



Chemistry of Life



Chemistry of Life

- **Matter** -- anything that has **MASS** and takes up **SPACE**
- **EVERYTHING** is made of matter



What makes up the chemistry of life?

Atom

- Greek word *atomos*, which means “unable to cut”.
- Word first used nearly 2500 years ago by Greek philosopher Democritus.
- He asked “If you take an object like chalk and break it in half are both pieces still chalk?”
- Suppose you break the chalk down again and again and again. Can you continue to divide without limit? Or is there a limit? Democritus thought there was a limit.
- Democritus called the smallest fragment the **atom**, a name scientists use today.



Chemistry of Life

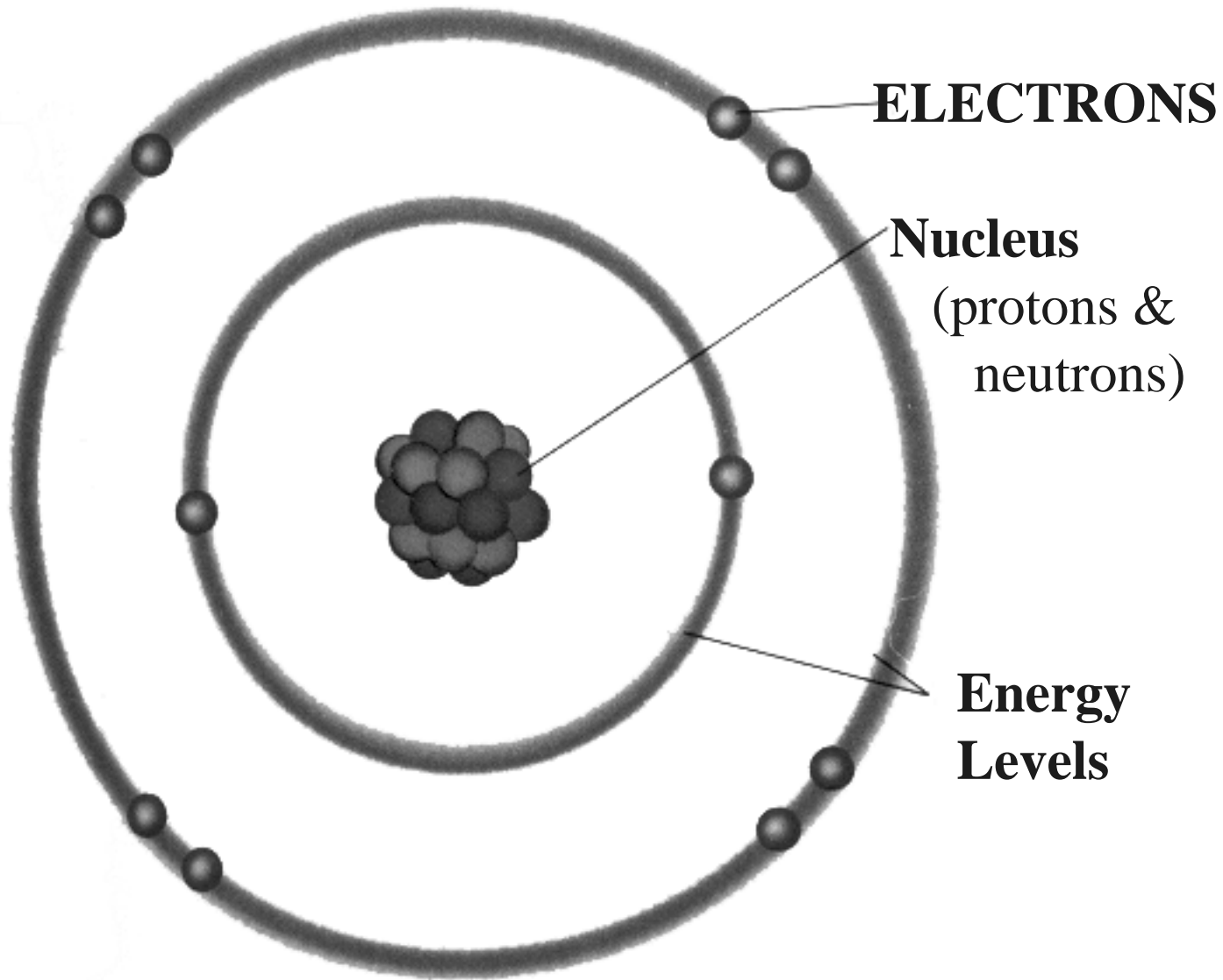
- **Atoms** – the **SMALLEST** particle that can exist and still be considered a certain kind of matter
- All **LIVING** and **NONLIVING** things are made of atoms



Atoms - three components

- **ELECTRONS** -- negatively charged
- **PROTONS** -- positively charged; found in nucleus
- **NEUTRONS** -- neutral; found in nucleus

Atom Structure





Michelangelo E- Moment

1. When you hear the word “JUMP” you will proceed to the front of the classroom in an orderly manner to get enough gumdrops and toothpicks to create a model of an atom.
2. Think carefully about what you will need. What questions are there?
3. JUMP



Chemistry of Life

- **Elements** - a substance that is made of only **ONE** kind of **ATOM**

Periodic Table of the Elements

1 IA	New Original																18 VIIIA	
1 H Hydrogen 1.00794	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA	
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797	
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948	
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.8457	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.409	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798	
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.293	
55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 to 71		72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.078	79 Au Gold 196.96655	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 to 103		104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Uub Ununbium (285)	113 Uut Ununtrium (284)	114 Uuq Ununquadium (289)	115 Uup Ununpentium (288)	116 Uuh Ununhexium (292)	117 Uus Ununseptium	118 Uuo Ununoctium

Atomic masses in parentheses are those of the most stable or common isotope.

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Note: The subgroup numbers 1-18 were adopted in 1984 by the International Union of Pure and Applied Chemistry. The names of elements 112-118 are the Latin equivalents of those numbers.

57 La Lanthanum 138.9055	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
89 Ac Actinium (227)	90 Th Thorium 232.0381	91 Pa Protactinium 231.03688	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)



Go and Get It

1. Hidden around the room are the basic elements of life.
2. When I say “Atom” each group is to collect one set of element cards. **C.HOPKINS CaFe MgNaCl**
3. When all 13 cards are collected have everyone in your group sit down.



Major Elements of Life

- C = Carbon
- H = Hydrogen
- O = Oxygen
- P = Phosphorus
- K = Potassium



Major Elements of Life

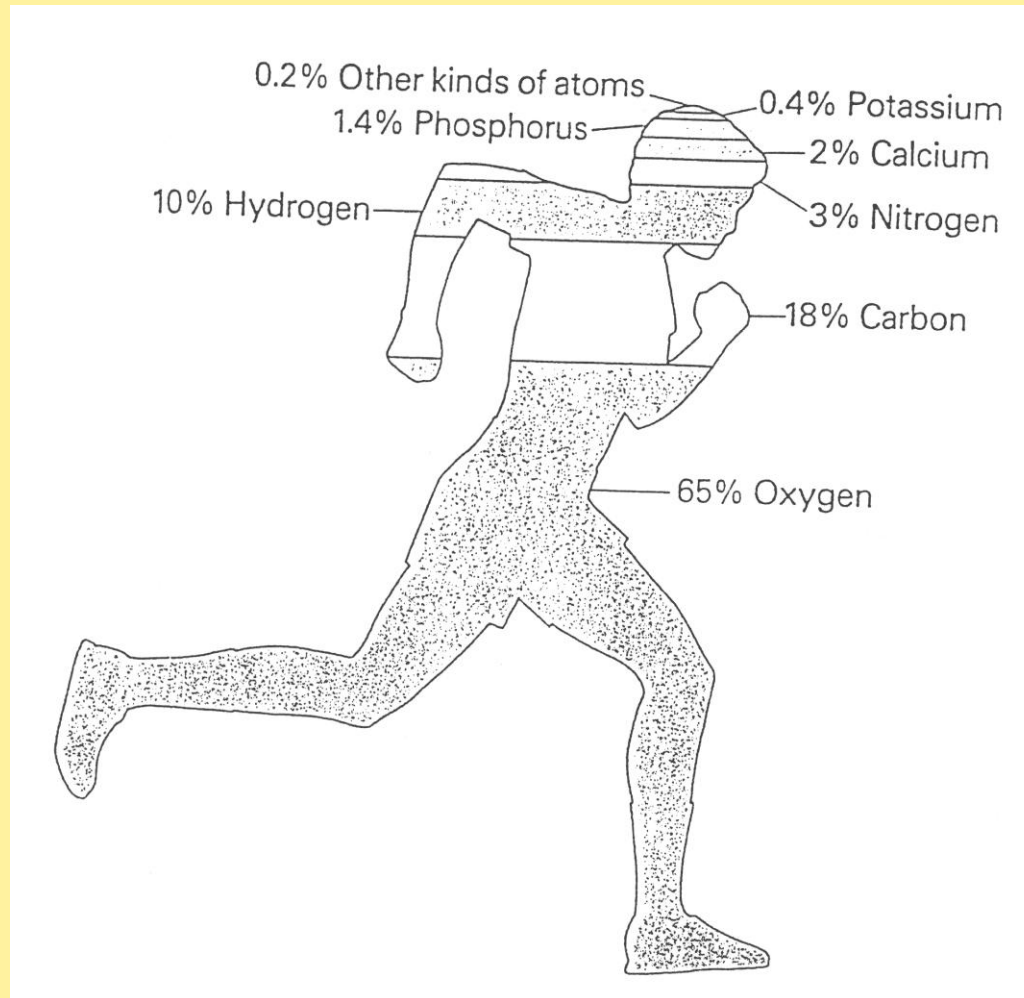
- I = Iodine
- N = Nitrogen
- S = Sulfur
- Ca = Calcium



Major Elements of Life

- Fe = Iron
- Mg = Magnesium
- Na = Sodium
- Cl = Chlorine

Major Elements in Human Body





Chemical Bonds

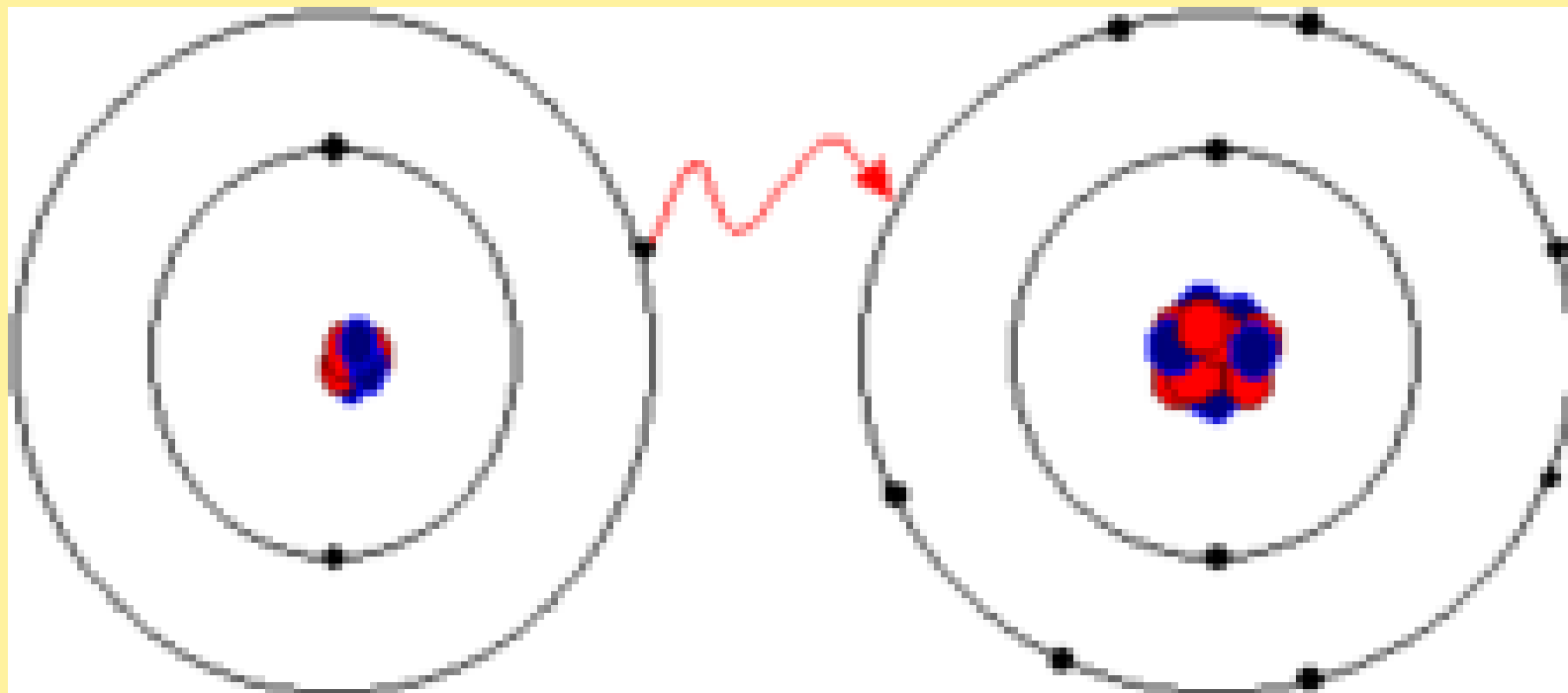
- The main types of Chemical Bonds in a compound are:
 - Ionic Bonds
 - Covalent Bonds



Ionic Bonds

- An IONIC BOND is formed when one or more electrons are **transferred** from one atom to another.

Ionic Bond Example

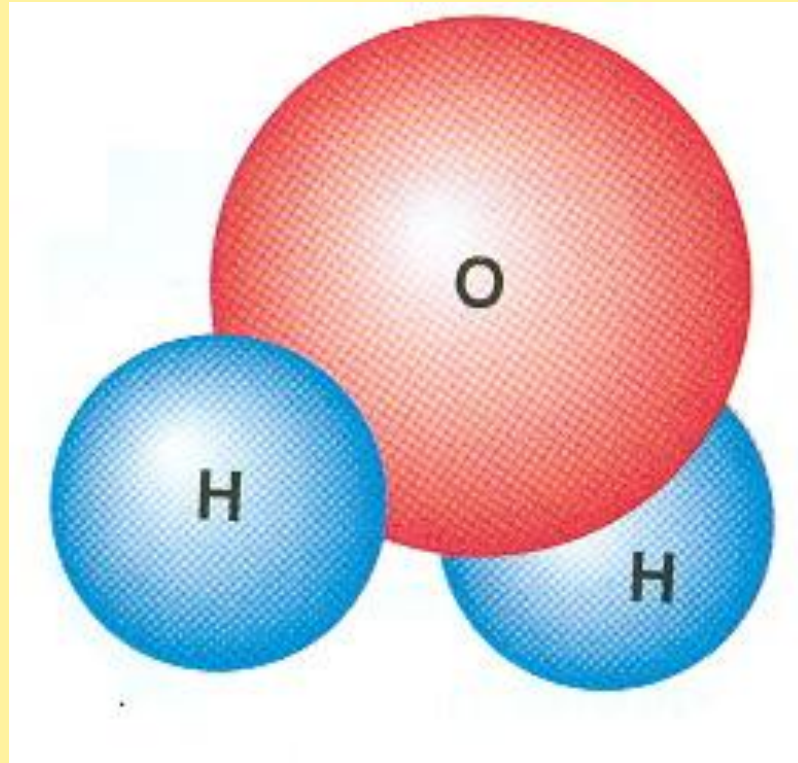




Covalent Bonds

- A **COVALENT BOND** is formed when electrons are *shared* between atoms.
- When the atoms share two electrons, the bond is called a **single bond**.
- When atoms share four electrons it is a **double bond**.
- When atoms share six or more electrons it is a **triple bond**.
- The structure the results when atoms are joined together by covalent bonds is called a **MOLECULE**.

Covalent Bond Example





Chemistry of Life

- **Compounds** – matter that is made of more than **ONE** kind of **ATOM**
- Compounds are made by atoms sharing or taking **ELECTRONS** from the other atoms in the compound



Inorganic Compounds

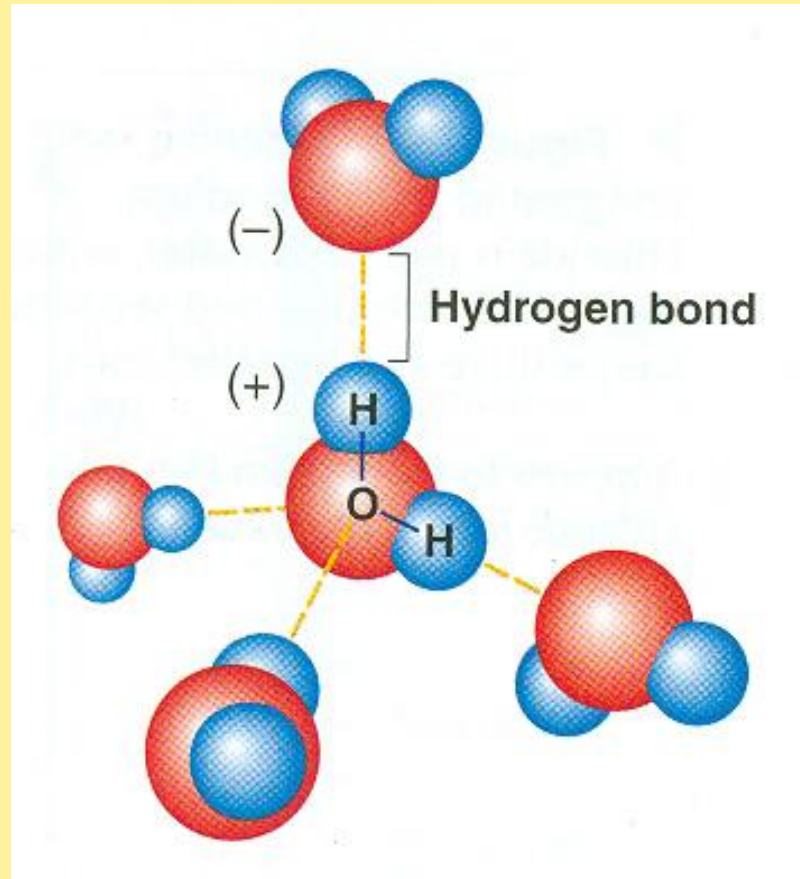
- Water (H_2O) – each molecule is made of two **HYDROGEN** atoms and one **OXYGEN** atom



The Water Molecule

- One atom of oxygen binds to two atoms of hydrogen to form H₂O.
- Like all molecules a water molecule (H₂O) is **neutral**.
- Water molecules are held together by a **hydrogen bond**.
- Hydrogen Bonds are not as strong as covalent or ionic bonds.
- The hydrogen atoms are attached to one side of the oxygen atom, resulting in a water molecule having a positive charge on the side where the hydrogen atoms are and a negative charge on the other side, where the oxygen atom is.
- Since opposites attract, water molecules tend to attract each other, making water kind of "sticky."

The Water Molecule





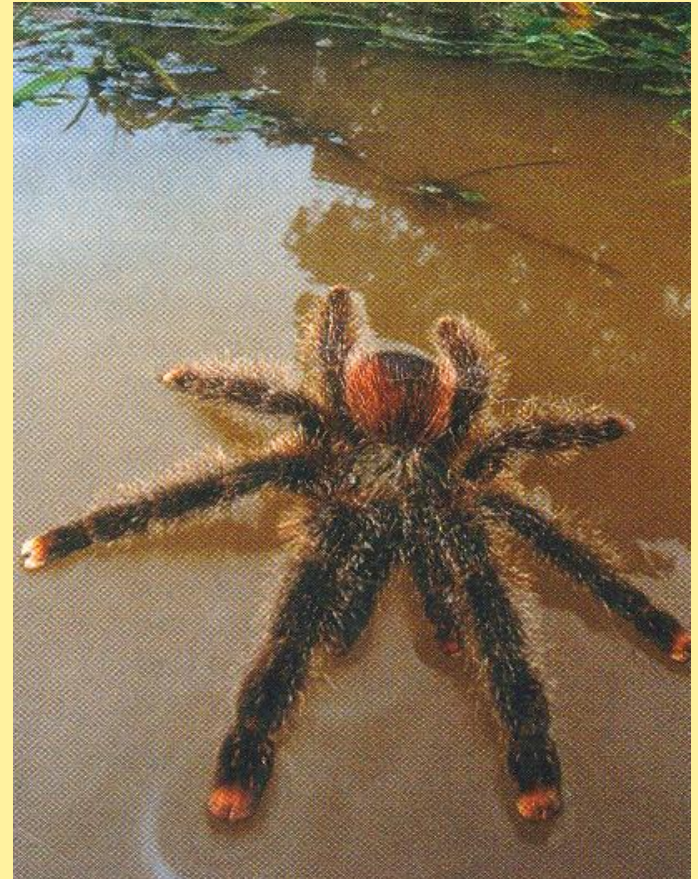
Properties of Water

- **Cohesion** is an attraction between molecules of the same substance.
- Water's cohesion causes molecules on the surface of water to be **drawn inward**,
(which is why drops of water form beads on smooth surface)



Example of Cohesion

- Cohesion explains why insects and spiders, such as this tarantula can rest on the water's surface.
- How does the tarantula's physical structure help it to stay afloat?





Properties of Water

- **Adhesion** is an attraction of between molecules of different substances.
- Adhesion between water and glass causes water to rise against the force of gravity. This is known as capillary action.
- **Capillary action** -draws water out of the roots of a plant and up into it stems and leaves.
- **Cohesion** holds the column of water together as it rises.



Examples of Cohesion & Adhesion

- Clear off desk tops.
- Place a teaspoon full of water on your desktop.
- Observe the following:
 - Cohesion – water molecules sticking together
- Run finger through water and observe:
 - Adhesion of water to desktop and finger.
- Get a paper towel and clean up desk



Why is water so important to life?

- At least 75% of animal body mass is water
- Plants contain 70-80% water
- Transports nutrients and wastes



Why is water so important to life?

- Dissolves compounds --
“Universal Solvent”
- Regulates body temperature
in animals
- Provides structure for plants



Conservation of Water

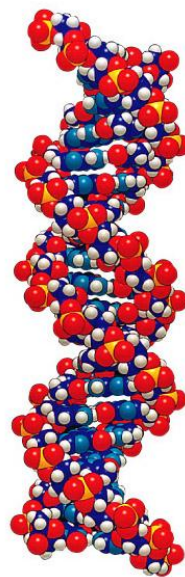
- Save Clean Water
- Dispose of products carefully
- Care for farmland, lawns and gardens carefully
- Practice sensible pest control



Conservation of Water

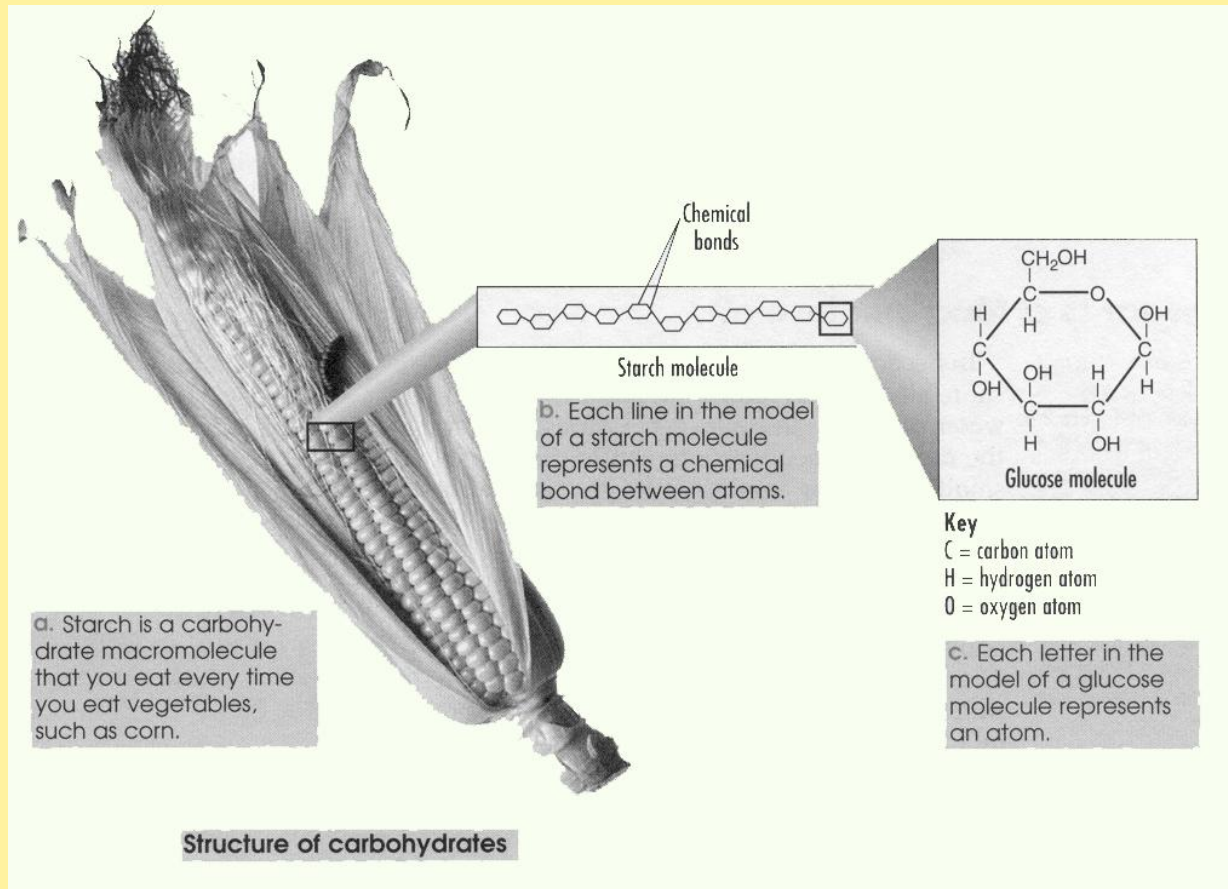
- Control runoff from fields, feedlots, lawns and gardens
- Control soil erosion
- Avoid spillage or dumping of chemicals, oil, fuel, etc.
- Proper control of sewage

Organic Compounds



Carbohydrates

- Provide energy





Carbohydrates

- Three Types
 - Monosaccharides
 - Disaccharides
 - Polysaccharides



Monosaccharides

- simple SUGAR
- contain $C_6H_{12}O_6$
- GLUCOSE, FRUCTOSE, AND GALACTOSE



Disaccharides

- double **SUGAR**
- contain two **RINGS**
- **SUCROSE** and **LACTOSE**

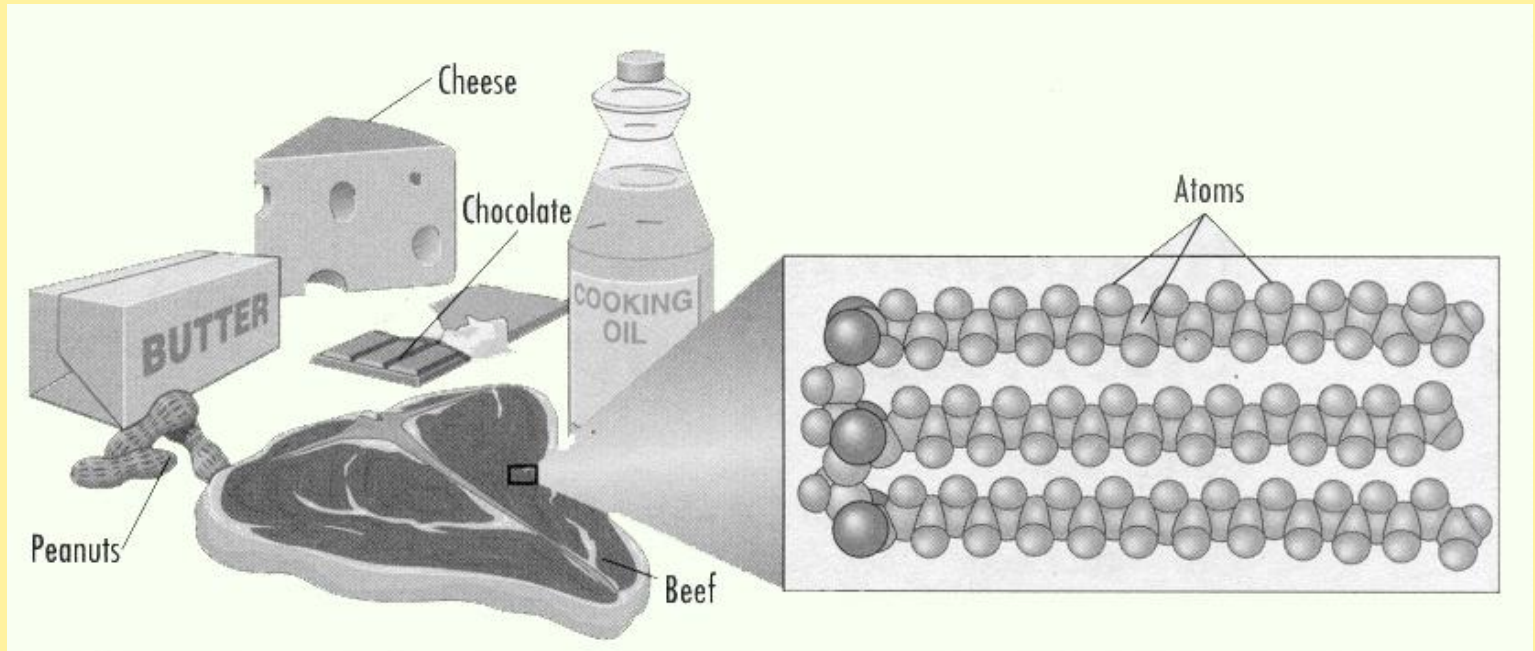


Polysaccharides

- complex CARBOHYDRATES
- made of RINGS of SUGAR
- STARCH, CELLULOSE, and GLYCOGEN

Proteins

- STRUCTURE and FUNCTION
- Made of H, O, C, N





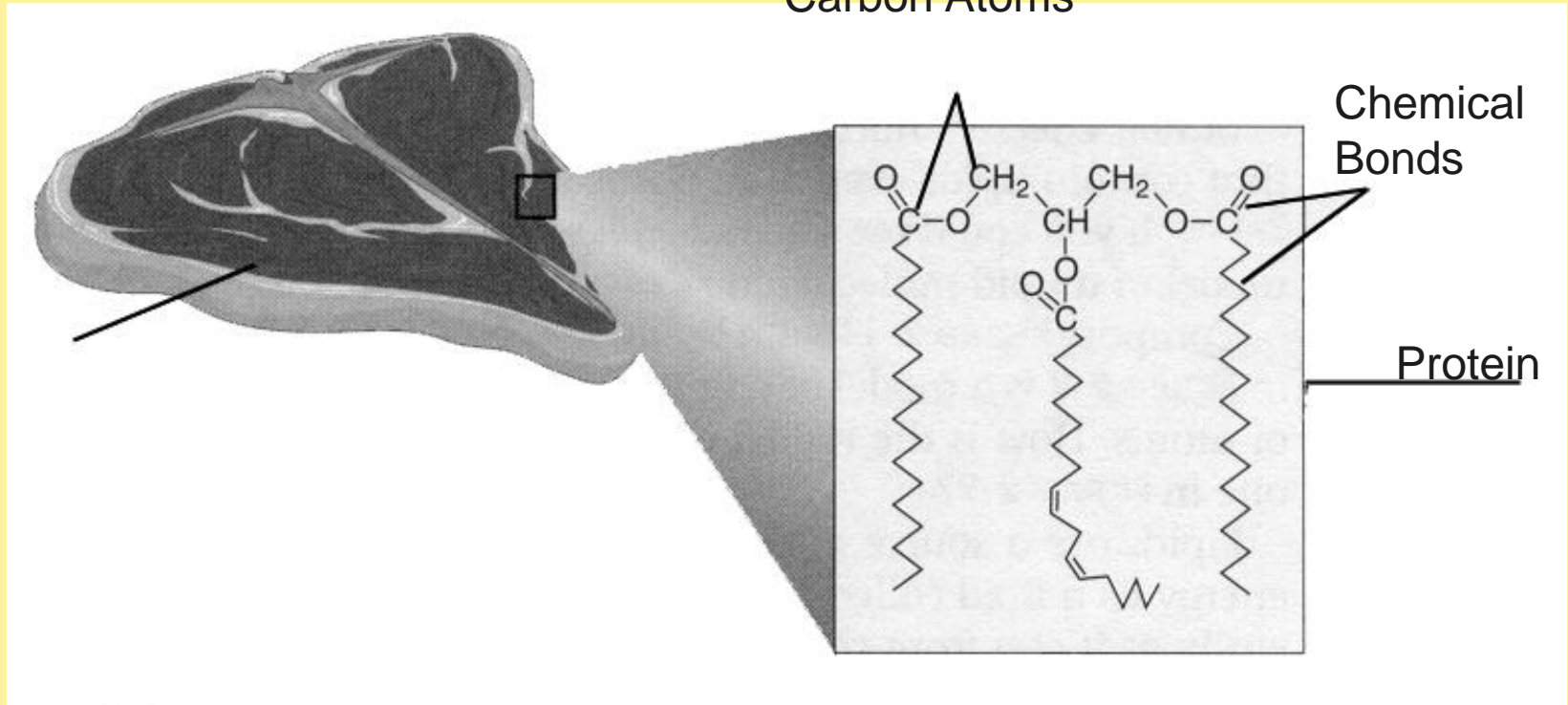
Structure of Proteins

- Amino Acids – building **BLOCKS**
 - 20 different kinds – all have the same elements but in different amounts
- Polypeptides – chains of **AMINO ACIDS**
Joined by peptide bonds
- Proteins – chains of **POLYPEPTIDES**
- Used to make **SKIN, HAIR, MUSCLE, ORGANS**, etc.



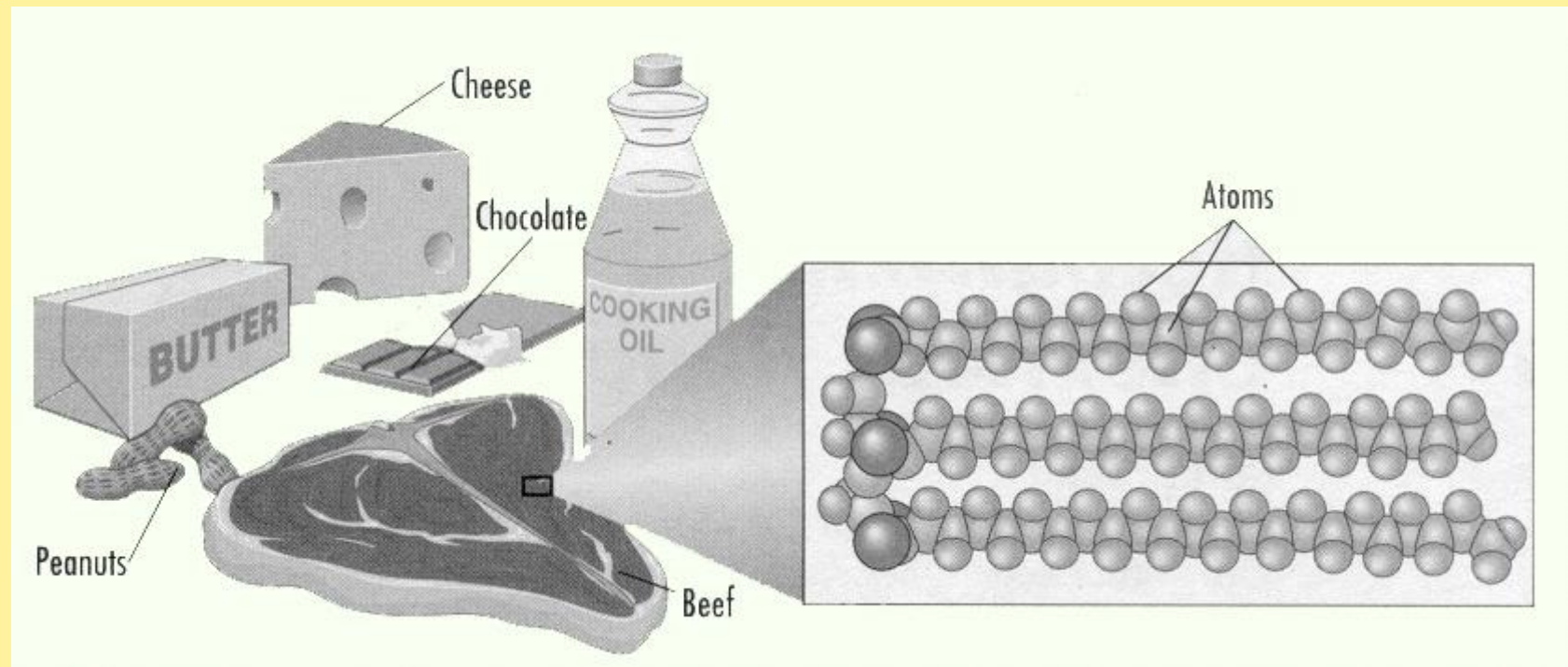
Carbon Atoms

Beef



Lipids

- FATTY molecules
- used to store ENERGY





Lipids

- Made of long chains of H & C followed by COOH
- Do not **DISSOLVE** in **WATER**
- Lipids have less **OXYGEN** than carbohydrates
- Examples of Lipids are: **FATS, OILS,**
AND WAXES



Nucleic Acids

- Store INFORMATION that controls CELL activities
- Made of a PHOSPHATE a SUGAR, and a BASE.
- Examples of Nucleic Acids are: DNA and RNA



Capillary Action Lab Activity




Enzymes

- Energy is released or absorbed whenever chemical bonds are broken
- Chemical reactions involve breaking and forming bonds, they involve changes in energy
- Enzymes are proteins & act as a catalyst
- **Catalyst-** speed up the rate of chemical reaction.



Enzymes

- Cells use enzymes to speed up chemical reactions that take place in cells.
- Chemical reactions create energy.



10,000 Pyramid Review

- **Get into Groups and determine Roles:** In each group there are three rolls: player, clue giver, and teleprompter. The clue giver and player sit facing each other, with the teleprompter standing behind the player, displaying the fact cards one at a time to the clue giver. The clue giver reads the facts to the player, adding additional information as necessary to help the player guess the fact.
- **Play the Game:** The game is played in rounds of sixty seconds each. When the player correctly guesses the information on a card the teleprompter places the card on the table. If the player is having a difficult time guessing a card, either the clue giver or the player may ask to pass to the next card. After each round the groups count the player's correct answers and each group score is recorded on the board. With each new round everyone switches roles and the entire deck is shuffled for the new player. If there is more than three people per group have them decide how to rotate. Play as many rounds as needed to allow each learner to play each role at least once. Should a group get through the entire deck, the cards are shuffled and play continues.