



## Structure of Water and Hydrogen Bonding

### SYI-1.A.1

The subcomponents of biological molecules and their sequence determine the properties of that molecule.

### SYI-1.A.2

Living systems depend on properties of water that result from its polarity and hydrogen bonding.



## Structure of Water and Hydrogen Bonding

### SYI-1.A.3

The hydrogen bonds between water molecules result in cohesion, adhesion, and surface tension.



**What type of bond is found in water molecules?**

- A. Covalent**
- B. Hydrogen**
- C. Ionic**
- D. Van der Waals**



**What type of bond is found in water molecules?**

**A. Covalent**

**Bonds between hydrogen and oxygen in water are covalent bonds. The two atoms are sharing their valence electrons.**

**Recall: This is a POLAR covalent bond since it is unequal sharing of the electrons**

# AP BIO INSTA-REVIEW

TOPIC

1.1



**How does the covalent bond IN water create the hydrogen bond BETWEEN water molecules?**

**How does the covalent bond IN water create the hydrogen bond BETWEEN water molecules?**



**The covalent bond is a POLAR covalent bond. This leads to an unequal sharing of electrons. This causes a partial positive end (hydrogen) and partial negative end (oxygen). The partially negative oxygen of one water molecule is attracted to the partially positive hydrogen of another water molecule.**



**Water property responsible for water movement UP the stem**

- A. Adhesion/Cohesion**
- B. Less dense as solid**
- C. Specific heat**
- D. Surface tension**



**Water property  
responsible for water  
movement UP the stem**

## **A. Adhesion/Cohesion**



**Adhesion is the attraction of water molecules to other polar substances. The water is hydrogen bonded to the walls of the capillary tubes (xylem) of the plant.**

**Cohesion is the attraction of water molecules to other water molecules. The water is hydrogen bonded to another water molecule creating a “string” of like when you connect a barrel of monkeys.**





**Water property responsible for evaporating cooling**

- A. Adhesion/Cohesion**
- B. Less dense as solid**
- C. Specific heat**
- D. Surface tension**

**Water property  
responsible for  
evaporating cooling**

**C. Specific heat**



**Specific heat involves the amount of heat absorbed or released to increase or decrease the temperature of the substance by 1 degree Celsius.**

**Water has a high specific heat, and the water (sweat) will absorb the heat to cool off the animal.**



**Water property responsible for  
lake life surviving winter**

- A. Adhesion/Cohesion**
- B. Less dense as solid**
- C. Specific heat**
- D. Surface tension**

# AP BIO INSTA-REVIEW

TOPIC

# 1.1

**Water property  
responsible for lake life  
surviving winter**

**B. Less dense as solid**



**Due to the hydrogen bonds, water molecules are unable to compact tightly which leaves space between the molecules and causes it to expand upon freezing making it less dense. This causes water to float to the surface creating a buffer to inhibit the lake from freezing which preserves life during winter.**



**What type of bond is found between water molecules?**

- A. Covalent**
- B. Hydrogen**
- C. Ionic**
- D. Van der Waals**

**What type of bond is found between water molecules?**

**B. Hydrogen**



**The bond WITHIN water between the oxygen and hydrogen is a covalent bond since the atoms are sharing electrons from their valence shells. This causes a partial positive charge at the hydrogen and a partial negative charge at the oxygen. Those partial charges lead to hydrogen bonds BETWEEN water molecules as the oxygen of one water is attracted to a hydrogen of another water.**



# AP BIO INSTA-REVIEW

TOPIC

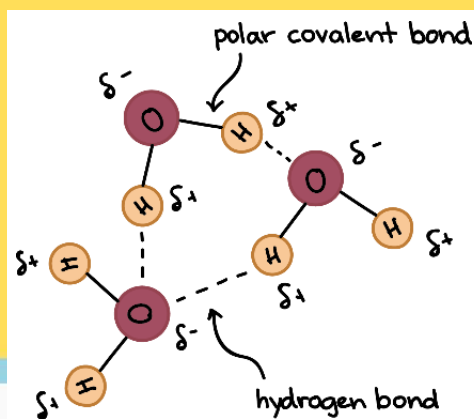
1.1



**What is a hydrogen bond?**



## What is a hydrogen bond?



**Attractive bond between an electronegative atom (e.g., oxygen or nitrogen) bonded to a hydrogen AND a hydrogen**

**Recall, the oxygen/nitrogen is partially negative, and the hydrogen is partially positive so the oppositely charged poles are attracted leading to the hydrogen**



**What property of water is responsible for skipping rocks on a pond?**

- A. Adhesion**
- B. Cohesion**
- C. Evaporative Cooling**
- D. Less Dense Solid**

**What property of water is responsible for skipping rocks on a pond?**

**B. Cohesion**



**Cohesion is due to the water molecules being attracted to other water molecules. These water molecules create a surface to the pond. Due to the large number of hydrogen bonds, the water has a high surface tension which is why the rock skips on the pond. Not enough force to break the bonds.**



**What property of water is responsible for aquatic life surviving winter?**

- A. Adhesion**
- B. Cohesion**
- C. Evaporative Cooling**
- D. Less Dense as Solid**

# AP BIO INSTA-REVIEW

TOPIC

1.1

**What property of water is responsible for aquatic life surviving winter?**

**D. Less Dense as Solid**



**Due to the hydrogen bonds, water molecules are unable to compact tightly which leaves space between the molecules and causes it to expand upon freezing making it less dense. This causes water to float to the surface creating a buffer to inhibit the lake from freezing which preserves life during winter.**





**What property of water is used by organism during sweating?**

- A. Adhesion**
- B. Cohesion**
- C. Evaporative Cooling**
- D. Less Dense as Solid**

# AP BIO INSTA-REVIEW

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**What property of water is used by organism during sweating?**

**C. Evaporative Cooling**



**Evaporative cooling is the act of water molecules absorbing the heat from the surface causing the water to evaporate (and taking the heat energy away from the organism).**

# AP BIO INSTA-REVIEW

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1.1



**What property of water is responsible for water reaching the leaves from the soil?**



**What property of water is responsible for water reaching the leaves from the soil?**

## **Adhesion and Cohesion**

**Adhesion is where water is attracted to another polar substance (aka the sides of the xylem in the plant)**

**Cohesion is where water is attracted to other water molecules.**



## Where are hydrogen bonds in proteins?

**Note:** There is more than one answer to this. Focus on the place where **ONLY** hydrogen bonds exist.

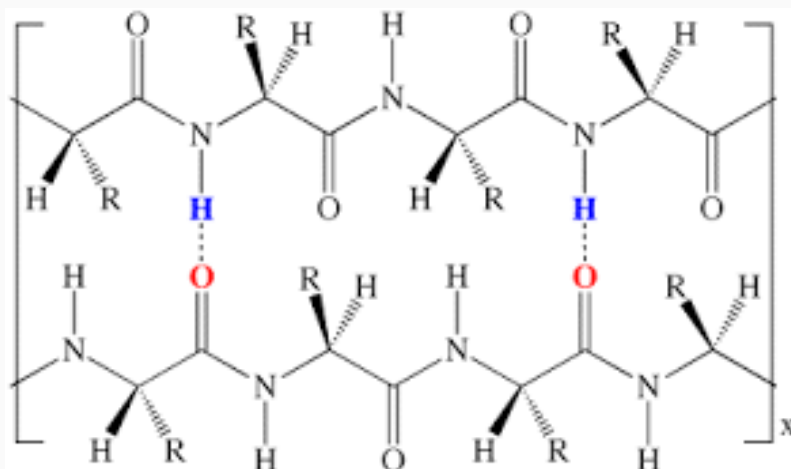
- A. Between amino acids**
- B. Between the backbone**
- C. Between the R groups**
- D. Between polypeptides**



**Where are hydrogen bonds in proteins?**

**B. Between the backbone**

**Hydrogen bonds are attractive bonds between an electronegative atom (e.g. O or N) and a hydrogen bonded to an electronegative atom. The backbone consists of the repeated amino and carboxyl groups. The amino has a nitrogen/hydrogen that is attracted to the carbonyl of the carboxyl group.**







**Where are hydrogen bonds in nucleic acids?**

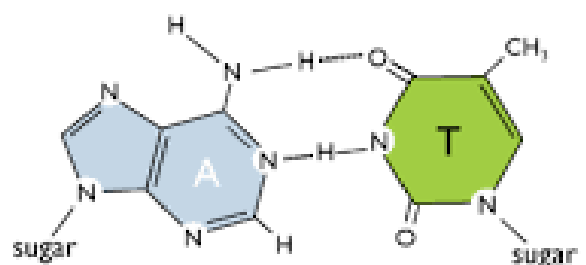
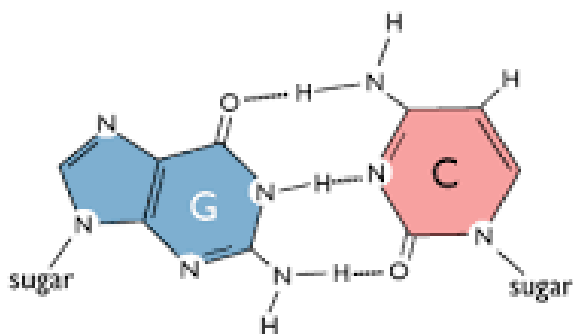
- A. Between carbons of sugar ring**
- B. Between nitrogenous bases**
- C. Between nucleotides**
- D. Between phosphates**



**Where are hydrogen bonds  
in nucleic acids?**

**B. Between nitrogenous  
bases**

**Hydrogen bonds are attractive bonds between an electronegative atom (e.g. O or N) and a hydrogen bonded to an electronegative atom. The nitrogenous bases have the nitrogen/hydrogen attracted to the oxygen of the carbonyl or nitrogen of another nitrogenous base.**



# AP BIO INSTA-REVIEW

TOPIC

1.1



**How do polar substances  
dissolve in water?**

**How do polar substances dissolve in water?**



**Due to the polar covalent bond in water molecules, there is a partial positive hydrogen and a partially negative oxygen/nitrogen. The solute will have the same polarity. This allows the substance to hydrogen bond to the opposite charge. In addition, salts can dissolve with the cation attracted to the partial negative and the anion attracted to the partial negative.**