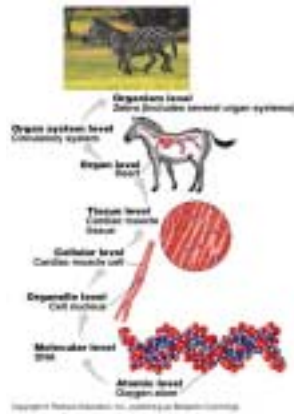


CHAPTER 2 THE CHEMISTRY OF LIFE WHAT ARE ATOMS ANYWAY?



Figure 2.1 The hierarchy of biological order from atom to organism



PROPERTIES OF ATOMS

- SOLIDS, LIQUIDS AND GASES
- BASED ON PROTONS IN THE NUCLEUS AND ELECTRONS ON ORBITALS ACTING AS COUNTERBALANCE.
- ATOMS HAVE PROTONS, NEUTRONS AND ELECTRONS

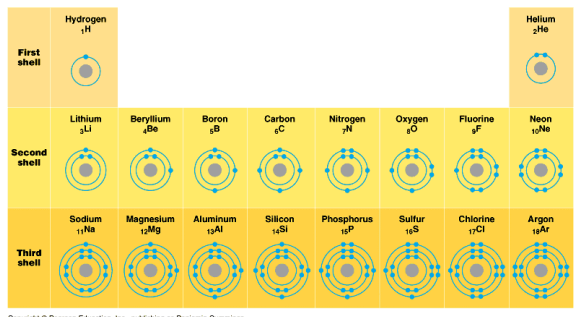
Table 2.1 Naturally Occurring Elements in the Human Body

Symbol	Element	Atomic Number (See p. 23)	Percentage of Human Body
O	Oxygen	8	65.8
C	Carbon	6	18.3
H	Hydrogen	1	9.3
N	Nitrogen	7	3.1
Ca	Calcium	20	1.3
P	Phosphorus	15	1.1
K	Potassium	19	0.4
S	Sulfur	16	0.3
Na	Sodium	11	0.2
Cl	Chlorine	17	0.2
Mg	Magnesium	12	0.1

These elements are also: fluorine (F), bromine (Br), iodine (I), cobalt (Co), copper (Cu), barium (Ba), cadmium (Cd), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se), silver (Ag), tin (Sn), vanadium (V), and zinc (Zn).

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Figure 2.10 Electron configurations of the first 18 elements



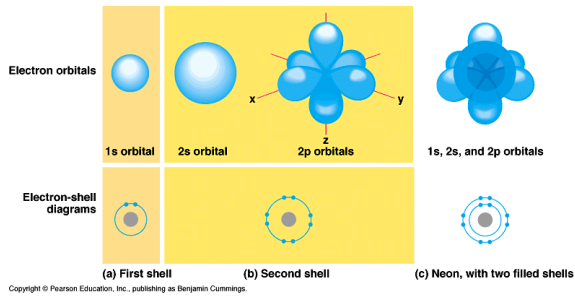
CHARACTERISTICS OF ATOMS

- ATOMS HAVE THE SAME NUMBER OF PROTONS AS ELECTRONS
- THE ATOMIC NUMBER IS THE NUMBER OF PROTONS
- THE NUMBER OF PROTONS AND NEUTRONS = ATOMIC WEIGHT
- ATOMS WITH DIFFERENT NUMBER OF NEUTRONS ARE CALLED ISOTOPES

ELECTRON PROPERTIES

- ELECTRONS ATTRACTED BY THE NUCLEUS ARE REPELLED BY EACH OTHER.
- ELECTRONS MOVE THRU CLOUD LIKE ORBITALS
- ENERGY LEVELS ARE THE DISTANCE FROM THE ATOMIC NUCLEUS: CLOSE/LOW: FAR/HIGH

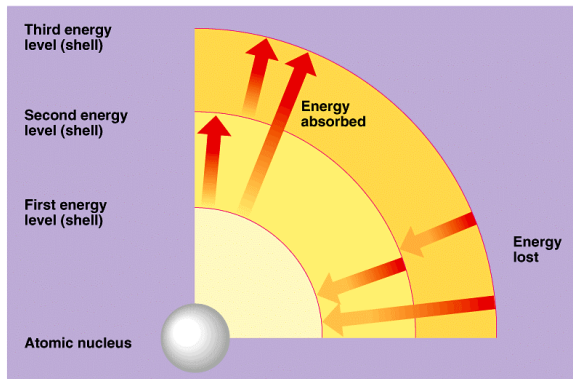
Figure 2.11 Electron orbitals



MORE THINGS ABOUT ELECTRONS

- ELECTRONS FILL LOWEST ENERGY LEVELS FIRST
- ELECTRONS ARE 2,8,8,18. ETC.
- ENERGY LEVEL FILLED IS MORE STABLE, LIKE THE INERT ELEMENTS. (He,Ne,Ar,Rn).
- IONS ARE ATOMS THAT HAVE LOST OR GAINED ELECTRONS

Figure 2.9 Energy levels of an atom's electrons



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ISOTOPES

- DIFFERENT FORM OF ATOM
- MORE NEUTRONS
- CARBON 12/CARBON 14
- C12: 6e,6n,6p/ C14: 6e,8n,6p
- MEASURES 1/2 LIFE/LOSS OF n
- ATOMS: DIFFERENT NEUTRON #
- USE:RADIOACTIVE DATING, MRI'S

FORMS OF BONDING

- IONIC BONDS
- IONS = ELECTRONS GAINED OR LOST.
- A TRANSFER OF ELECTRONS
- SODIUM AND CHLORINE =NaCl
- SODIUM LOOSES 1 ELECTRON
- CHLORINE GAINS 1 ELECTRON

Figure 2.14 Electron transfer and ionic bonding

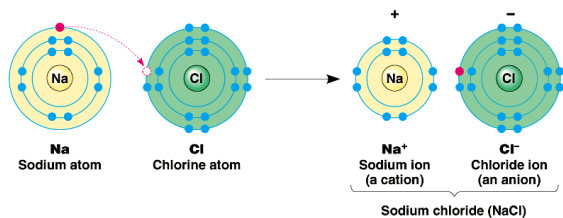
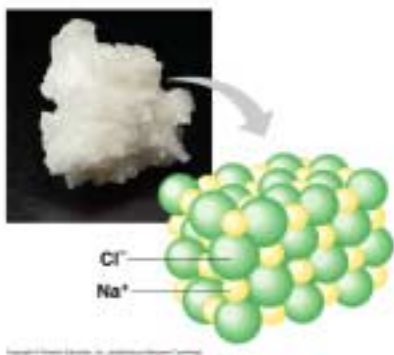


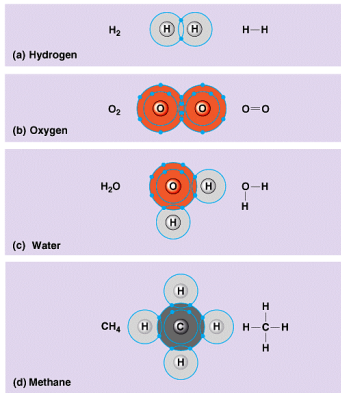
Figure 2.15 A sodium chloride crystal



COVALENT BONDS

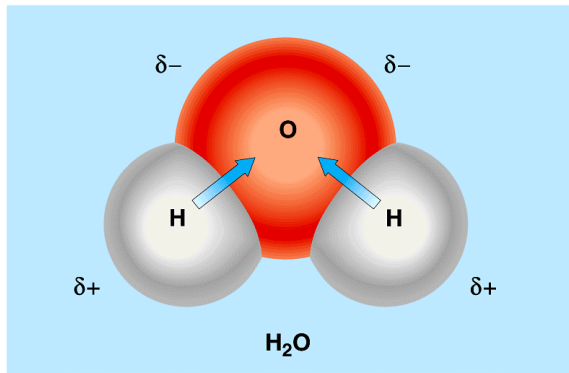
- PAIRS OF ELECTRONS SHARED
- C-C-C OR C-H OR C=C OR C=H
- CAN HAVE TRIPLE BONDS
- SYMMETRICAL CHARGES: NON-POLAR COVALENT
- ASYMMETRICAL CHARGES: POLAR COVALENT SUCH AS H₂O

Figure 2.12 Covalent bonding in four molecules



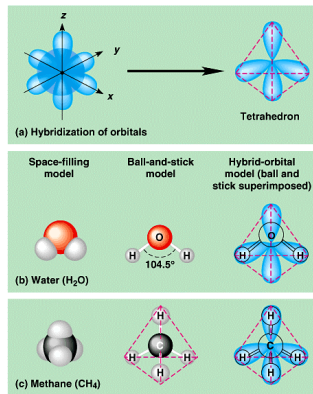
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Figure 2.13 Polar covalent bonds in a water molecule



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Figure 2.17 Molecular shapes due to hybrid orbitals

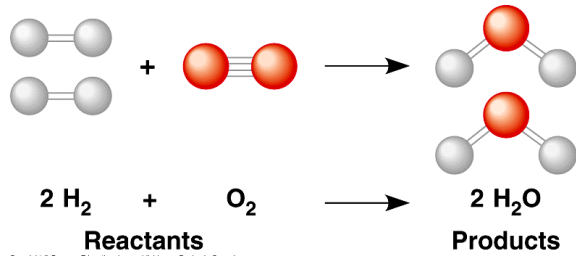


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CHEMICAL REACTIONS

- SYNTHESIS (DEHYDRATION)
- REMOVES WATER, BUILDS MOLECULES, ASSEMBLES.
- ANABOLISM REACTION $A + B = AB$
- REACTANTS = PRODUCTS
- $AA + AA = \text{PEPTIDE (- WATER)}$
- $\text{PEPTIDE} + \text{PEPTIDE} = \text{DIPEPTIDE}$

Unnumbered Figure (Page 38) Chemical reaction between hydrogen and oxygen



- DECOMPOSITION REACTIONS
- HYDROLYSIS ADDS WATER
- CATABOLISM/SPLITS CMPDS.
- $AB + \text{WATER} = A + B$
- DIGESTION
- $\text{PROTEIN} + \text{WATER} = AA + AA$
- REDOX REACTIONS
- TRANSFER OF ELECTRONS
- LOOSE OR GAIN ELECTRONS

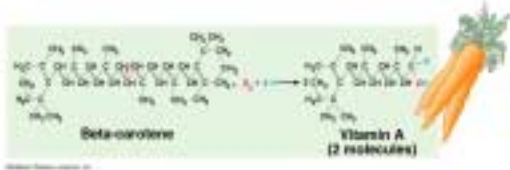
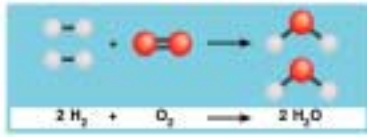


Figure 2.20 Photosynthesis: a solar-powered rearrangement of matter