Water

Importance of Water to Living Things

Ted-Ed Water in Your Body

A. Water is the most abundant substance on the surface of Earth.

B. It is essential to all life.

C. It is a very unique molecule.

D. Life began in water, and all living organisms are "water-based."

E. All living organisms have adaptations for maintaining water levels. (e.g. human skin, plant stomata, bacterial cysts)

Water is important for living things

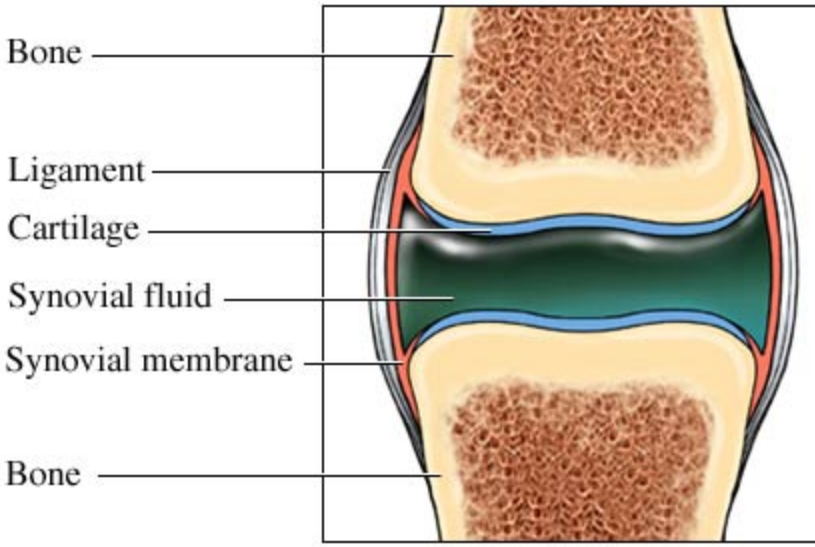
A. Human body is approx. 60 – 70% water

B. Only substances dissolved in water can enter the cell membrane of cells (eg. Glucose, AA's)

C. Water carries away dissolved substances from cells and wastes excreted in liquids (eg. Sweat and urine)

D. Ions are necessary for many body processes
   A. Ca^{++} for movement
   B. K^{+} and Na^{+} for generation of nerve impulses
   C. Ions are formed when an ionic substance is dissolved in water

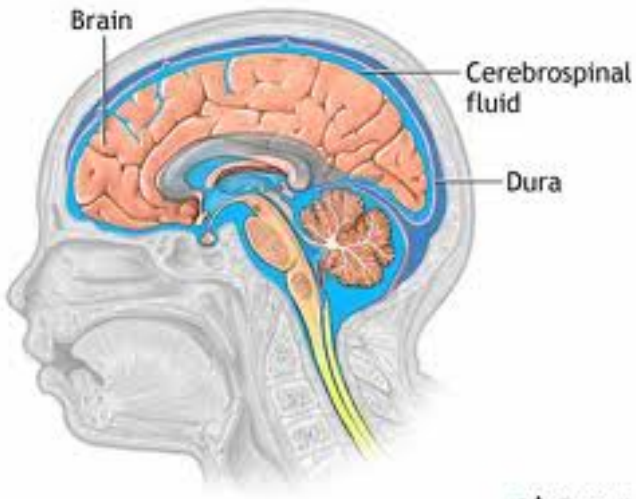
E. Water and water based solutions act as lubricants (e.g. your joints are lubricated by synovial fluids



Cross section of a healthy joint

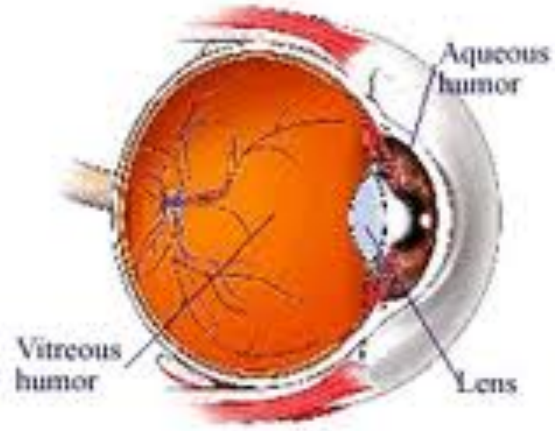
F. Water regulates temperature in living systems because water does not heat up easily or cool down easily when compared to metal or sand

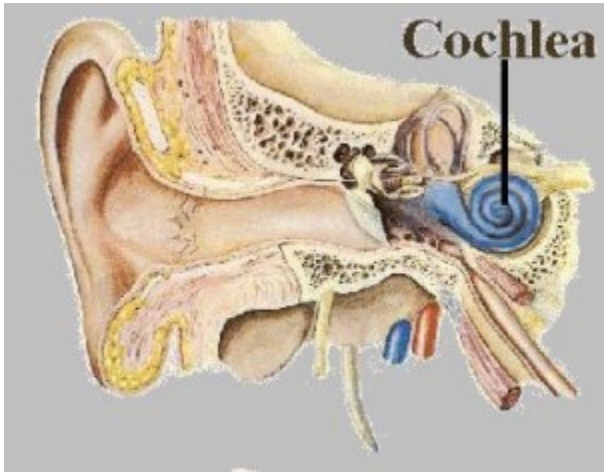
G. Human brains are partially protected against shock by a watery layer.



H. Sense organs require water

- Eyes are filled with a thick fluid
- Hearing depends upon a fluid filled structure called the cochlea that detects and transmits vibrations



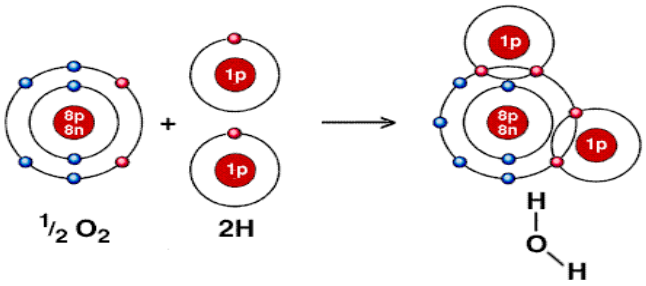


I. Hydrolytic enzymes are involved in breaking bonds between molecules and this requires water.

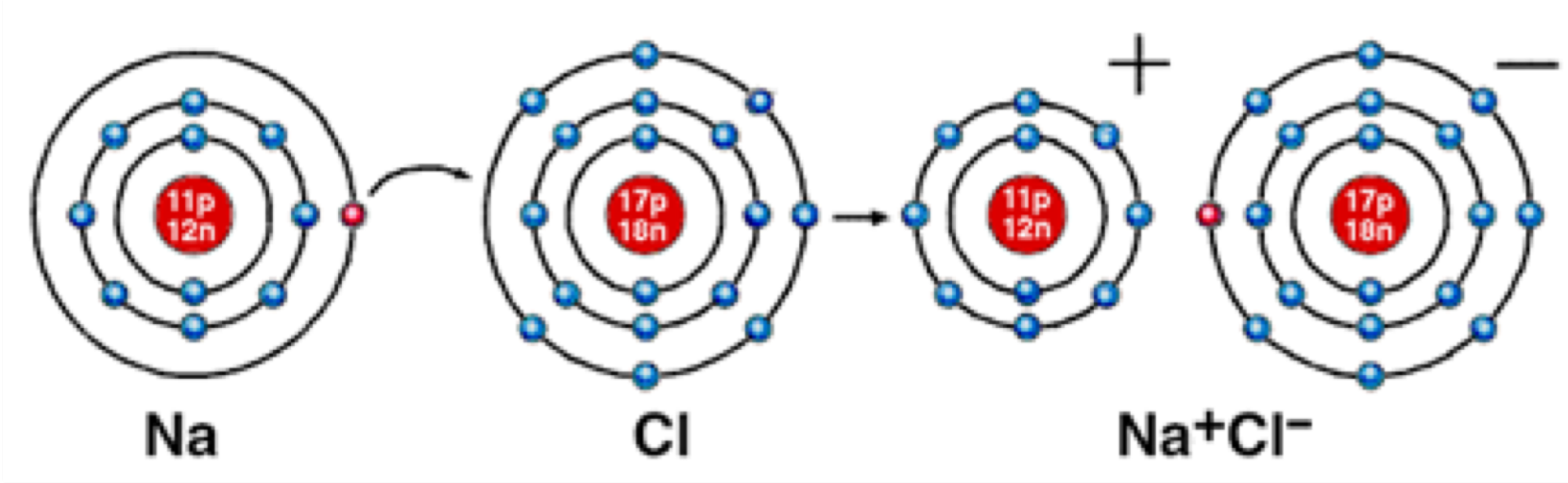
The Chemistry of Water

A. Water is covalently bonded

- Bonds are formed when atoms share electrons
- Covalent bonds are strong bonds when compared with ionic and hydrogen bonds

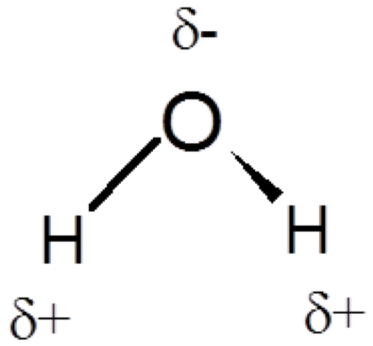


- An ionic bond is a bond in which electrons are transferred between atoms



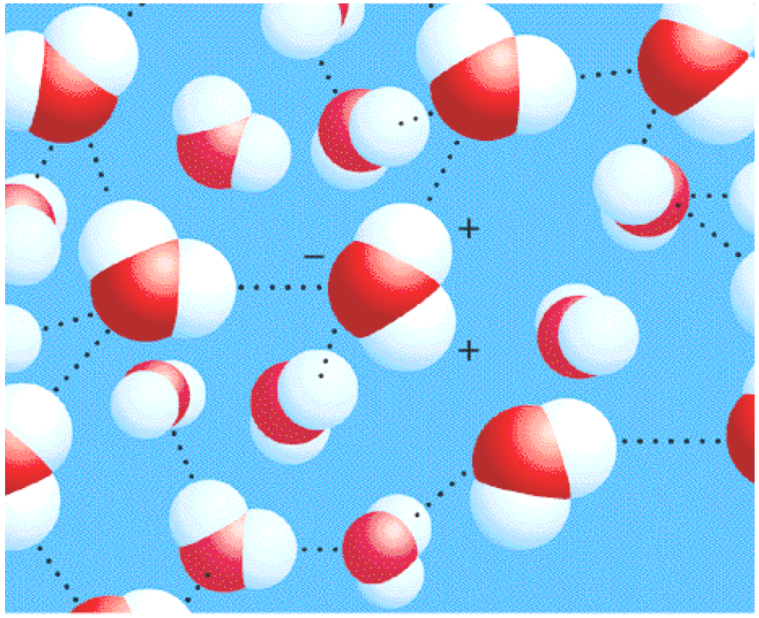
B. Water is polar TED-Ed Lesson: How Polarity works

- The shared electrons spend more time circulating near the larger oxygen than the smaller hydrogen. Thus the oxygen has a slight net negative charge while the hydrogen have a small net positive charge

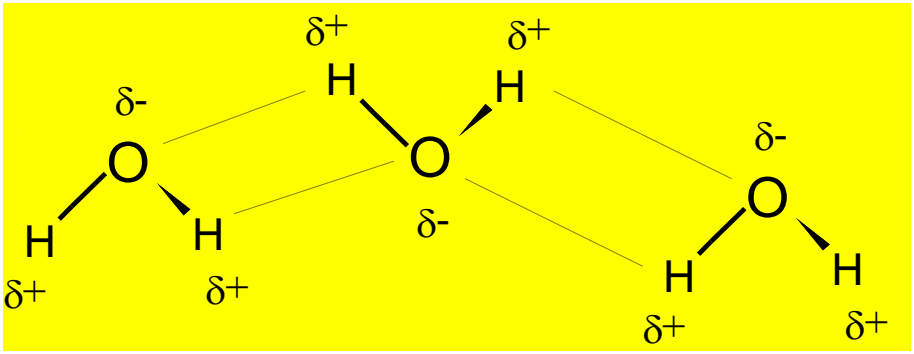


Polar bonding

- Hydrogen bonds occurs whenever a partially positive H is attracted to a partially negative atom (ex. oxygen and nitrogen)
- It is represented by a dotted line because it is weak and fairly easily broken compared to covalent and ionic bonds.



- There are lots of water molecules found in living systems so the net effect of all those weak H-bonds, can add up to have a large effect.



III. Water has Unique Characteristics

- It is abundant through the biosphere
- Hydrogen bonding makes it have a low freezing point and a high boiling point, so that it is liquid at body temperature
- Water absorbs much heat before it warms up or boils, and gives off much heat before it **freezes because it takes a lot of energy to break the hydrogen bonding. (Specific Heat Capacity)**

- Water has high cohesiveness

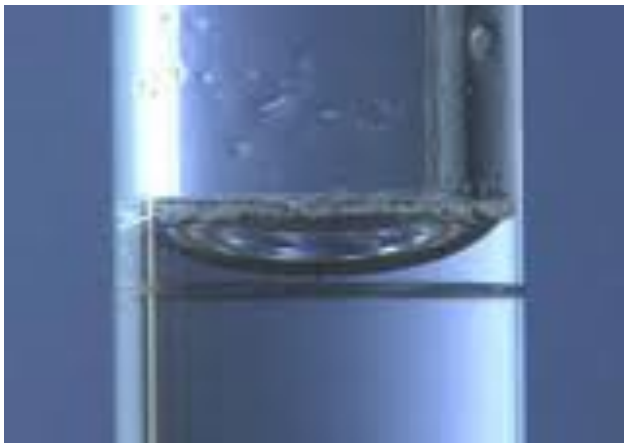
1. Water molecules tend to cling together and draw dissolved substances along with it.

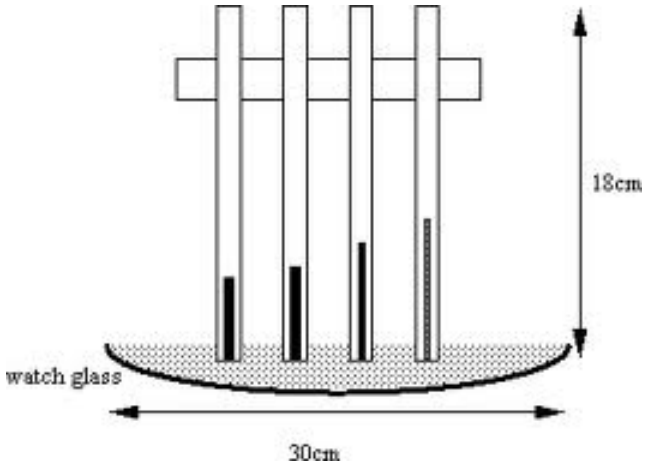
2. This makes it good for transporting materials through tubes.

- Water has high adhesiveness

    1. Water molecules tend to cling to surfaces

    2. ex. capillary action





- Liquid water is more dense than ice because of hydrogen bonding.
    1. Ice will float on top of the water
    2. The ice layers helps protect organisms below. Ted-Ed: Why Does Ice Float?

- Water dissolves other polar molecules and is one of the best solvents known so it is often called the “universal solvent.”