Name:_____Hour:_____

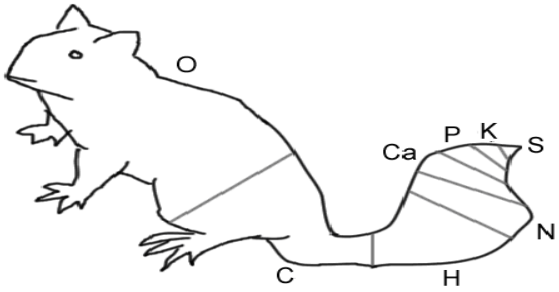
Elements & Macromolecules in Organisms

Most common elements in living things are **carbon, hydrogen, nitrogen, and oxygen**. These four elements constitute about **95% of your body weight.** All compounds can be classified in two broad categories --- **organic and inorganic compounds**. Organic compounds are made primarily of **carbon**. Carbon has **four outer electrons** and can form four bonds. Carbon can form **single** bonds with another atom and also bond to other carbon molecules forming **double, triple, or quadruple bonds**. Organic compounds also contain **hydrogen**. Since hydrogen has only one electron, it can form only **single bonds**.

Each small organic molecule can be a unit of a large organic molecule called a **macromolecule.** There are **four classes of macromolecules** (polysaccharides or **carbohydrates**, triglycerides or **lipids**, polypeptides or **proteins**, and **nucleic acids** such as DNA & RNA). **Carbohydrates and lipids** are made of only carbon, hydrogen, and oxygen **(CHO**). **Proteins** are made of carbon, hydrogen, oxygen, and nitrogen **(CHON). Nucleic acids** such as DNA and RNA contain carbon, hydrogen, oxygen, nitrogen, and phosphorus **(CHON P).**
Use the drawing of the **amino acid on this worksheet** (look ahead to pg.4 for this sketch and remember that the NUMBER OF LINES from a single atom is their NUMBER OF BONDS) to determine the number of bonds formed by:

_____ Oxygen _____Hydrogen_____ Nitrogen

The body also needs trace amounts of other elements such as calcium, potassium, and sulfur for proper functioning of muscles, nerves, etc. ***Color*** each of the **elements on the next page** according to the color listed next to the element's symbol. Then ***Color code*** the **squirrel** with the correct proportion of each element's color. Now ***color code*** the carrot with the same colors as you used on the squirrel.



Questions:

1. Name the 4 main elements that make up 95% of an organism.

2. Name the 4 types of bonds carbon can form.

3. What are macromolecules?

5. Give 2 examples of nucleic acids.

6. What elements make up carbohydrates & lipids (symbols)?

7. Name 3 elements your body needs trace amounts of for proper functioning.

The **four main classes of organic macromolecules** (carbohydrates, lipids, proteins, and nucleic acids) that are essential to the proper functioning of all living things are known as **polymers or macromolecules**. All of these compounds are built primarily of **carbon, hydrogen, and oxygen** but **in different ratios**. They have different ratios of carbon and hydrogen and oxygens.This gives each compound different **properties.**

Carbohydrates are used by the body for **energy** and **structural support** in cell walls of plants and exoskeletons of insects and crustaceans. They are made of smaller subunits called **monosaccharides**. Monosaccharides have carbon, hydrogen, and oxygen in a **1:2:1 ratio**. Monosaccharides or **simple sugars** include **glucose, galactose, and fructose**. Although their chemical formulas are the same, they have **different structural formulas. This makes them isomers of each other.** These simple sugars combine to make **disaccharides** (double sugars like sucrose) and **polysaccharides** (long chains like cellulose, chitin, and glycogen).

4. Name the 4 classes of organic macromolecules.

Questions:

8. Macromolecules are also known as _____.

9. If all the macromolecules are made mainly of the elements **CHO,** how are they different?

10. Name 2 ways your body uses carbohydrates.

11. What are the subunits called that make up carbohydrates?

12. What is the ratio of C, H, and O in monosaccharides?

13. Name 3 monosaccharides.

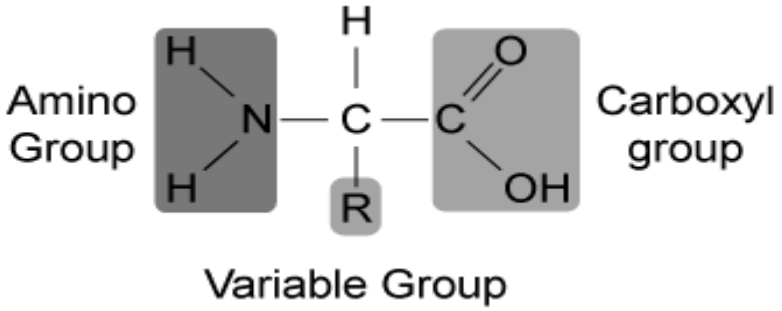
14. Monosaccharides are _____ sugars.

15. What are disaccharides & give an example?

16. Long chains of sugars are _____. Name three.

Proteins are made of subunits called **amino acids** and are used to build cells and do much of the work inside organisms. They also act as **enzymes** helping to control metabolic reactions in organisms. Amino acids contain two **functional groups**, the **carboxyl group (-COOH)** and the **amino group (-NH_2).**

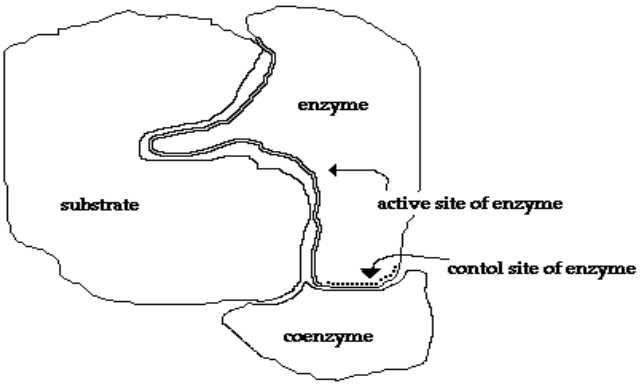
Basic Structure of Amino acid



Enzymes are protein molecules that act as **biological catalysts**. Cells contain **thousands** of different enzymes to control the functions of the cell. Enzymes must physically fit a specific **substrate(s)** to work properly. The place where a substrate fits an enzyme to be catalyzed is called the **active site**. **Excess heat, a change in pH from neutral**, etc. change the shape of enzymes and their active sites so the enzyme is unable to work. Some enzymes have a second site where a coenzyme attaches to help make the substrate better fit the active site of the enzyme.

Color the enzyme purple, the substrate yellow, and the coenzyme green. Also ***color*** the active site red. **Enzyme-Substrate Complex:**

Condensation (removal of a water molecule) links amino acids link together to form chains called **polypeptides**. Polypeptide chains join to form proteins. The bonds holding amino acids to each other are known as **peptide bonds**.



Questions:

17. What subunits make up proteins?

18. Proteins also act as _____ in cells to control reactions.

19. Name the 2 functional groups in amino acids.

20. Cells have _____ of enzymes to act as biological _____.

21. Enzymes have an attachment site called the _____ site for the _____ to join.

22. What is the effect of excess heat or temperature on an enzyme?

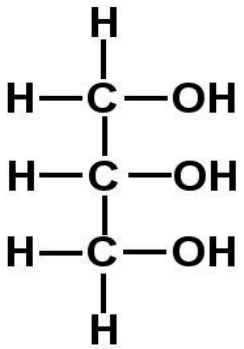
23. Amino acids are linked together to make proteins by removing a molecule of _____ in a process called _____.

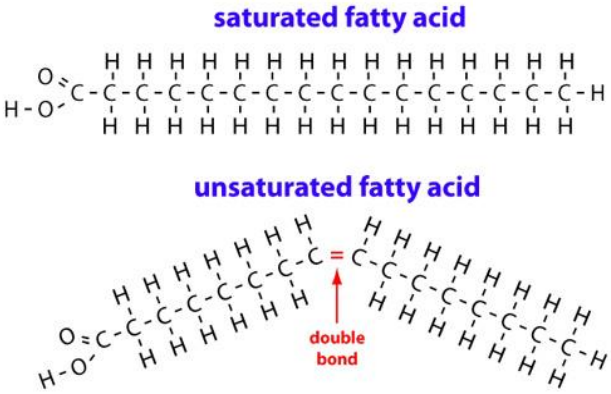
24. Chains of amino acids make _____ which can join together to make a _____.

25. _____ bonds form when water is removed to hold _____ acids together.

Lipids are large, **nonpola**r (won't dissolve in water) molecules. **Phospholipids** make up cell membranes. Lipids also serve as waxy coverings **(cuticle)** on plants, **pigments** (chlorophyll), and **steroids**. Lipids have **more carbon and hydrogen atoms** than oxygen atoms. Fats are made of a **glycerol** (alcohol) and **three fatty acid chains**. This subunit is called a **triglyceride**. The fatty acid chains may be **saturated** (only single bonds between carbons) or **unsaturated** (contain at least one double bond). A **carboxyl functional group** (-COOH) is found on the end of the fatty acid that does NOT attach to glycerol.
A special type of lipid called phospholipids help make up the cell membrane. Two layers of these phospholipids make up the membrane. Phospholipids have a "water-loving" hydrophilic head and two "water-fearing" hydrophobic tails.

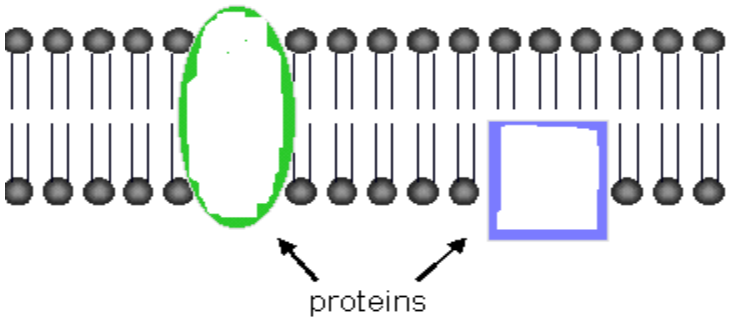
Glycerol





Proteins are also embedded in the cell membrane. ***Color*** the two proteins in the cell membrane **blue**.

Cell Membrane



Questions:

26. Lipids are nonpolar. What does this mean?

27. What **WILL** lipids (oils and fats) dissolve in? (Question for thought)

28. _____ makes up cell membranes.

29. Name a waxy lipid covering plants.

30. Plant pigments like _____ are also _____.

31. Lipids have more _____ and _____ than they do oxygen atoms.

32. Fats are made of an alcohol called _____ and three _____ _____ chains. This is known as a _____.

33. If there are all SINGLE bonds between _____ in the fatty acid chain, then it is said to be _____.

34. If there is a DOUBLE bond between _____ in the fatty acid chain, then it is said to be _____.

35. The end of the fatty acid that does NOT attach to glycerol has what functional group? Write the formula for this group.

36. _____ layers of _____ make up the cell membrane.

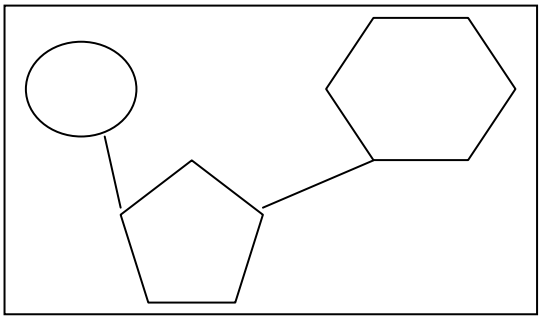
37. The head of a phospholipid _____ water and is said to be _____.

38. The 2 tails of a phospholipid _____ water and is said to be _____.

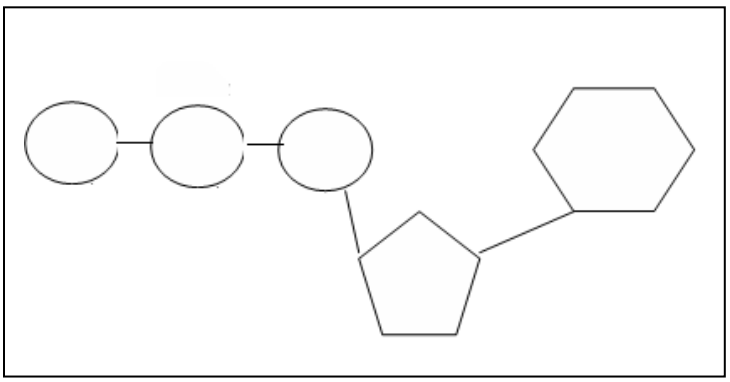
Nucleic acids carry the genetic information in a cell. **DNA or deoxyribose nucleic acid** contains all the instructions for making every protein needed by a living thing. **RNA** copies and transfers this genetic information so that proteins can be made. The subunits that make up nucleic acids are called **nucleotides**.

COLOR AND LABEL the parts of a nucleotide --- **sugar (5-sided)**-green, **phosphate group (round)**-yellow, and **nitrogen base (6-sided)**-blue. ATP used for cellular energy is a high energy nucleotide with three phosphate groups. ***Color*** code the ATP **the same way** and **LABEL THE PHOSPHATES.**

Nucleotide



ATP



Questions:

39. Nucleic acids carry _____ information in a molecule called _____ or _____ _____ acid.

40. DNA has the instructions for making a cell's _____.

41. The nucleic acid _____ copies DNA so _____ can be made.

42. _____ are the subunits making up nucleic acid.

43. The 3 parts of a nucleotide are a 5 carbon _____, a phosphate, and a nitrogen _____.

44. _____ is a high energy molecule made from a _____ with _____ phosphates.