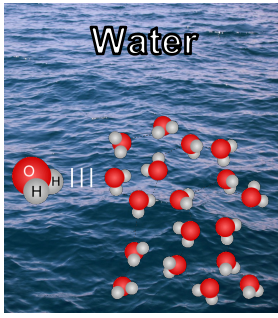


Today's Topics

- Polar Covalent bonds
- Hydrogen bonds
- Emergent Properties of Water
- pH
- Carbon-based molecules



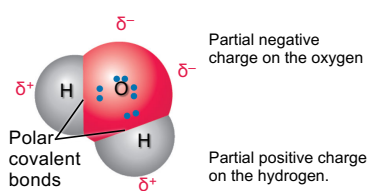
**Water**

Sept 1, 2023

1

## Polar covalent bonds

Oxygen is more electronegative than hydrogen



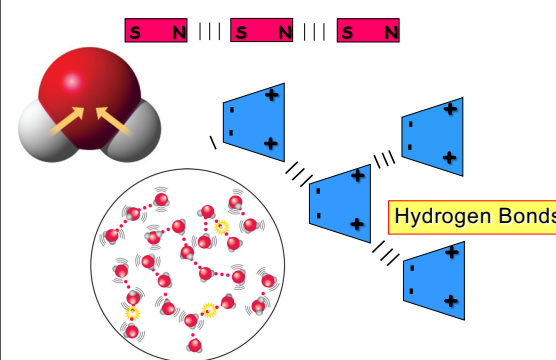
Partial negative charge on the oxygen

Partial positive charge on the hydrogen.

Polar covalent bonds

2

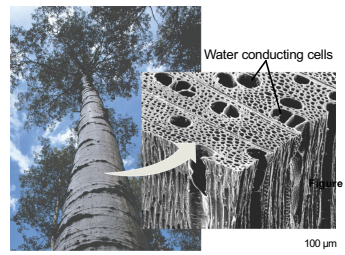
Like little magnets:




Hydrogen Bonds

3

### 1. Cohesion - water molecules stick to one another



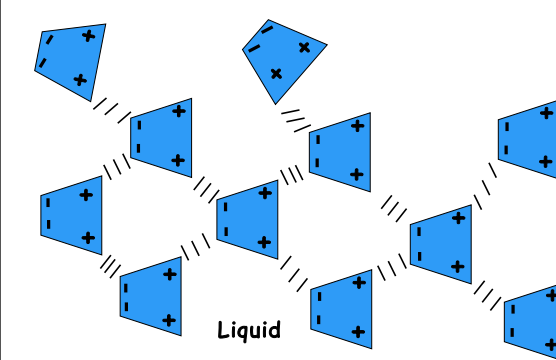
Water conducting cells



Surface Tension

Figure 3.3  
100  $\mu$ m

4

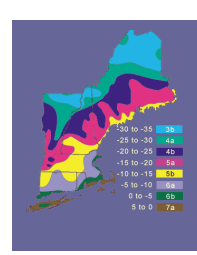


Liquid


5

### 2. Temperature Moderation

water has a **high specific heat**

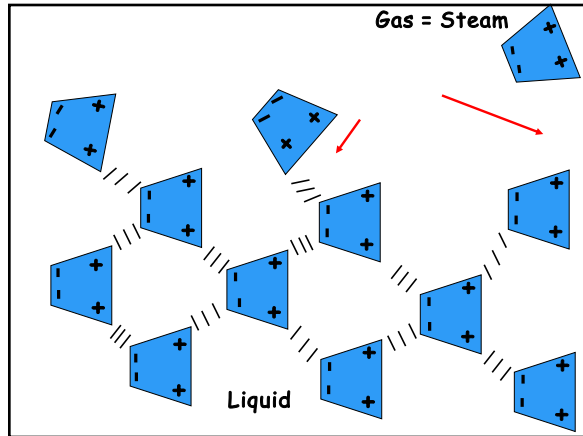


Climate Zones



Evaporative cooling

6



7

**3. ICE is less dense than Water**

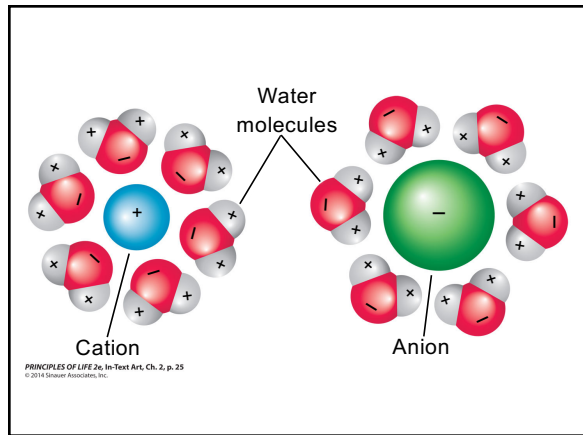
Hydrogen bond

**Ice**  
Hydrogen bonds are stable

**Liquid water**  
Hydrogen bonds constantly break and re-form

**Insulates bodies of water, melts from surface**

8



9

**4. Water is a great Solvent**

Negative oxygen regions of water molecules are attracted to sodium cations (Na<sup>+</sup>).

Positive hydrogen regions of water molecules cling to chloride anions (Cl<sup>-</sup>).

Figure 3.6

10

Polar molecules dissolve in Water

**“Like dissolves Like”**

**“Like dissolves Like”**

Nonpolar molecules dissolve in nonpolar solvents

11

**C-H bonds are non-polar**

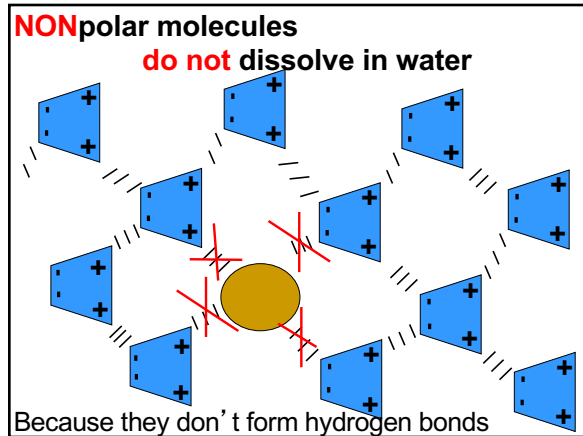
*Why are they non-polar?*

**C<sub>9</sub>H<sub>20</sub>**

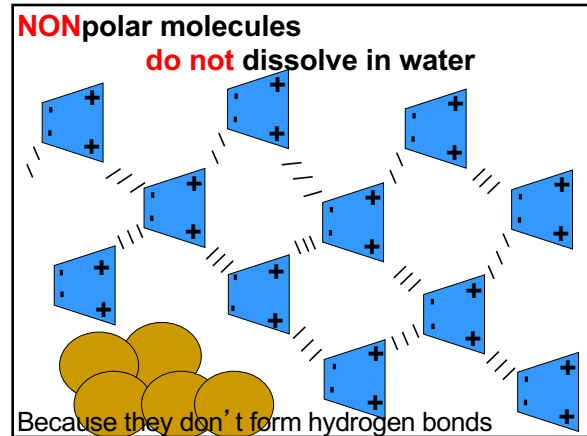
$$\begin{array}{ccccccccccc}
 & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\
 & | & | & | & | & | & | & | & | & | & | \\
 \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\
 & | & | & | & | & | & | & | & | & | & \\
 & \text{H} & \text{CH}_3 & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & 
 \end{array}$$

Will this molecule dissolve in water?

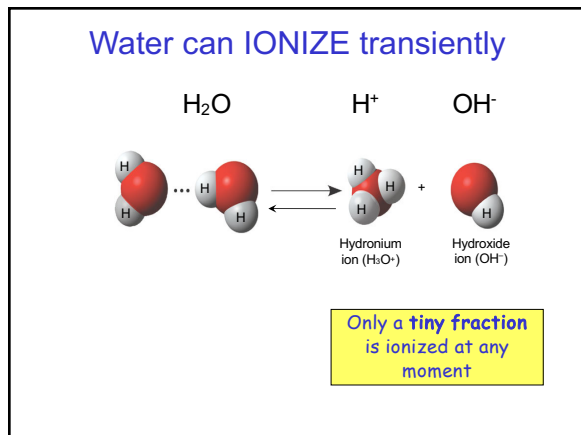
12



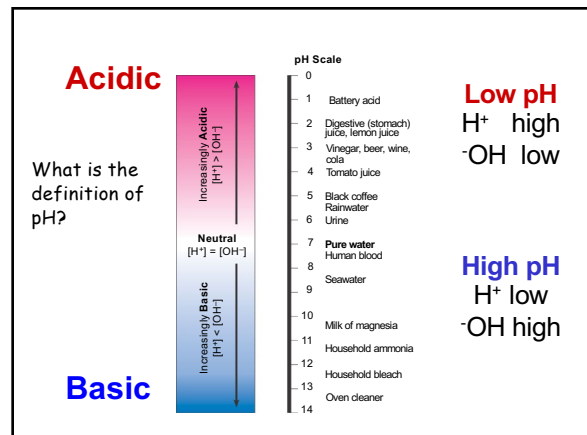
13



14



15

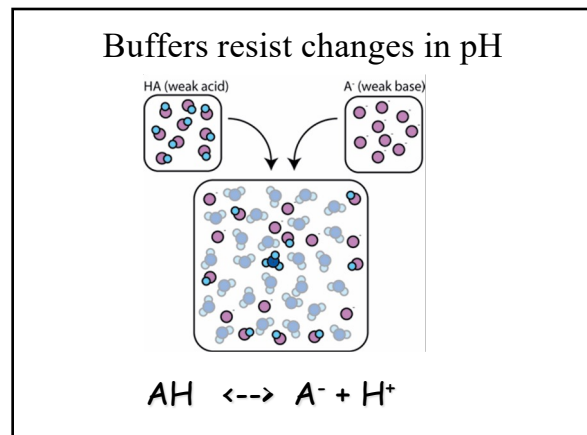


16

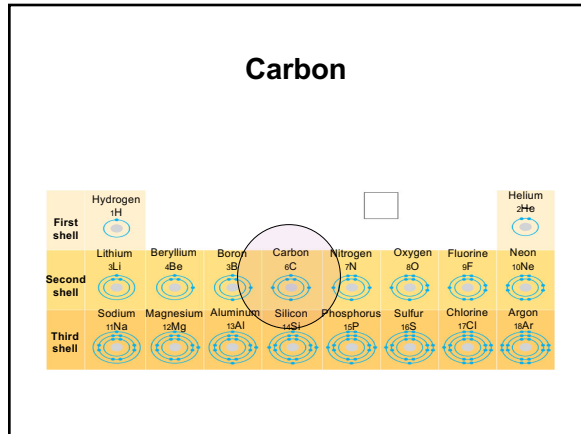
Just for fun: How big is a mole?  
 $6.02 \times 10^{23}$

- $10^{17}$  seconds since the big bang.  
14 billion years x 31,557,600 seconds per year
- That is less than *one millionth* of a mole of seconds!

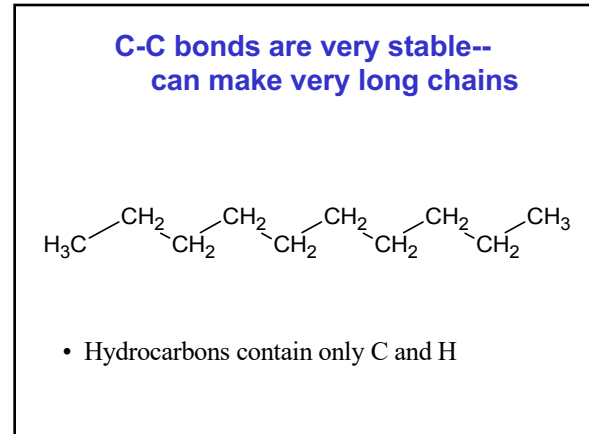
17



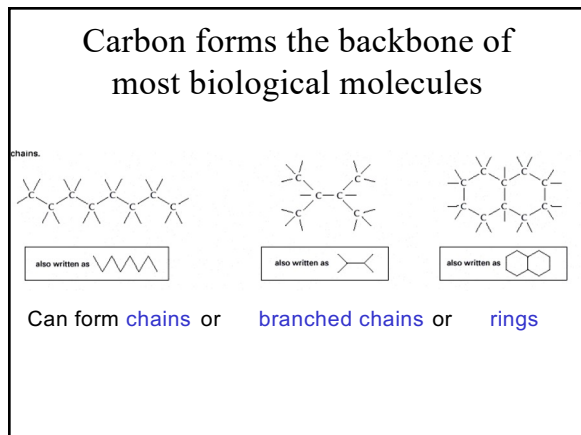
18



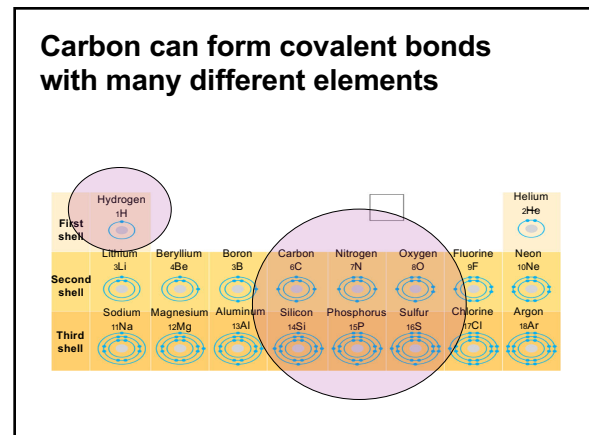
19



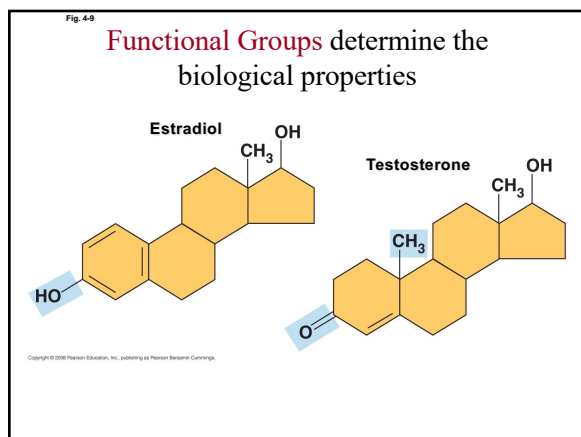
20



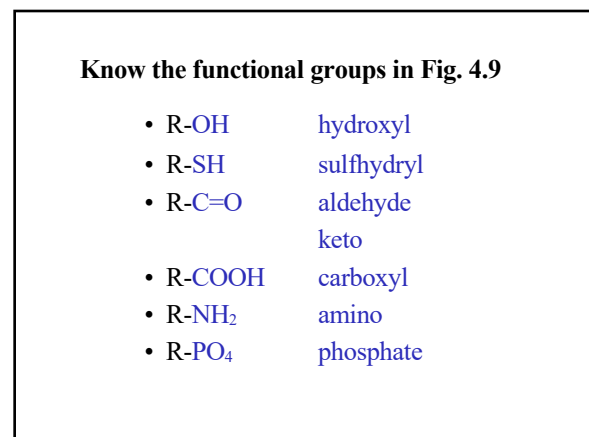
21



22



23



24