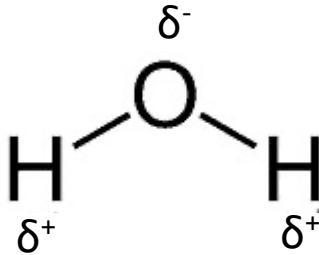


The useful **biological properties** of **water** can be explained by **two** of water's properties:

### A. POLARITY

- Part of the molecule has a **slight positive charge** and part of the molecule has a **slight negative charge**.
- This means it is **polar**.

**Electrons** are more attracted to **oxygen** than to **hydrogen**

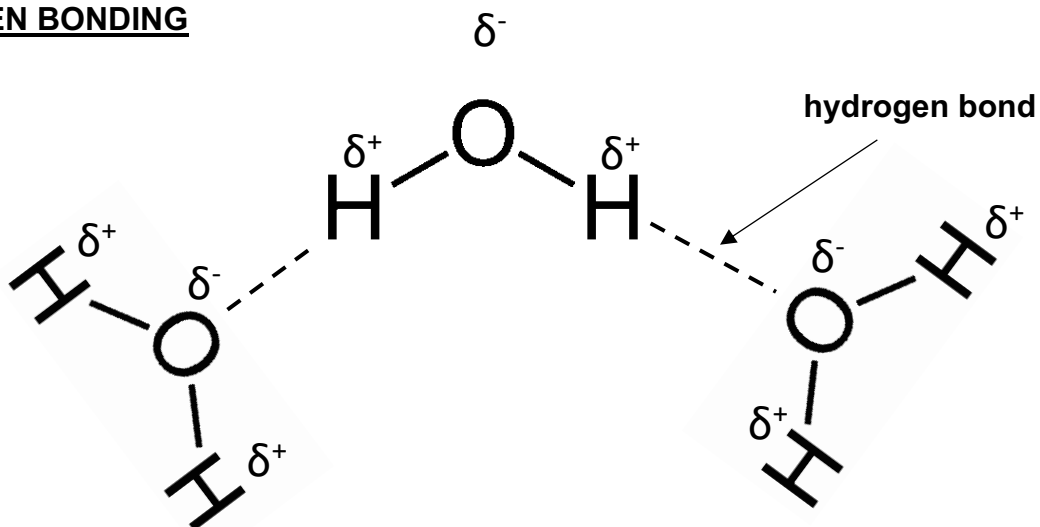


**oxygen** atom has a slight **negative** charge

**hydrogen** atoms have a slight **positive** charge

- Water molecules have two poles, so they are **dipolar**.

### B. HYDROGEN BONDING



- You are **expected** to be able to **draw** three water molecules forming **hydrogen bonds**.
- A water molecule is **polar**.
- The **slightly positive** (hydrogen) pole is **attracted** to **negative ions** (e.g.  $\text{Cl}^-$ )
- The **slightly negative** (oxygen) pole is **attracted** to **positive ions** (e.g.  $\text{Na}^+$ )
- Water forms **hydrogen bonds** with **polar** substances such as **glucose**.

### HIGH SPECIFIC HEAT CAPACITY

It takes a **lot** of **heat** energy to **break hydrogen bonds** and **change** its **temperature**

(So) plays a role in **homeostasis** / keeping **habitat** temperatures **stable**

### HIGH HEAT OF VAPORISATION

It takes a **lot** of **heat** energy to **break hydrogen bonds** and turn **water** into a **gas**

(So) plays a role **sweating** / as a **coolant**

### GREATEST DENSITY AT 4°C

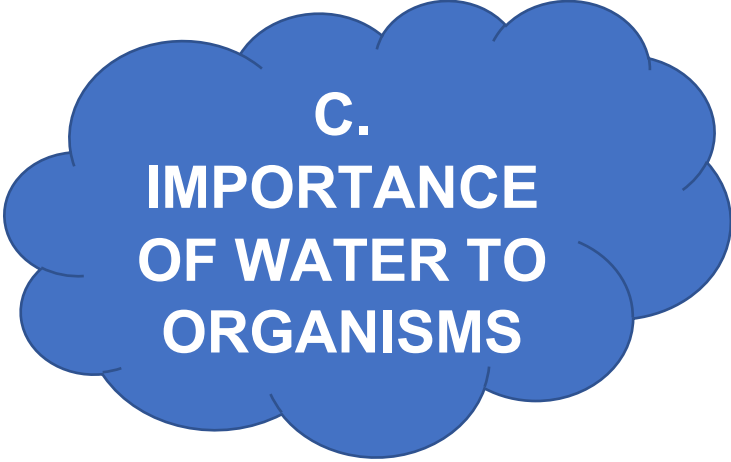
Allows **ice** to form on **water surfaces**

(So) **fish**/living organisms **below** are **insulated**

### COHESION

Water molecules **stick together** by **hydrogen bonds**

(So) **continuous water column**/transpiration stream can be **pulled up the xylem** under **tension**



## C. IMPORTANCE OF WATER TO ORGANISMS

### ADHESION

Water molecules are **attracted** to **other polar** molecules  
e.g. **cellulose cell walls**

(So) **capillary action** helps water to **rise** in the **xylem**

### SOLVENT

Water can **attract** and **dissolve polar** molecules.

(So) a **transport** medium in **blood/xylem**

### SURFACE TENSION

**Cohesion** between **water molecules** creates **surface tension**

(So) organisms can **live** on **water surfaces**

### MEDIUM FOR REACTIONS

**Chemical reactions** happen **dissolved in water**

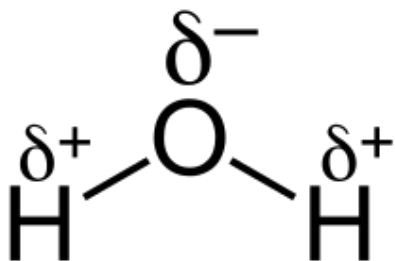
Needed for **hydrolysis** and **photosynthesis**

#### D. COMPARING THE THERMAL PROPERTIES OF WATER AND METHANE

- **Water** (H<sub>2</sub>O) and **methane** (CH<sub>4</sub>) have a **similar** molecular **mass**.
- **Methane** has **weaker** intermolecular forces and **no hydrogen bonds**.
- For **all** properties in the table, water has **higher** values than methane.

Property	Water	Methane	Main Idea
<b>Specific heat capacity</b> / per g per °C	4.2	2.2	<b>Hydrogen bonds</b> between water molecules <b>restrict movement</b>  A <b>lot</b> of <b>heat energy</b> is needed to <b>break</b> these <b>hydrogen bonds</b> to turn: <ul style="list-style-type: none"><li>• water into a gas</li><li>• ice into water</li></ul>
<b>Heat of vaporisation</b> /J per g	2257	760	
<b>Boiling point</b> / °C	100	-160	
<b>Melting point</b> / °C	0	-182	

WATER



METHANE

