Focus Questions

1. What is water’s composition?
2. What is water’s chemical formula?
3. What is polarity in terms of molecules like water?
4. What kinds of molecules can water dissolve?

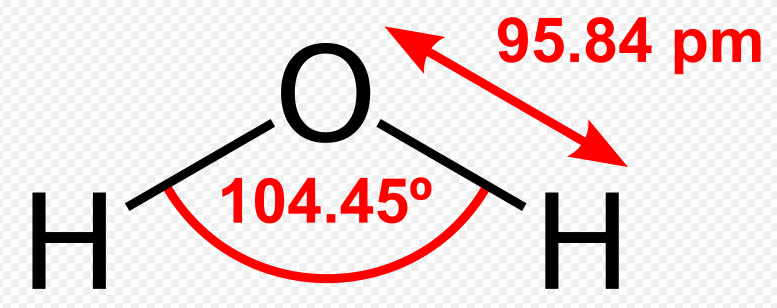
Composition of Water

* \_\_\_\_\_ is an unusual compound with \_\_\_\_\_ physical properties.
* As a result, it’s the compound of \_\_\_\_\_. (*Consider John 4:14*)
* And is the most \_\_\_\_\_ compound in the \_\_\_\_\_ of Earth.
* Water consists of only \_\_\_\_\_ and \_\_\_\_\_.

Electrolysis of Water

* Water can be \_\_\_\_\_ into its constituent elements (hydrogen and oxygen) using \_\_\_\_\_.
* In theory, there should be \_\_ molecules of H2 released for every \_\_ molecule of O2.
* In REAL LIFE this is never the case.

How can we reduce experimental \_\_\_\_\_?



* Better \_\_\_\_\_
* Better \_\_\_\_\_
* \_\_\_\_\_ Review

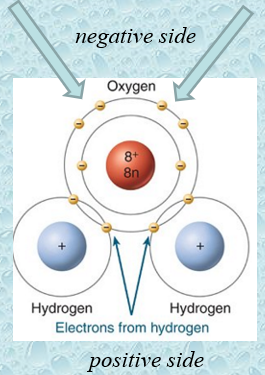
Chemical \_\_\_\_\_ of Water H2O

* Use chemical \_\_\_\_\_ of elements (Periodic Table on page 320)
* Show how many atoms of each element are involved in a formula.
  + Glucose C6H12O6 has \_\_ Carbon atoms, \_\_ hydrogen atoms, and \_\_ oxygen atoms in ONE molecule.
* Vinegar has \_\_ carbon atoms, \_\_ hydrogen atoms, and \_\_ oxygen atoms. What is vinegar’s chemical formula?
  + C2H4O2  or CH3COOH
* NaOH is sodium hydroxide, the active ingredient in “Drano”. How many atoms of each element are represented in the formula?
  + \_\_ Sodium \_\_ Oxygen \_\_ Hydrogen
* Enrichment: Al2(SO4)3 is calcium sulfate. How many atoms of each element are represented in the formula?
  + \_\_ Aluminum \_\_ Sulfur \_\_ oxygen
  + *Multiply all element inside the parenthesis by the subscript “3”*

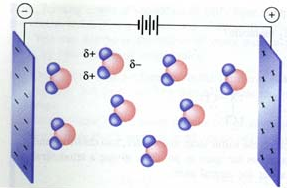
Water Chemistry

* Water (H2O) is formed by \_\_\_\_\_ bonds (sharing of electrons) between \_\_\_\_\_ Hydrogen atoms and \_\_\_\_\_ Oxygen atom.

Water is a “\_\_\_\_\_” Molecule



* \_\_ Hydrogen atoms each share \_\_ electron with one Oxygen atom in the \_\_\_\_\_ bond they make.
* The Oxygen atom has 4 remaining electrons (not used in to hold the hydrogen atoms). 🡪
* This gives the Oxygen side of the molecule a \_\_\_\_\_ charge, and the Hydrogen side a slight \_\_\_\_\_ charge.
* This creates the \_\_\_\_\_ characteristic of water (\_\_\_\_\_ side of the molecule having \_\_\_\_\_ charges)
* \_\_\_\_\_ charges \_\_\_\_\_
* Unlike charges \_\_\_\_\_



Polarity

* As a result of polarity, water molecules easily bond together.



Notice that the negative end of water points towards the positive place (right).

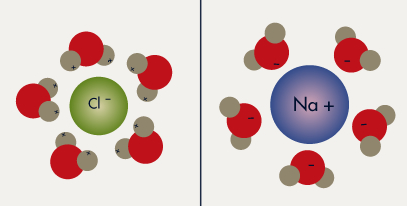
Effects of Water’s Polarity

* Universal \_\_\_\_\_
* \_\_\_\_\_ Bonding
  + Density of Water
  + Cohesion
  + Adhesion
  + Surface Tension
  + Capillary Action
  + Water
* Many substances \_\_\_\_\_ in water so it is commonly referred to as the \_\_\_\_\_ solvent.
* Because of this, water in nature and in use is rarely pure and some properties may vary from those of the pure substance.

Water Dissolves Substances

* Because of it’s chemical composition, water is able to \_\_\_\_\_ many \_\_\_\_\_ and \_\_\_\_\_.
* Water uses it’s \_\_\_\_\_ (\_\_\_\_\_ side to attract \_\_\_\_\_ ions and it’s \_\_\_\_\_ side to attract) and dissolve \_\_\_\_\_ ions.

Dissolving Ionic Compounds



Like Dissolves Like

* Refers to "polar" and "nonpolar" solvents and solutes.
* Basic example: Water is \_\_\_\_\_. Oil is \_\_\_ polar. Water will \_\_\_ dissolve oil.
* Water is polar. Salt (NaCl) is \_\_\_\_\_ (which is considered extremely \_\_\_\_\_). Like dissolves like, that means \_\_\_\_\_ dissolves \_\_\_\_\_, so water dissolves salt.

F2 gas is a molecule composed of two atoms chemically bonded together. Is this molecule polar or nonpolar? Explain.

* Fluorine gas is \_\_\_\_\_ because the two atoms are identical so electrons pull \_\_\_\_\_ apart.

If the comb is brought near the water, will anything happen?

* When you bring the \_\_\_\_\_ comb near the faucet it is \_\_\_\_\_ to the \_\_\_\_\_ end of the water. (*in this case – to +*)

Why are water molecules polar?

* The hydrogen and oxygen atoms “fight” over the \_\_\_\_\_ they share and \_\_\_\_\_ pulls harder, making it slightly \_\_\_\_\_. The \_\_\_\_\_ end is slightly \_\_\_\_\_.

Hexane has \_\_ carbon atoms (C) & \_\_ hydrogen atoms (H). What is its chemical formula?

* C7H16

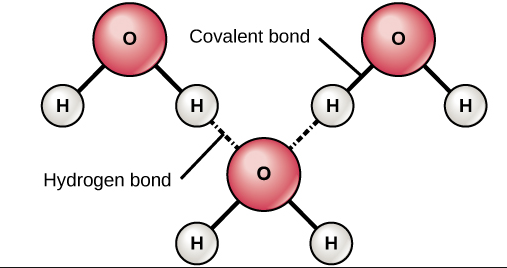
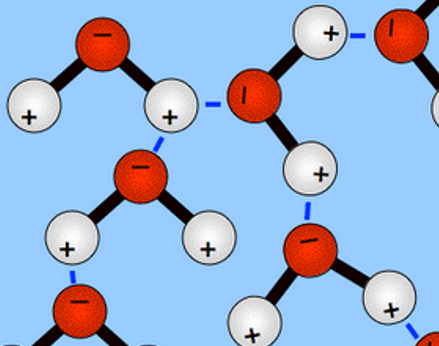
If a substance dissolves in water, will it dissolve in vegetable oil, a nonpolar substance?

* Vegetable oil does \_\_ dissolve in water because water is \_\_\_\_\_ and oil is \_\_\_\_\_. “Like dissolves \_\_\_\_\_.” Water dissolves \_\_\_\_\_ and \_\_\_\_\_ compounds.

4B Water: Focus Questions

1. Why does water have so many special properties?
2. What is hydrogen bonding?
3. What kind of special properties does water exhibit?
4. What is the difference between “hard” and “soft” water?

Hydrogen Bonds

* \_\_\_\_\_ of bonds spend more time around \_\_\_\_\_ atom than around hydrogen atom … so a slight \_\_\_\_\_ charge exists.
* Because of the slight charges, and the fact that “opposites \_\_\_\_\_”, water molecules organize themselves with \_\_\_\_\_ bonding.

Unusual Property of Water

* Hydrogen forms water (H20) & other similar compounds using elements of the same “\_\_\_\_\_” 🡪 H2S, H2Se, and H2Te.
* All four molecules have \_\_\_\_\_ chemical \_\_\_\_\_ (elements in same “family”).
* The other three molecules are \_\_\_\_\_ at room temperature, but water is a \_\_\_\_\_.

D\_\_\_\_\_ of Water

* Water is the only substance whose \_\_\_\_\_ form is \_\_\_\_\_ dense than its \_\_\_\_\_ form.
* In it’s solid form (ice), water is able to \_\_\_\_\_ because the molecules are \_\_\_\_\_ further \_\_\_\_\_ as a \_\_\_\_\_ than as a liquid, making it less dense.

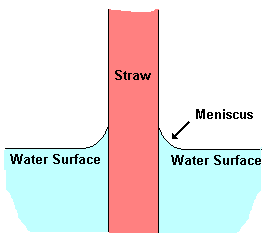
C\_\_\_\_\_

* The action or property of “\_\_\_\_\_” molecules \_\_\_\_\_ together
* Water is strongly cohesive due to its \_\_\_\_\_ bonds

A\_\_\_\_\_

* The action or property of “\_\_\_\_\_” molecules sticking together
* E.g. Adhesive tape

Cohesion and adhesion help explain phenomena such as \_\_\_\_\_, \_\_\_\_\_ tension and \_\_\_\_\_ action.

What makes water droplets the way they are; i.e. hanging onto a spider web, keeping their shape …?

* \_\_\_\_\_ causes water to form drops, \_\_\_\_\_ tension causes them to be nearly spherical, and \_\_\_\_\_ keeps the drops in place.

\_\_\_\_\_ Action

* \_\_\_\_\_ & \_\_\_\_\_ cause the liquid to work against \_\_\_\_\_.
* Cohesion holds the liquid together (sticks to \_\_\_\_\_)
* Adhesion causes the liquid to stick to the \_\_\_\_\_ of the \_\_\_\_\_

T\_\_\_\_\_

* \_\_\_\_\_ in a leaf.
* Hydrogen bonds allows \_\_\_\_\_ between water molecules and cellulose xylem wall.
* Hydrogen bonds allows \_\_\_\_\_ between water moelcules in xylem
* Uptake across root.

Surface \_\_\_\_\_

* Capillary action includes the high surface tension produced by \_\_\_\_\_ and \_\_\_\_\_.
* Mercury’s cohesion is so great it’s \_\_\_\_\_ forms a “convex” shape.

\_\_\_\_\_ Water

Bathtub faucet with built up \_\_\_\_\_ (hard water).

* Water that contains a significant quantity of dissolved \_\_\_\_\_ (like \_\_\_\_\_ and \_\_\_\_\_).
  + Ca+2 and Mg+2 ions; Limestone, chalk
* Hard water is to blame for dingy looking clothes, dishes with spots and \_\_\_\_\_, and bathtubs with lots of \_\_\_\_\_ and soap \_\_\_\_\_. Even hair washed in hard water may feel sticky and look dull.

Soft Water

* Why would soft water make you feel "not quite clean"? One reason is that when soap and mineral scum are absent, your natural \_\_\_\_\_ \_\_\_\_\_ make your skin feel \_\_\_\_\_, which some people interpret as being “\_\_\_\_\_”.
* Water \_\_\_\_\_ is the removal of \_\_\_\_\_, \_\_\_\_\_, and certain other \_\_\_\_\_ ions in hard water. The resulting soft water is more compatible with soap and extends the lifetime of plumbing.

\_\_\_\_\_ is the only substance where all \_\_\_\_\_ states of matter (solid, liquid, gas) can be readily observed in everyday life (in nature)