldehyde & dihydroxyacetone; $C_3H_6O_3$</p> <p>Extra reading exercise: State the importance of glyceraldehyde and dihydroxyacetone.</p>	 <p style="text-align: center;">Glyceraldehyde Dihydroxyacetone</p>
<p>2. _____ sugar (5C sugar) Eg: ribose, ribulose; $C_5H_{10}O_5$, & deoxyribose; $C_5H_{10}O_4$</p> <p>Extra reading exercise: State the functions of Pentose Sugars.</p> <ul style="list-style-type: none"> • Component of ATP / AMP / ADP • Component of DNA • Component of RNA 	 <p style="text-align: center;">Ribose 2-Deoxyribose</p>
<p>3. _____ sugar (6C sugar) Eg: glucose, galactose, fructose; $C_6H_{12}O_6$</p>	<p style="text-align: center;">Glucose Fructose</p> 

b) Classification of Monosaccharide based on the **position of functional group**:

<p>i. Aldose sugar</p> <ul style="list-style-type: none"> • Carbonyl group is located at the _____ of carbon chain. • Eg: glucose 	 <p style="text-align: center;">glucose</p>
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i. Ketose sugar

- Carbonyl group is located in the _____ of carbon chain.
- Eg: fructose

2. **Importance of monosaccharides:**

You can refer to books¹ or go to websites² for extra readings. Here are some informations on the main importance of monosaccharides.

- Energy source;** ~ major respiratory substrate, primary energy source
Eg: Glucose
- Basic building units** ~ as monomers for disaccharide & polysaccharide

Exercise 1.2 (a): Examine these diagrams in the tables given and identify the difference(s) between **X** and **Y**. Circle the difference(s).

i. Pentose Sugar	
X	Y
ii. Hexose Sugar	
X	Y