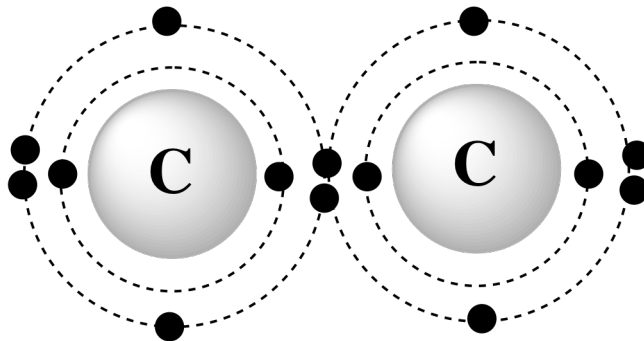


CONCEPT: IMPORTANT CHEMICAL BONDS AND ATTRACTIONS

Properties of Atoms

- The properties and structure of atoms allow for the _____ of chemical bonds
 - An atom has a core of neutrons and protons, which is surrounded by a negatively charged electron cloud
 - **Electron shells** contain the orbiting electrons circling the atom's core
 - Incomplete electron shells are less stable, therefore supporting a chemical bond
 - There are 90 naturally occurring atoms, but are found in cells (Carbon, Hydrogen, Nitrogen, Oxygen = 95%)
 - In cells, these elements do not exist by themselves, but instead form bonds
 - Carbon can form four bonds, and serves as a foundational element of biological chemistry in cells

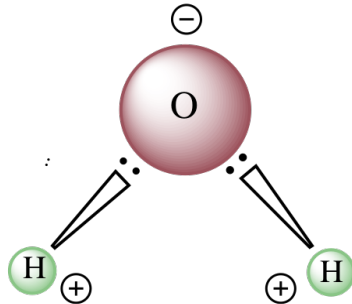
EXAMPLE: Electron shells of two bonded carbon atoms



Covalent Bonding

- **Covalent bonds** are formed through sharing electrons
 - Occurs when the outer electron shells of two molecules “want” to be complete, so they _____ electrons
 - Can share two electrons (*single bond*), four electrons (*double bond*) or six electrons (*triple bond*)
 - Molecule **polarity** occurs through the unequal sharing of electrons (**nonpolar** molecules share electrons equally)
 - Concentration of negative/positive charges on different atoms in a molecule
 - **Electronegativity** describes atoms with an ability to attract electrons
 - Covalent bonds have a high **bond strength**, defined as the amount of _____ needed to break the bond
 - The bond strength required to break a single Carbon-Oxygen bond is 84 kcal/mol

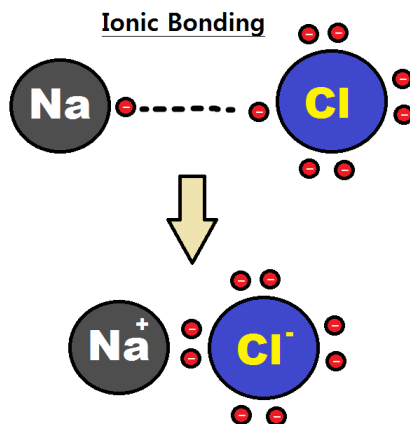
EXAMPLE: Formation of water through covalent bonding results in the polarity of the water molecules



Noncovalent Bonding

- **Noncovalent bonds** (intermolecular forces) are bonds that _____ involve the sharing of electrons
- **Ionic bonds** (salt bridges) are formed by donating or accepting electrons
 - Occurs when the outer electron shells donate or take in an electron in order to be complete
 - After the electron moves between the molecules they become charged
 - **Cations** are positively charged (Na^+) and **Anions** are negatively charged (Cl^-)
 - These ions are then attracted to each other by their charges (NaCl)
 - Ionic bonds are _____ (1-5 kcal/mol) and are easily dissolved in water

EXAMPLE: Ionic bond formation between Sodium and Chloride



- **Hydrogen bonds** are formed through attractions between a hydrogen atom and an electronegative atom
 - The partial positive charge of the hydrogen attracts electronegative atoms

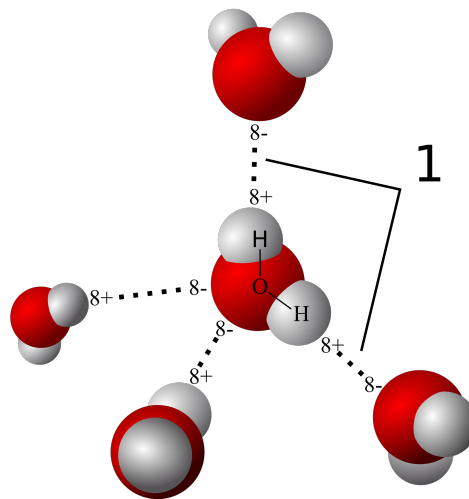
□ Hydrogen bonds are extremely important in providing water it's important properties

- _____ in water depends on the ability to create hydrogen bonds

- Result in attraction between water molecules

□ Hydrogen bonds are weak (1-2 kcal/mol)

EXAMPLE: Hydrogen bonds form between water molecules



● **Van der Waals** attractions are nonspecific attractive forces that occur as two atoms approach each other

□ Can occur in polar or nonpolar molecules

□ Strength of bond _____ with distance of the atoms

- Very weak bonds (1kcal/mol)

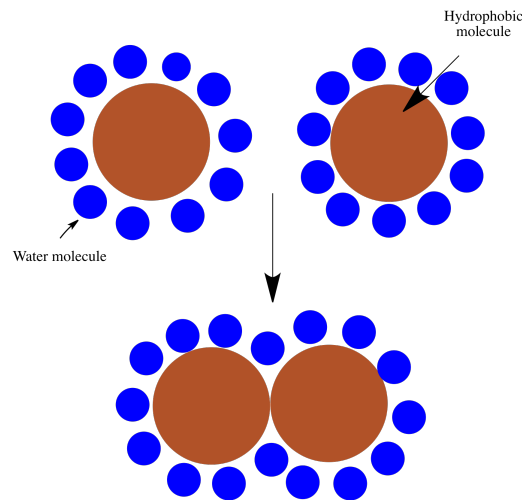
EXAMPLE: Van der waals forces are responsible for the sticky nature of geico toes



Attractive Forces

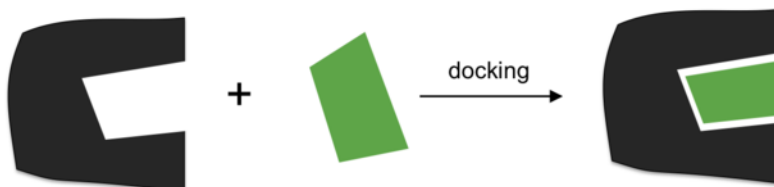
- The **hydrophobic effect** explains attractions between _____ molecules
 - Attraction that explains the aggregation of fat molecules in water
 - **Hydrophilic** molecules dissolve in water, **hydrophobic** molecules do not dissolve in water
 - Hydrophobic molecules have a neutral charge, and therefore cannot form hydrogen bonds in water
 - Therefore, the hydrophobic molecules are surrounded by hydrogen bonding water molecules
 - **Hydrocarbons** are _____, hydrophobic molecules made up of Hydrogen and Carbon
 - Because they do not dissolve in water, they are able to form important cellular structures in water

EXAMPLE: Hydrophobic molecules cluster together in water due to the hydrophobic effect



- Certain characteristic features of these bonds allow for the formation of important biological structures
 - Noncovalent bonds are weak individually, but can be _____ together to create a strong effective force
 - DNA molecules are held together by a series of weak noncovalent interactions
 - Some molecules fit together like a “lock and key”
 - *Molecular complementarity* describes the nearly perfect fit between properties of two molecules
 - **Affinity** is determined by the fit of the molecule; the higher the fit the the higher the affinity

EXAMPLE: Lock and key fit between two molecules



PRACTICE:

1. Which of the following bonds form through the sharing of electrons
 - a. Ionic bonds
 - b. Hydrophobic effect
 - c. Van der Waals attractions
 - d. Covalent bonds
2. Which of the following bonds form through the donating and receiving of electrons?
 - a. Ionic bonds
 - b. Hydrophobic effect
 - c. Van der Waals attractions
 - d. Covalent bonds

3. Which of the following bonds form through nonspecific attractive forces that arise when two molecules approach each other?
- a. Ionic bonds
 - b. Hydrophobic effect
 - c. Van der Waals attractions
 - d. Covalent bonds