

Exercise walk-through

1.1

Structure of Water and Hydrogen Bonding

AP Biology

Water and hydrogen bonding

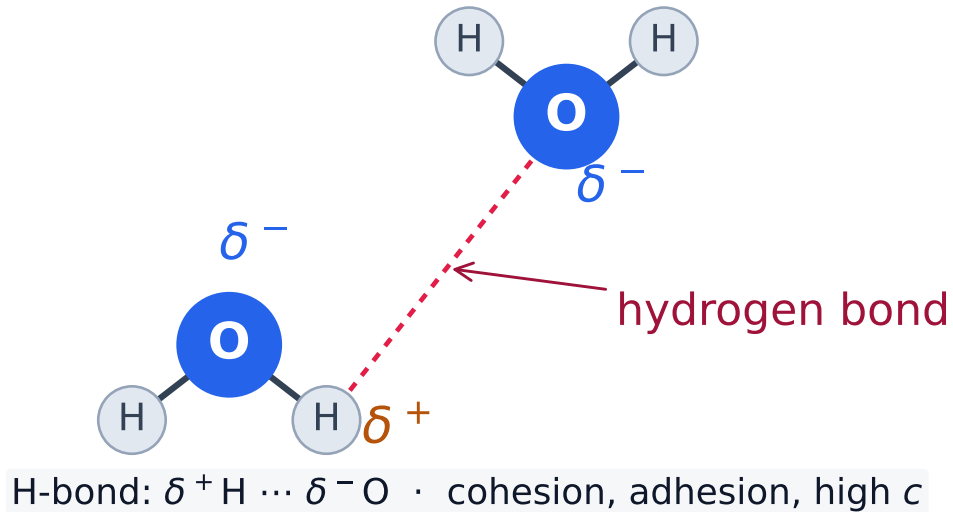
Water is a **polar molecule** :
oxygen is more
electronegative , so it is a
dipole (δ^- O, δ^+ H). Neighbours
attract by **hydrogen bonds** .

Many weak bonds give **emergent properties** : cohesion, high specific heat, ice floats.



Ice floats – hydrogen bonds hold an open lattice

A hydrogen bond between two polar water molecules



A hydrogen bond between two polar water molecules

Every property of water follows from its polarity

polar

oxygen pulls the electrons more strongly, leaving a slightly negative O and slightly positive H

cohesion

water sticks to water – surface tension, and the column that rises in a plant

adhesion

water sticks to other polar surfaces – capillary action

high specific heat

and a high **heat of vaporization**, which is what makes evaporative cooling work

ice floats

the solid is **less dense** than the liquid, so lakes freeze from the top down

a great solvent

for polar and ionic substances – which is why cells are mostly water

Name the polarity first, then the property. An answer that lists properties without the cause is a description, not an explanation.

Exercises 2.1-2.3

2.1 Why is water described as polar?

[1]

2.2 Name the bond that forms between two water molecules.

[1]

2.3 State one biological benefit of water's high specific heat.

[1]

Exercises 2.1-2.3

2.1 Why is water described as polar?

[1]

2.1

- Its oxygen pulls electrons more strongly, giving a slightly negative O and slightly positive H (uneven charge)

2.2 Name the bond that forms between two water molecules.

[1]

2.2

- A hydrogen bond

2.3 State one biological benefit of water's high specific heat.

[1]

2.3

- It stabilizes the temperature of cells/organisms/habitats (resists rapid temperature change)

Exercise 3.1

3.1 Water can dissolve many substances because it is

[1]

☐

A nonpolar

B polar

C acidic

D a gas

Exercise 3.1

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[1]

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A nonpolar

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3.1 B

- polar

Exercise 3.2 (a)

3.2 Water rises up the xylem of a tall tree.

(a) Name the two properties of water involved.

[2]

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3.2 Water rises up the xylem of a tall tree.

(a) Name the two properties of water involved.

[2]

(a)

- Cohesion and adhesion

Exercise 3.2 (b)

3.2 Water rises up the xylem of a tall tree.

(b) Explain how hydrogen bonding causes cohesion.

[2]

Exercise 3.2 (b)

3.2 Water rises up the xylem of a tall tree.

(b) Explain how hydrogen bonding causes cohesion.

[2]

(b)

- Water molecules are polar, so the slightly positive H of one attracts the slightly negative O of another, holding the molecules together

Exercise 3.3

3.3 Explain how water's high specific heat helps organisms survive changes in environmental temperature. [2]

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3.3

- Hydrogen bonds absorb a lot of energy before the temperature rises, so water (and the organisms in it) warms and cools slowly, buffering them against sudden temperature swings