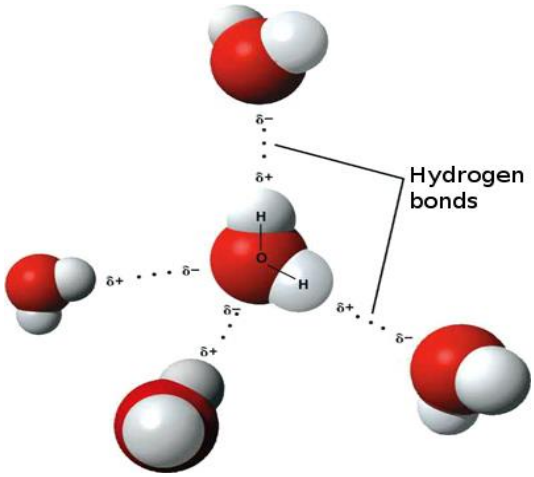
Understanding:

1. Describe how hydrogen bonding is formed.

- Water molecules have polarity due to the asymmetrical structure of the molecule and the electronegativity difference of oxygen and hydrogen. Hence oxygen is partially negative and hydrogen partially positive.

These polarities form hydrogen bonds, which are intermolecular forces, with other water molecules. Hydrogen bonds itself are weak but since a water molecule is small, it has many bonds per unit volume, hence collectively becomes stronger.

A picture to illustrate



2. Explain the properties of hydrogen bonding, including cohesion, adhesion, thermal properties and solvent properties.

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Cohesive properties	Cohesion is the attraction between same types of molecules. In this case, water is cohesive due to hydrogen bonding. This is useful in xylem vessels where plants have to supply to the top of tree.
Adhesive properties	Adhesion is the attraction between different types of molecules. Again, this is due to hydrogen bonding, but with other molecules. This is useful to keep the cell walls moist.
Thermal properties	1. Due to the many intermolecular bonds, it takes a lot of heat energy to boil the water; hence water has high heat capacity, which means that water temperature remains stable. This is useful for aquatic organisms. 2. Water has high latent heat capacity. I.e., it takes a significantly amount of energy to evaporate. This has the effect of cooling! 3. Since it has high boiling point, it can be found in liquid state in various temperatures.
Solvent properties	Since water molecules are polar, it can essentially break down most of molecules that have some partial charge. This prevents clumps forming and eases the transport.

3. State that substances can be hydrophobic and hydrophilic.

- Hydrophilic substances like water. They have a negative/positive charge which makes it possible for water to be attracted.

However, hydrophobic do not have any charge. Strictly speaking, it is not actually fearing water, but it does not have the ability to attract water molecules strongly enough to get dissolved, thus water only interacts with themselves and hydrophobic substances with themselves.

Applications and skills:

1. Compare thermal properties of water and methane, and give reasons.

- There are strong differences between methane and water just due to the hydrogen bonds.

Property	Methane	Water
Formula	CH_4	H_2O
Molecular mass	16	18
Density	$0.46g/cm^3$	$1g/cm^3$
Specific heat capacity	2.2J/Celsius gram	4.2J/Celsius gram
Latent heat capacity	760J/g	2257J/g
Melting point	-182C	0C
Boiling point	-160C	100C

Wow!

2. Explain how sweating cools our body.

- Well, we all know how sweating works. But let's look more into the preceding process.

Hypothalamus is the *brain* behind everything, Badum chum! It detects our blood temperature and temperature in skin and if needed, it stimulates sweat glands. It can secrete up to 2L of sweat/hour!

We usually do not sweat unless we are overheated. Well, except when we are nervous, but this is because adrenaline is released and brain anticipates that intensive activity will happen very soon.

3. Explain how transport of essential biochemical in relation to solubility in water.

- Sodium chloride is an ionic compound, thus this is very easily dissolved in water and hence easily transported.

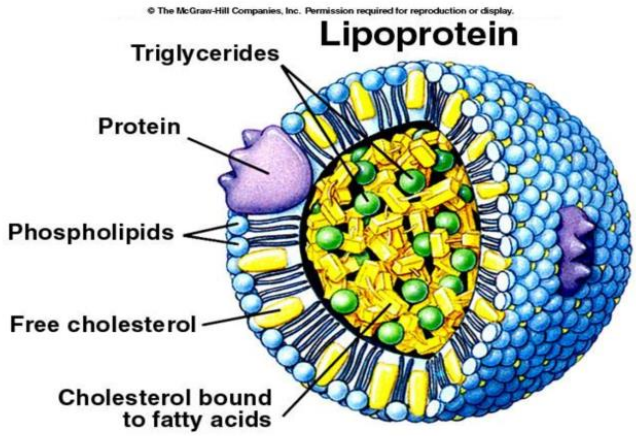
Amino acids vary in their polar properties, but they have enough polarity to be easily dissolved in water.

Glucose is also polar.

Oxygen is non-polar. Oxygen is small enough to be dissolved in water, but it is not enough to supply the amount our body needs. Thus the method our body uses is through haemoglobin. This greatly increases the capacity of oxygen transport.

Fats are non-polar so it cannot be dissolved in water. To solve this problem, we have this container called lipoproteins.
These have one layer of phospholipid, which means that it is hydrophilic on outside while hydrophobic in inside. This is where fatty acids are stored.

Cholesterol is also hydrophobic. Just like fatty acids, it is transported via lipoproteins.



TOK:

1. Claims about the "memory of water" have been categorized as pseudoscientific. What are the criteria that can be used to distinguish scientific claims from pseudoscientific claims?