

## Water is Weird

adapted from: [http://nanosense.sri.com/activities/finefilters/scienceofwater/FF\\_Lesson2Teacher.pdf](http://nanosense.sri.com/activities/finefilters/scienceofwater/FF_Lesson2Teacher.pdf)

1. Why does all bonding occur between atoms, ions, and molecules?

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2. Draw two water molecules. Label the atoms that make up each water molecule with their chemical symbol. If there is an electrical charge or a partial electrical charge on any of the atoms, indicate that by writing the symbols on the atoms.

+ = positive charge

- = negative charge

$\delta+$  = partial positive charge

$\delta-$  = partial negative charge

Label the types of bonds formed between the atoms of one water molecule and between the two water molecules.

3. Explain the term “polar” molecule.

4. What is a hydrogen bond/how is it formed?

5. Define “specific heat”.

6. Explain how a spider can walk on water.

7. Fill out the following table: Name and describe the four emergent properties of water that contribute to life and provide an example of a phenomenon in nature due to each of these properties.

Property of Water	Description	Example

8. Define:

Hydrophobic =

Hydrophilic =

Examine the following compounds or cellular components and their solubility in water in the table below. Based on their properties determine whether they are hydrophobic/hydrophilic and polar/nonpolar.

Compound	Soluble/Insoluble in water	Hydrophobic/Hydrophilic	Polar/Nonpolar
Sugar	Soluble		
Oil	Insoluble		
Salt	Soluble		
DNA	Soluble		
Cell Membrane	Insoluble		

## Water is Weird

1. Why does all bonding occur between atoms, ions, and molecules?

All bonding occurs because of electrostatic forces and attraction of opposite charges.

2. Draw two water molecules. Label the atoms that make up each water molecule with their chemical symbol. If there is an electrical charge or a partial electrical charge on any of the atoms, indicate that by writing the symbols on the atoms.

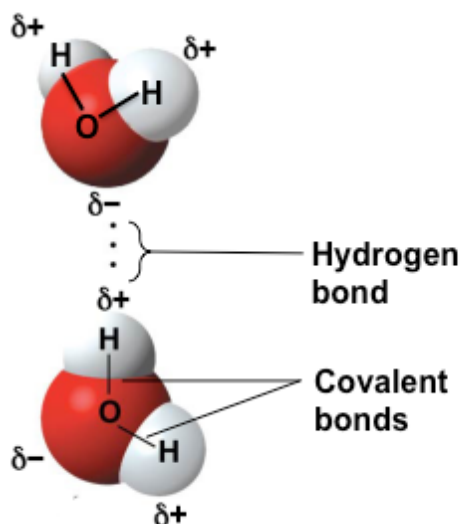
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Label the types of bonds formed between the atoms of one water molecule and between the two water molecules.



3. Explain the term “polar” molecule.

A polar molecule has a more positive end and a more negative end, allowing it to interact with other molecules via attractions between opposite charges

4. What is a hydrogen bond/how is it formed?

A hydrogen bond occurs between the positively charged hydrogen of one molecule and a negatively charged atom of another molecule

5. Define “specific heat”.

The energy required to raise 1 gram of a substance by 1°C

6. Explain how a spider can walk on water.

The surface tension of the water is greater than the pull of the gravity on the spider's feet

7. Fill out the following table: Name and describe the four emergent properties of water that contribute to life and provide an example of a phenomenon in nature due to each of these properties.

Property of Water	Description	Example
Cohesive behavior	High surface tension due to hydrogen bonds formed between water molecules allows water to move upwards or act like a skin	Spiders can walk on water
Ability to moderate temperature	Water has a high specific heat, which means it requires a lot of energy to raise its temperature	The climate of the California coast is moderate and relatively stable
Versatility as a solvent	Water can interact with and dissolve other substances that have positive or negative charges	Salts within our bloodstream are dissolved
Expansion upon freezing	Hydrogen bonds between water molecules are stabilized when frozen causing water to be less dense as a solid	Ice floats on water

8. Define:

Hydrophobic = “water fearing”. A substance that does not have an affinity for water.

Hydrophilic = “water loving”. A substance that has an affinity for water.

Examine the following compounds or cellular components and their solubility in water in the table below. Based on their properties determine whether they are hydrophobic/hydrophilic and polar/nonpolar.

Compound	Soluble/Insoluble in water	Hydrophobic/Hydrophilic	Polar/Nonpolar
Sugar	Soluble	Hydrophilic	Polar
Oil	Insoluble	Hydrophobic	Nonpolar
Salt	Soluble	Hydrophilic	Polar
DNA	Soluble	Hydrophilic	Polar
Cell Membrane	Insoluble	Hydrophobic	Nonpolar