**CHEMISTRY**

The Chemical Basis of the Body Notes

**MATTER**- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*\* Three states:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 3.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Made up of chemical building blocks called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**I. Elements-** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cannot be broken down into simpler substances by ordinary chemical means.

\_\_\_\_\_\_ Elements (92 occurring naturally) \_\_\_\_\_\_\_\_\_\_ found in the human body.

C, H, O, N - \_\_\_\_\_\_\_\_% of the human body.

S and P make up 99% of the body.

**II. Atoms-** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A. Composed of two basic components:

1. Nucleus
2. Outer energy levels or clouds

Sketch & Label

B. Structure of an Atom 🡪

C. Nucleus

 1. Protons (\_\_\_ charge)

 # of protons is element’s atomic number

 2. Neutrons (\_\_\_\_charged)

 # of \_\_\_\_\_\_\_\_\_\_ plus # of \_\_\_\_\_\_\_\_\_\_\_ form the element’s atomic weight

 3. Electrons (\_\_\_\_\_\_ charged that orbit around nucleus)

 # of \_\_\_\_\_\_\_\_\_\_ always equals the # of \_\_\_\_\_\_\_\_\_\_ in an atom.

D. Ions (Electrolytes)

Most atoms have too many or too few \_\_\_\_\_\_\_\_\_\_\_ in their outermost energy level which is not complete.

\_\_\_\_\_\_\_\_\_\_\_\_\_ is the number of extra or deficient electrons in outermost orbital.

Anions - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_electrons in outermost orbital which creates a net \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_charge.

Cation - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_electrons in outermost orbital which creates a net \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_charge.

Electrolytes - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Major Elements in the Body**

The four major elements in the body are:

 C – carbon

 H – hydrogen

 O – oxygen

 N - nitrogen

**III. Molecules-** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 May be atoms of the same element-- H2, O2, N2, etc.

 May be atoms of different elements -- NaCl, HCl etc.

**IV. Compounds-** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Molecules of a compound always contain atoms of two or more \_\_\_\_\_\_\_\_\_\_\_\_\_ elements.

 \*\*\*All compounds are molecules but not all molecules are compounds\*\*\*

**V. Chemical Bonding**

Chemical bonds are formed between atoms when electrons in the outermost orbital are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Types of Chemical Bonds

 1. Ionic Bonding- Bonding when one atom gains an electron and another atom loses an electron.

 \*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons from one atom to another.

 \*Bonds together two \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions.

 \*Strongest type of chemical bonding.

 \*An example is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 2. Covalent Bonding- \_\_\_\_\_\_\_\_\_ of electron pairs by more than one atom

 \*single covalent bond: share \_\_\_\_\_\_ pair of electrons

 \*double covalent bond: share\_\_\_\_\_\_\_\_ pairs of electrons

 \*triple covalent bonds: share \_\_\_\_\_\_\_\_\_pairs of electrons

 3. Hydrogen Bonds- A hydrogen atom covalently bonded to another atom.

 \*Very \_\_\_\_\_\_\_\_\_\_ bond.

 Often serves as a bridge between molecules.

 Many large molecules can contain hundreds of these bonds.

**pH Scale**

A scale used to describe the degree of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of a solution.

Expressed on a base 10 scale that runs from \_\_\_\_\_\_\_\_\_ with 7 being a neutral pH:

 > 7 is a basic or alkaline solution

 < 7 is an acidic solution

Actually represents the number of \_\_\_\_\_\_\_ ions or \_\_\_\_\_\_\_ ions in solution.

**I. Acids**

 A substance that dissociates into one or more \_\_\_\_\_\_\_\_\_\_\_\_\_ ions and one or more *negative* ions (anions)

Acids are proton donors.

Closer to\_\_\_\_\_\_\_= more acidic

**II. Bases**

A substance that dissociates into one or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions and one or more *positively* charged ions (cations)

Bases are proton acceptors

Closer to \_\_\_\_\_\_\_= more basic (alkaline)

**III. Salts**

A substance, that when dissolved in water, dissociates into both anions and cations \_\_\_\_\_\_\_\_\_\_of which is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**IV. Neutral pH and pH of Blood**

Neutral pH is considered to be \_\_\_\_\_\_\_\_ on the pH scale. This is distilled water which has \_\_\_\_\_\_\_\_\_\_\_\_concentrations of H+ and OH-.

The pH of blood is slightly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ranging from \_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_.

**V. Water “Universal solvent”**

 \*Participates in or is essential in many chemical reactions \*Important transport medium

 \*Absorbs and releases heat very slowly \*Functions as a lubricant in various regions of the body

Sketch:

Water Molecule 🡪

**Classification of Chemical Compounds**

**I. Inorganic Compounds**

 \*Small ionically bonded molecules

 \*Generally lack a \_\_\_\_\_\_\_\_ atom

 \*Vital to normal physiological functioning

**II. Organic Compounds**

 \*Contains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atoms

 \*Contains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atoms

 \*Almost exclusively held together by covalent bonds

**Inorganic Compounds -- \_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Organic Compounds --**

1. Carbohydrates (sugars & starches)
2. Lipids (fats)
3. Proteins
4. Nucleic Acids (DNA & RNA)

**1. Carbohydrates-** include \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Account for about \_\_\_\_\_\_% of body mass.

Contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules in a general formula of (C H2 O)n.

Functions of carbohydrates:

 a.

 b.

 c.

Glucose Molecule= the \_\_\_\_\_\_\_\_\_\_\_\_ form of Carbohydrates

**2. Lipids (FATS**)- most are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in water

Most highly concentrated source of\_\_\_\_\_\_\_\_\_\_\_\_\_ (9.2 kcal/gm).

Less efficient as a body fuel than carbs.

Made up of C, H, and O in structural units called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (triglycerides).

Types of fats determined by the types of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the molecule. A. saturated fat B. unsaturated fat (mono or poly)

**3. Proteins**- All contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (many also contain S and P).

Composed of molecules called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (There are 20).

Type of protein is determined by the \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of amino acids.

Amino acids are joined together at the N atoms in a chemical bond called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond

1. Types and Functions of Proteins
2. Structural Proteins- Form the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of various body parts (muscle, skin, hair, nails, etc.)
3. Regulatory Proteins- Function as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to control a variety of physiological processes (insulin)
4. Contractile Proteins- Serve as the contractile elements in \_\_\_\_\_\_\_\_\_\_\_\_\_ (actin and myosin)
5. Immunological Proteins- Serve as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to protect the body (gamma globulin)
6. Transport Proteins- Transports \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ throughout the body (hemoglobin)
7. Enzymatic Proteins- Alter the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of chemical reactions (amylase, lipase, lactase)

**4. Nucleic Acids**- \_\_\_\_\_\_\_\_\_\_\_ and\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Building blocks of life

All contain C, H, O, N, and P

Made up of structural units called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DNA contains the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DNA and RNA assist with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ synthesis

1. **DNA(Deoxyribonucleic Acid)**

Nucleotides are molecules composed of C, H, O, and a nitrogen base of:

 \*thymine- binds with adenine

 \*guanine- binds with cytosine

Contains a pentose sugar called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and a phosphate group

**Structure of DNA**

Sketch & label (phosphate, deoxyrbose, thymine, guanine, adenine, cytosine)

 A two stranded molecule that twists around each other (double helix).

 looks like a twisted ladder

 Sides or uprights of the ladder are made of alternating phosphates and the deoxyribose section of the molecule.

 The rungs of the ladder contain the paired nitrogen bases.

 thymine (T) - adenine (A)

 guanine (G) - cytosine (C)

1. **RNA (Ribonucleic Acid)-** Molecule is a \_\_\_\_\_\_\_\_\_\_\_strand of nucleotides.

The sugar portion of the molecule is a pentose sugar, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Nitrogen base \_\_\_\_\_\_\_\_\_\_\_\_ in DNA is replaced by \_\_\_\_\_\_\_\_\_\_\_\_\_ in RNA.

**Adenosine Triphosphate** (ATP)- High energy compound that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for most chemical reactions.

Found in all living systems.

Formed during a process called cellular respiration which takes place in the cytoplasm and the mitochondria of cells.

**Structure of ATP-** Adenine unit composed of an adenine molecule and a five carbon sugar (ribose).

Three phosphate groups attached to the end of the molecule.

Tremendous amount of energy is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when the terminal phosphate is removed.

ATP <----> ADP + P + ENERGY