

## Chemical Basis of Life

A Review of Some of the Basic  
Chemical Principles

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## Elements and Compounds

- Most Common Elements that make up living things
  - C, H, O, N,
  - 3.1.2 Ca, P, K, S, Na, Fe, Cl, Mg, and Trace elements
    - Give an example of a role for each in Prokaryotes, and Plants/Animals

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## Roles of Other Elements

- Sulfur: Disulfide Bridges in Protein Tertiary Structure
- Calcium: Muscle Contraction, Neurotransmitter release.
- Phosphorus: Phosphate groups
- Iron: Hemoglobin
- Sodium: Nerve Conduction

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## Atoms and Molecules

- Atom – Smallest possible unit of matter that retains the properties of its element
  - Subatomic particles
    - Protons (mass is 1.007 dalton) about the mass of a hydrogen atom or  $1.67 \times 10^{-24}$  g
    - Neutrons
    - electrons

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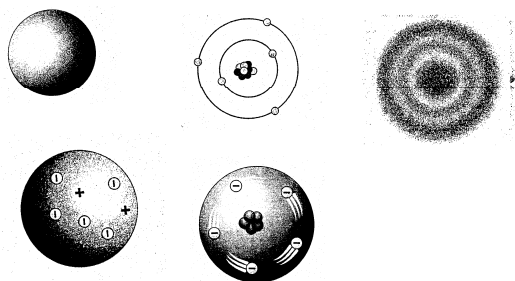
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## Atomic Models



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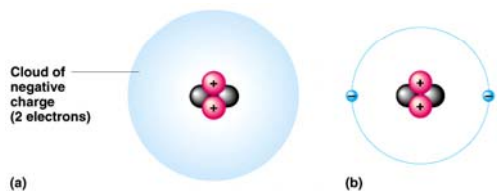
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## Atom



(a)  
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(b)

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## Atoms and Molecules

- Atomic number – same as the number of protons and electrons  ${}_8\text{O}$
- Atomic mass – number of protons and neutrons  $^{16}\text{O}$ 
  - Can figure out the number of neutrons by subtracting the atomic number from atomic mass

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## Isotopes

- Atoms of the same element that have differing number of neutrons.
  - Naturally they have mixtures of isotopes
  - Some are radioactive
  - Uses
    - Dating
    - Half life
    - Tracers

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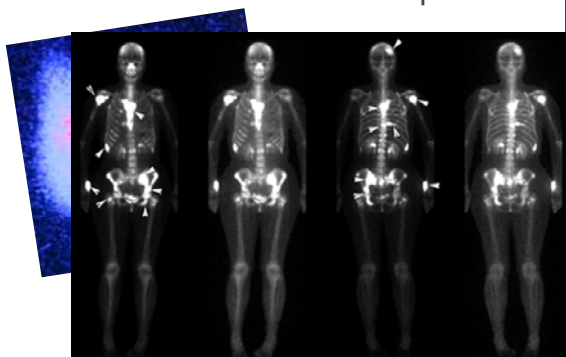
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## Uses of Radioactive Isotopes



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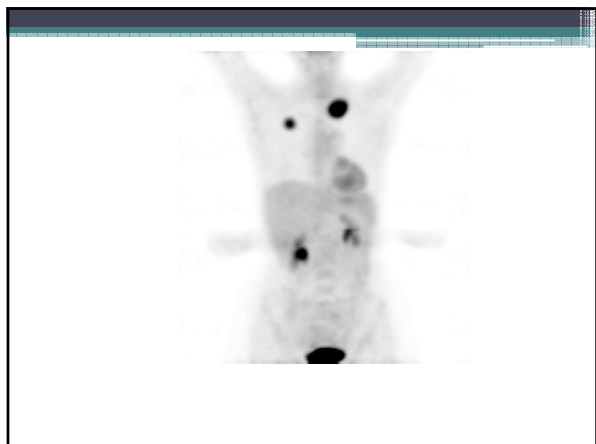
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## Bonding

- Ionic bonds
  - Ion is a charged atom or molecule
  - Anion- gained one or more electron
  - Cation- lost one or more electron
  - Ionic bond is formed by an electrostatic attraction after complete transfer of electrons.
  - Ionic compounds are called salts

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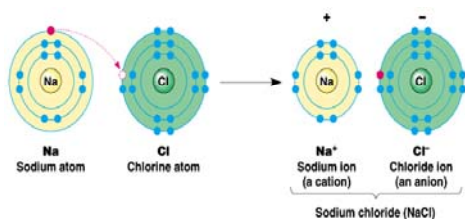
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## Ionic Bonds



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## Ionic Compounds

- Some have different ratios
  - $\text{MgCl}_2$
  - $\text{NH}_4\text{Cl}$

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## Bonding

- Covalent
  - Sharing a pair of valence electrons
  - Strong
    - Single
    - Double
    - Triple

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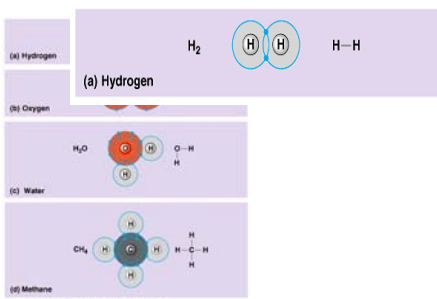
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## Single and Double



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## Bonding

- **Electronegativity**
  - The more electronegative an atom the more strongly it attracts shared electrons
  - Scale determined by Linus Pauling
    - O = 3.5
    - N = 3.0
    - S and C = 2.5
    - P and H = 2.1

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## Bonding

- **Non-polar and polar covalent bonds**
  - Non-polar – equal sharing of electrons
  - Polar- unequal sharing
    - Due to different electronegativities
    - H<sub>2</sub>O

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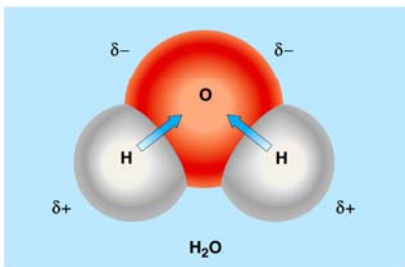
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## Polar



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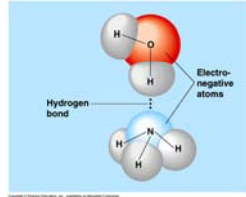
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## Weak Bonds and Life

- Weak bonds are very important to living things.
  - Hydrogen bonds
  - Ionic bonds in water (weak)
  - Van der Waals



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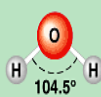
## Water's Shape

Space-filling model

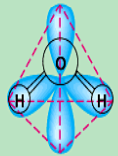


(b) Water (H<sub>2</sub>O)

Ball-and-stick model



Hybrid-orbital model (ball and stick superimposed)



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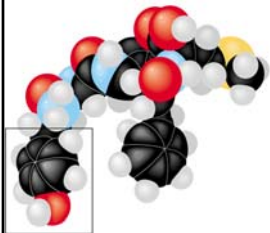
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## Distant Chemical Relatives



An endorphin



Morphine

Carbon Nitrogen Oxygen  
Hydrogen Sulfur

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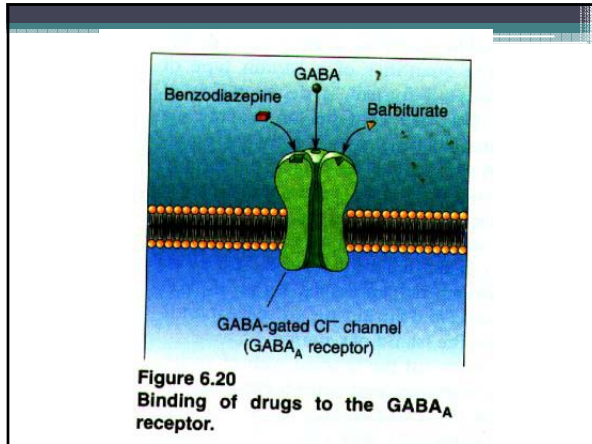
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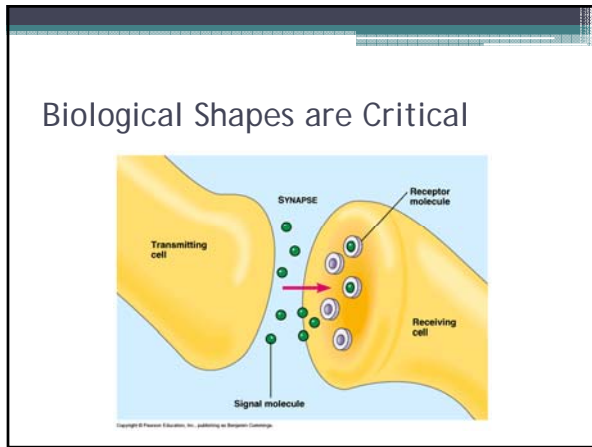
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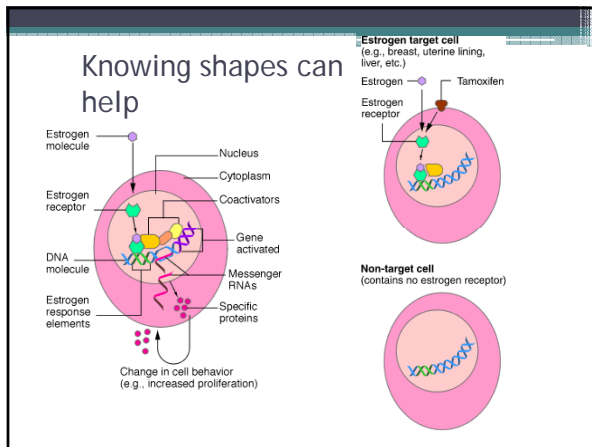
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