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 their was a limit.
- Democritus called the smallest fragment the **atom**, a name scientists use today.

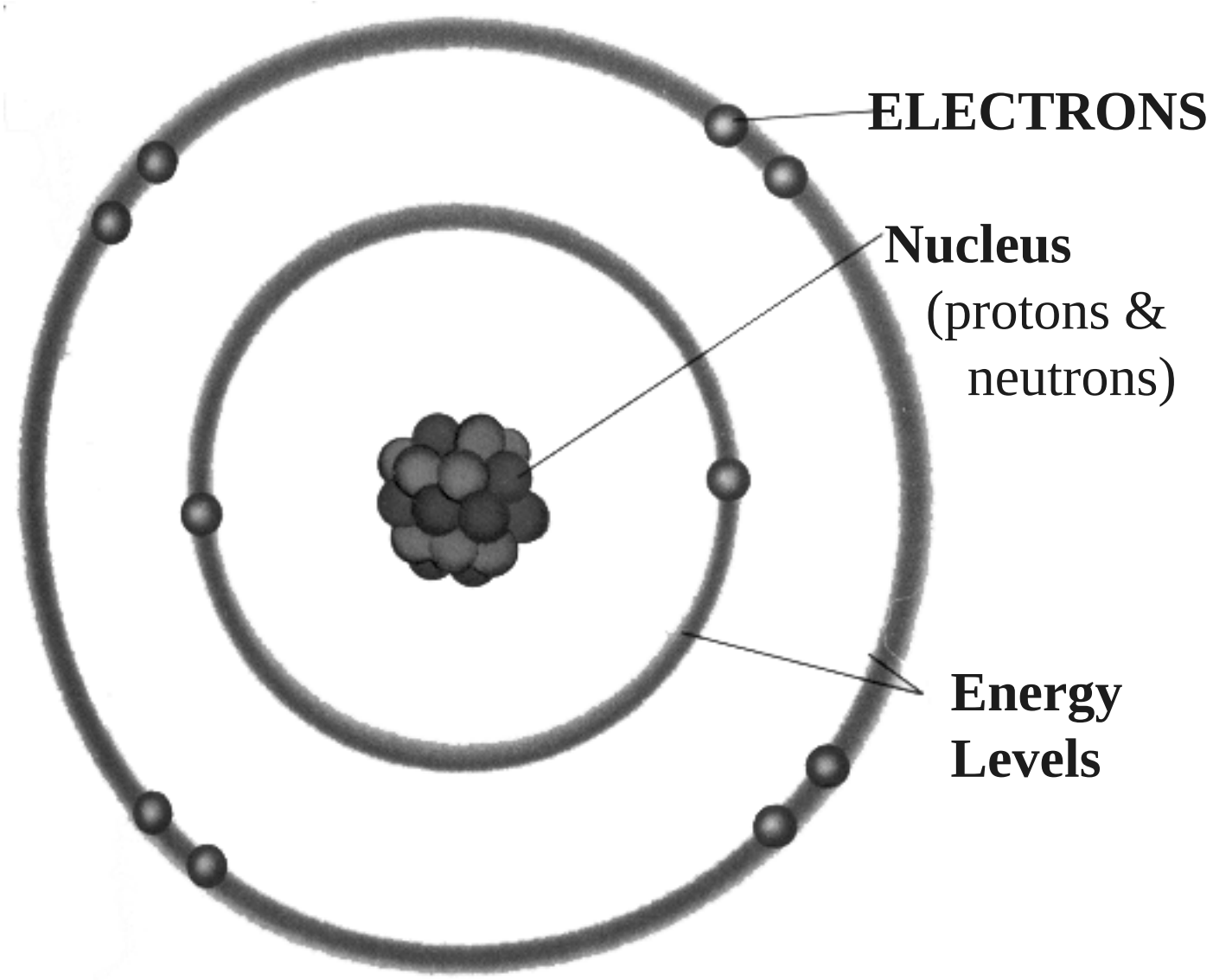
Chemistry of Life

- **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



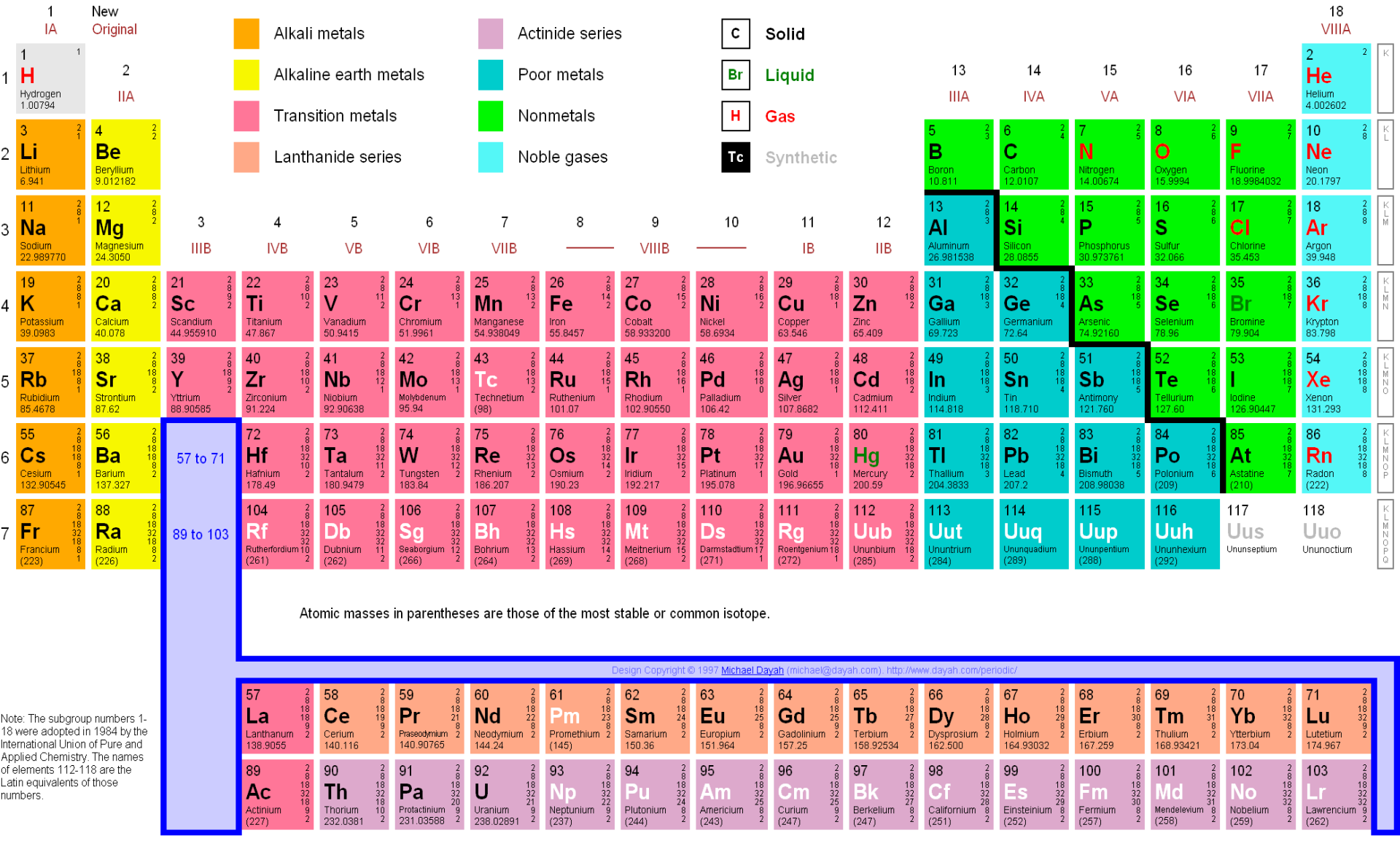
Michelangelo E-Moment

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



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

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.

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

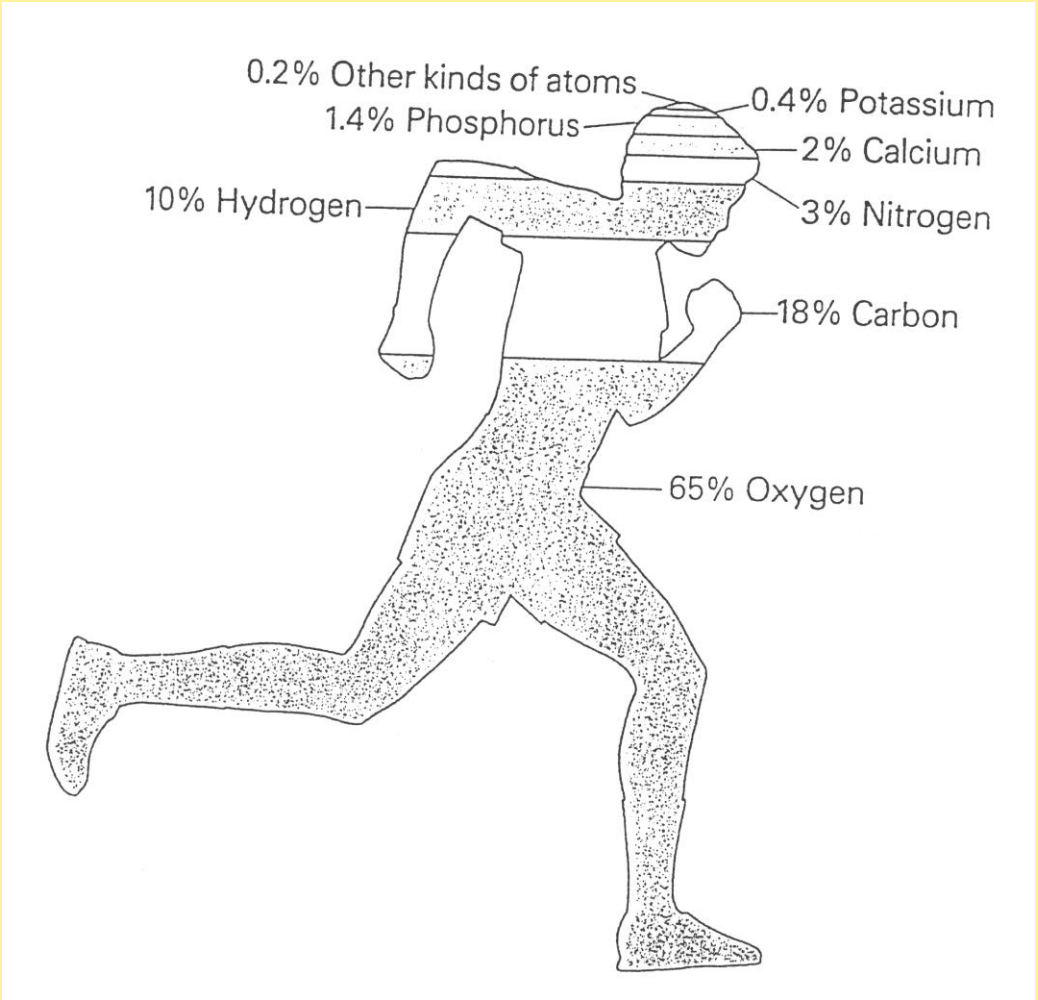
Major Elements of Life

- 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



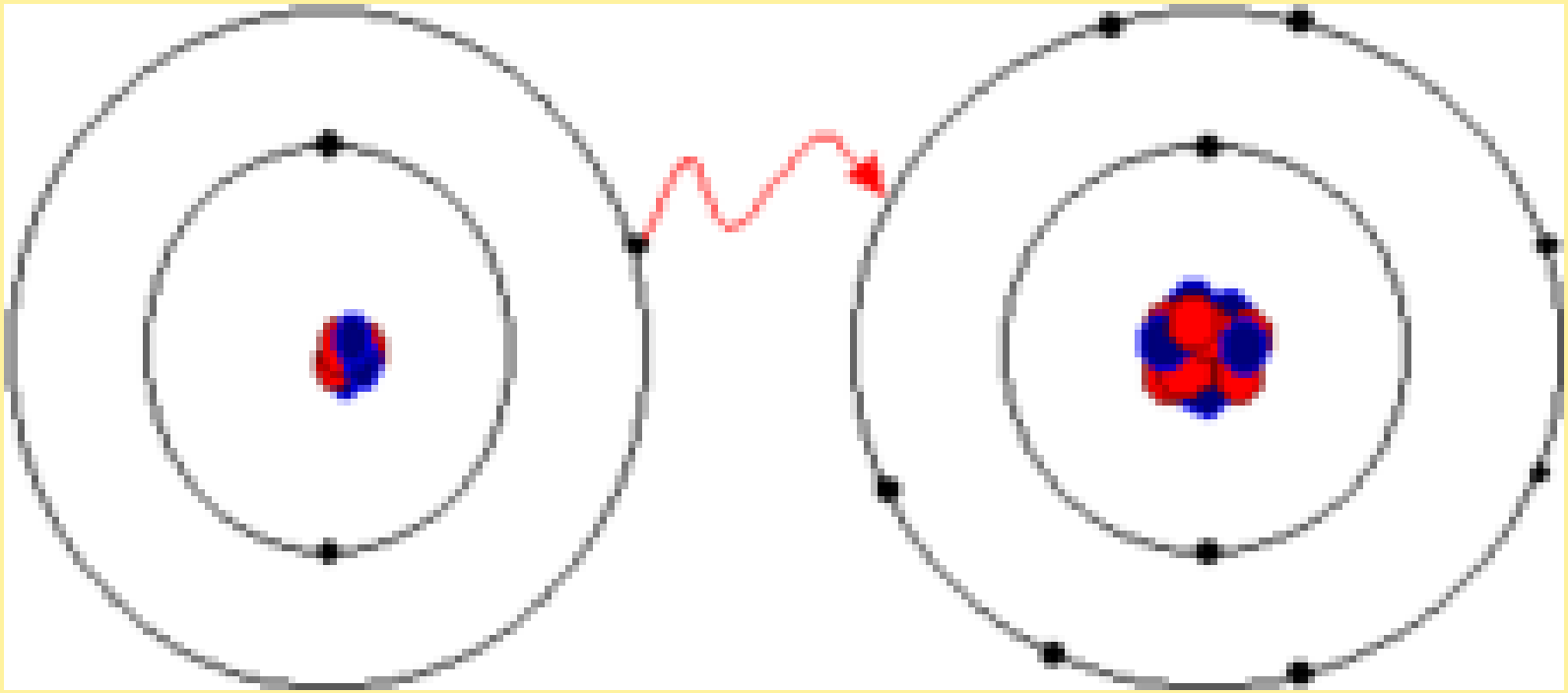
Chemical Bonds

- 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

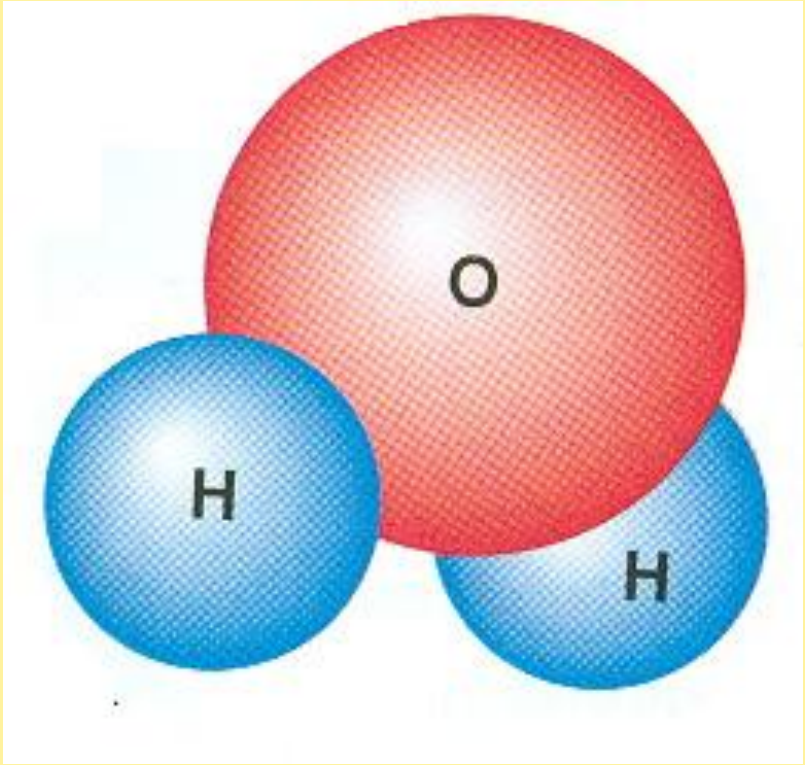


Covalent Bonds

- 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

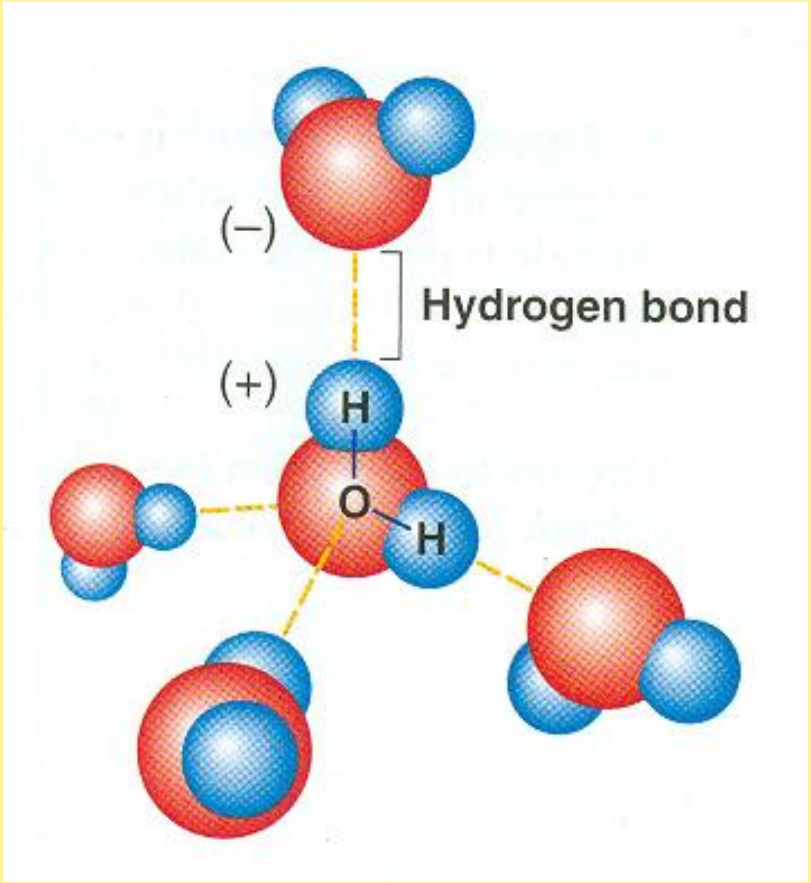
Inorganic Compounds

- 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 H20.
- Like all molecules a water molecule (**$H_2$0) 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

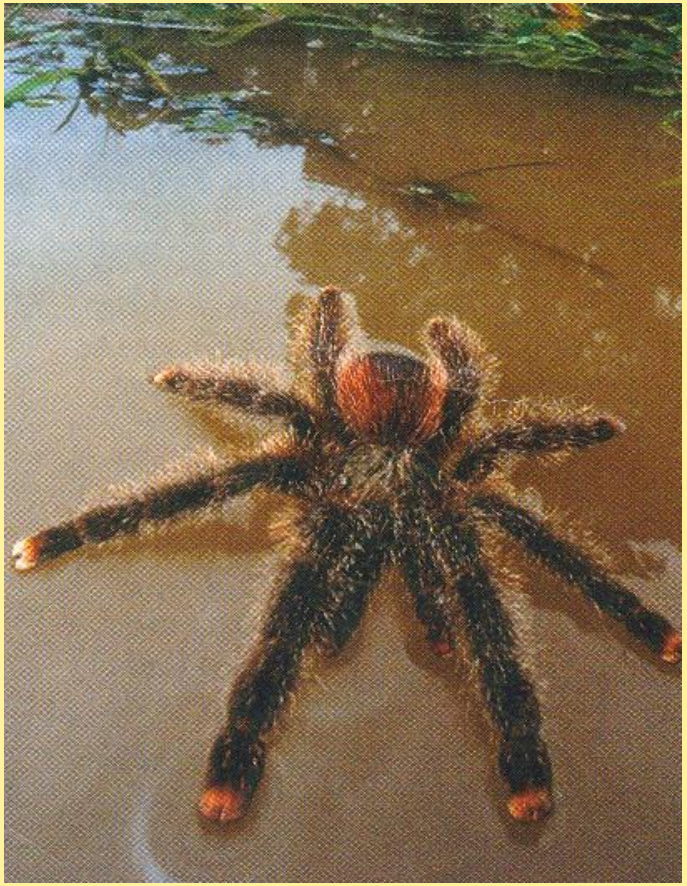
- **<u>Cohesion</u>** is an attraction between molecules of the same substance.

- 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

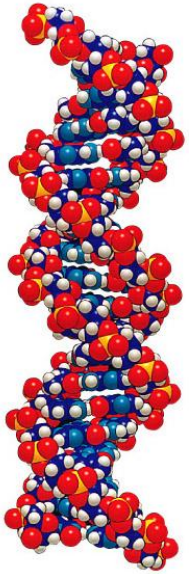
Conservation of Water

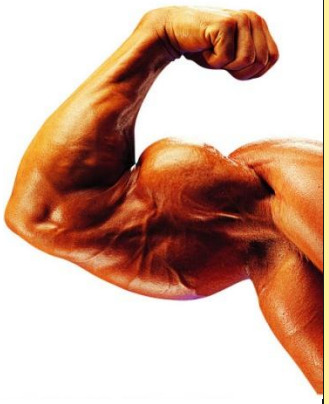
- Save Clean Water
- Dispose of products carefully
- Care for farmland, lawns and gardens carefully
- Practice sensible pest control

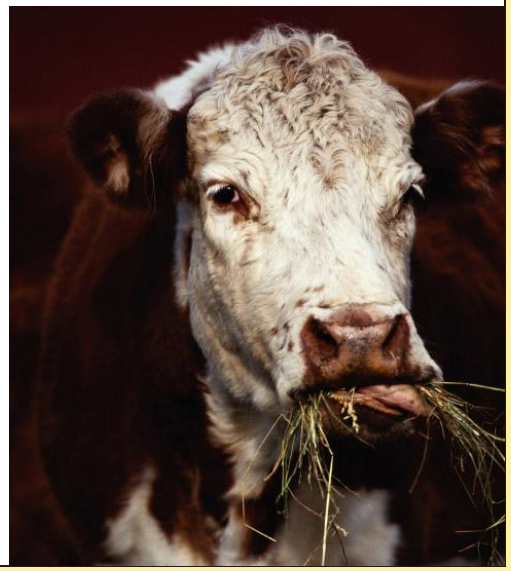
Conservation of Water

- 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

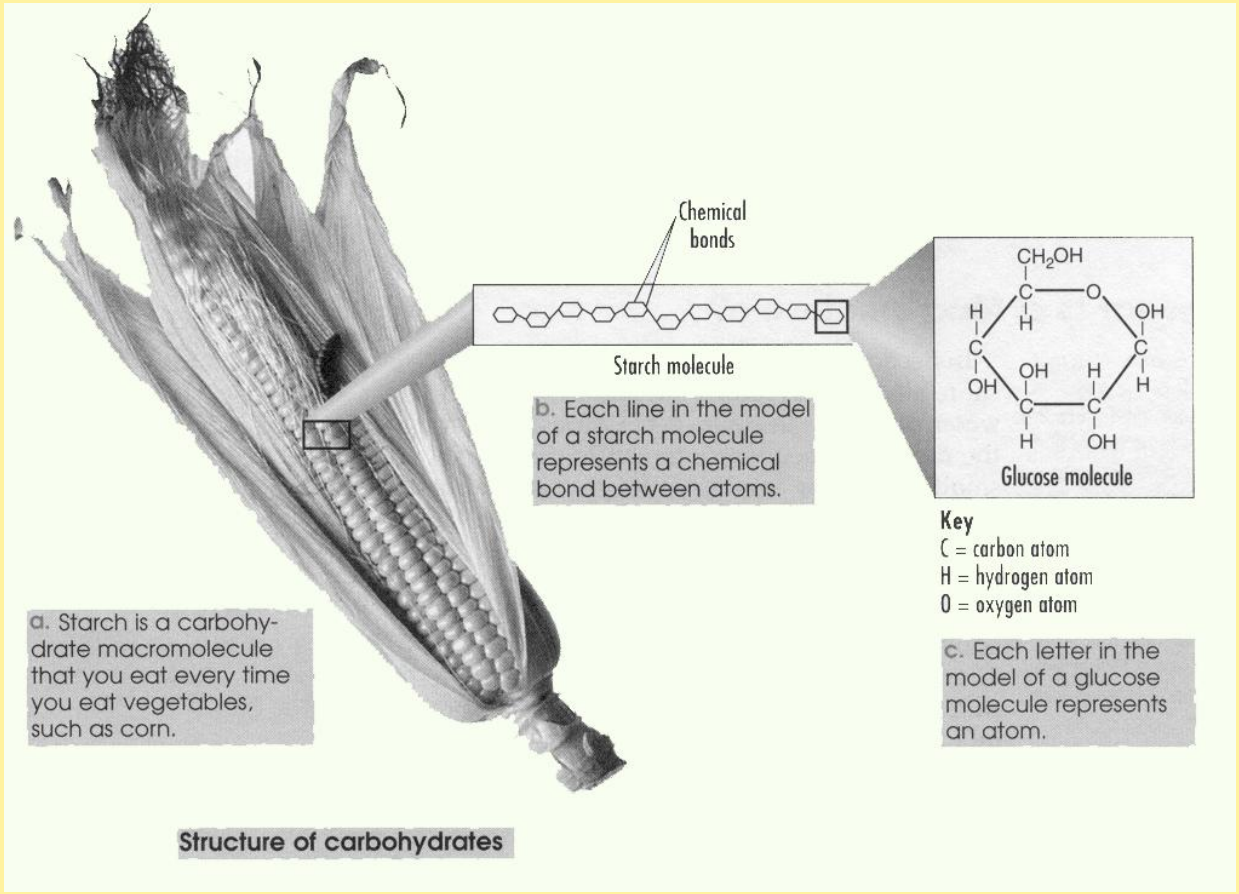






Carbohydrates

- Provide **energy**



Structure of carbohydrates

Carbohydrates

- Three Types
  - Monosaccharides
  - Disaccharides
  - Polysaccharides

Monosaccharides

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

Disaccharides

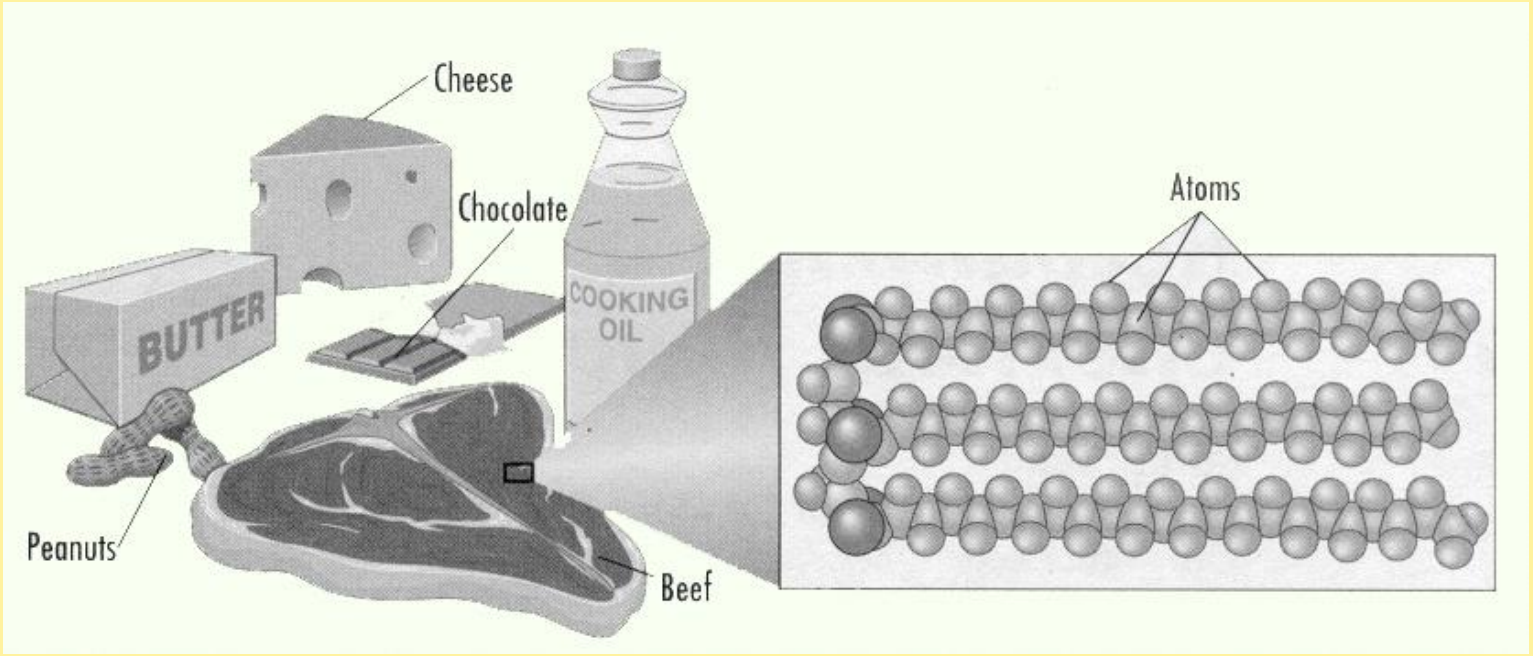
- double **SUGAR**
- contain two **RINGS**
- **SUCROSE** and **LACTOSE**

Polysaccharides

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

Proteins

- **<u>STRUCTURE</u>** and **<u>FUNCTION</u>**
- 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

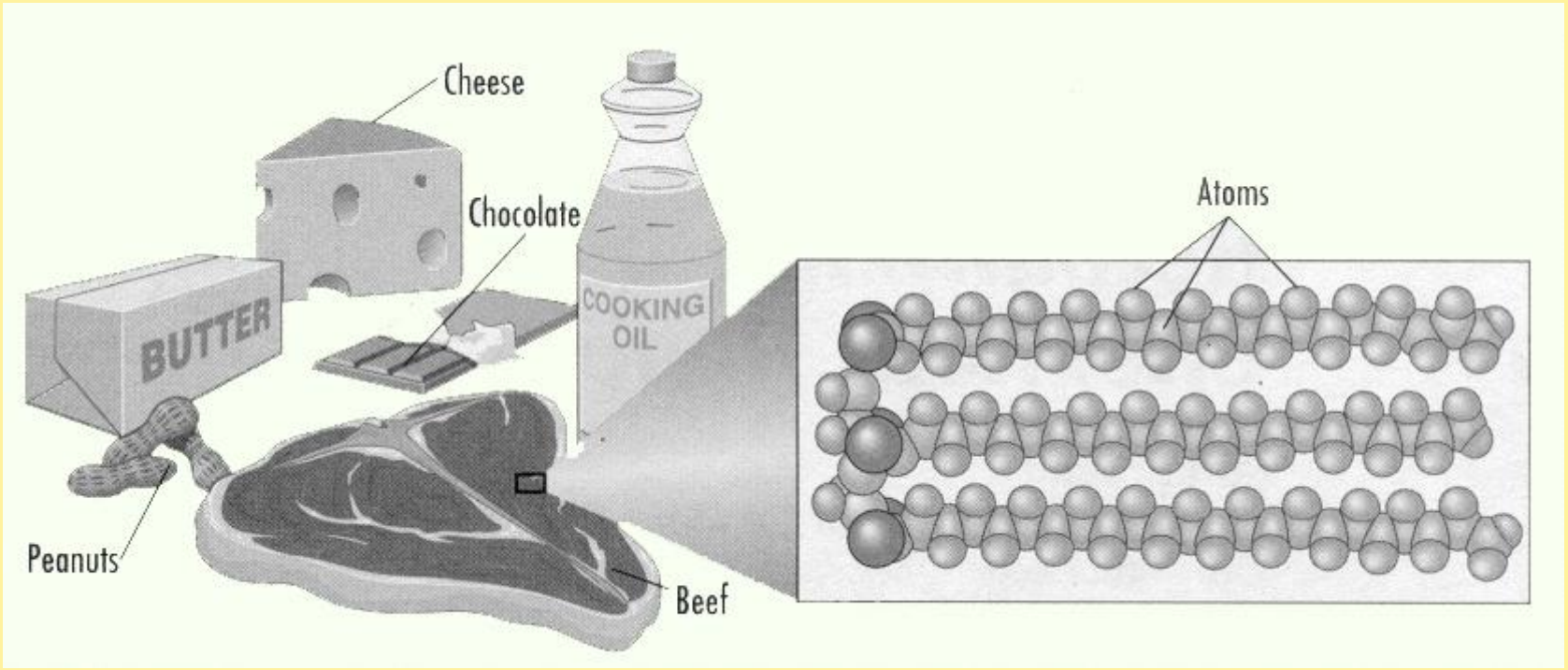
Beef

Chemical Bonds

Protein

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.