

## *Elements & Macromolecules in Organisms*

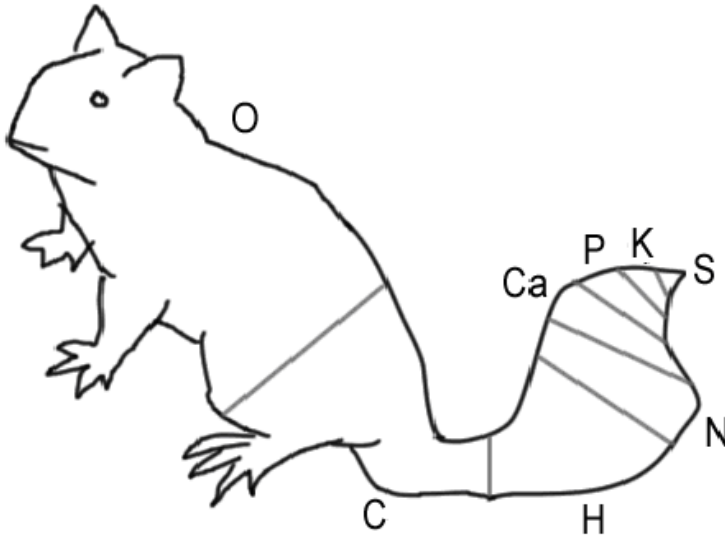
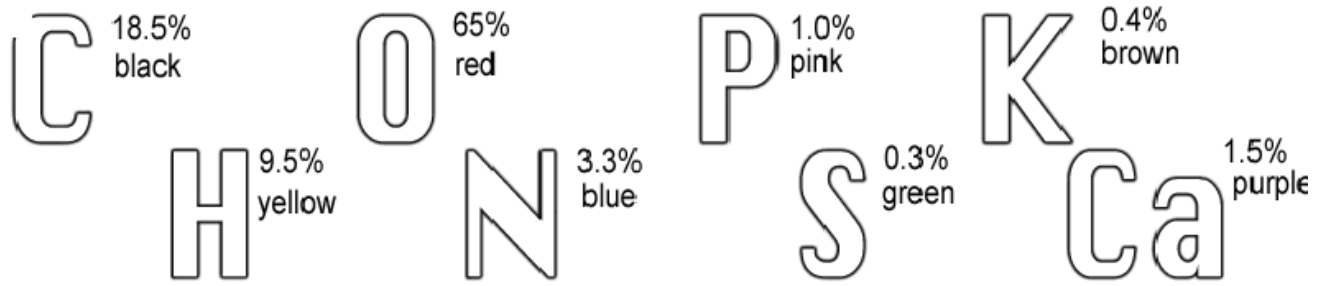
Most common elements in living things are **carbon, hydrogen, nitrogen, and oxygen**. These four elements constitute about **95% of your body weight**. All compounds can be classified in two broad categories --- **organic and inorganic compounds**. Organic compounds are made primarily of **carbon**. 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, or triple**. 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 another page 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 3 types of bonds carbon can form.
3. What are macromolecules?
4. Name the 4 classes of 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 compounds** (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. This gives each compound different **properties**.

### Carbohydrates

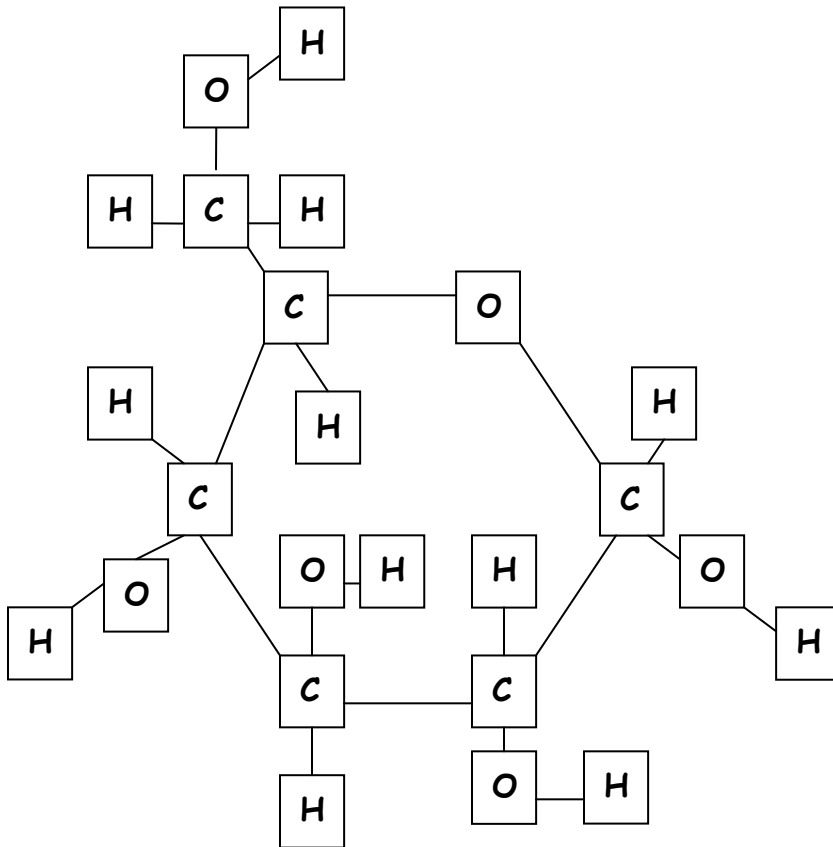
Carbohydrates are used by the body for **energy** and **structural support** in cell walls of plants and exoskeletons of insects and crustaceans. They are made of smaller subunits called **monosaccharides**. Monosaccharides have carbon, hydrogen, and oxygen in a **1:2:1 ratio**. Monosaccharides or **simple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

*Color code* the glucose molecule on this worksheet (carbon-black, hydrogen-yellow, and oxygen-red).

Use the diagram of glucose to tell how many carbons, hydrogens, and oxygens are in a single molecule.

#C \_\_\_\_\_ # H \_\_\_\_\_ # O \_\_\_\_\_

*Glucose Molecule*



**Questions:**

8. Macromolecules are also known as \_\_\_\_\_.

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

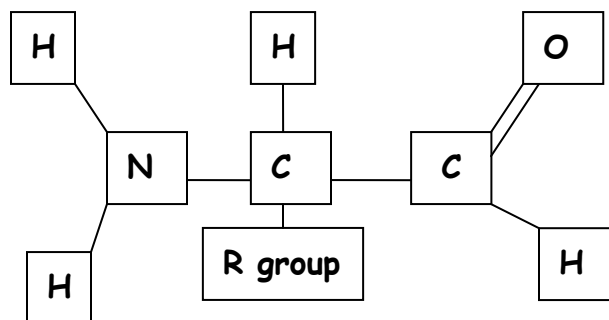
10. Name 2 ways your body uses carbohydrates.
11. What are the subunits called that make up carbohydrates?
12. What is the ratio of C, H, and O in monosaccharides?
13. Name 3 monosaccharides.
14. Monosaccharides are \_\_\_\_\_ sugars.
15. What are disaccharides & give an example?
16. Long chains of sugars are \_\_\_\_\_. Name three.

### Proteins

**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<sub>2</sub>)**.

*Color code* the amino acid on this worksheet (carbon-black, hydrogen-yellow, nitrogen-blue, and oxygen-red).

#### Basic Structure of Amino acid



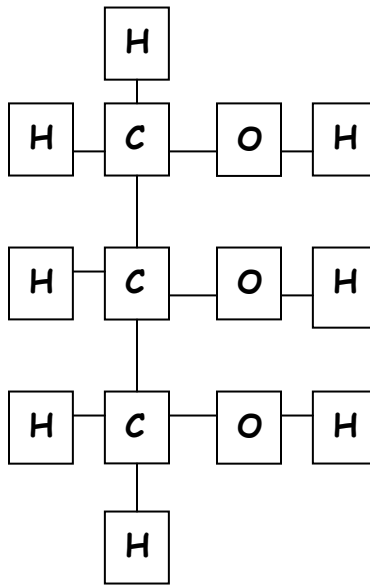
### **Questions:**

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.

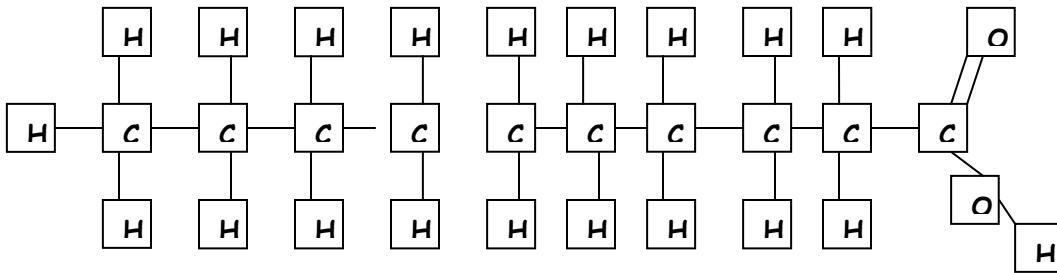
### Lipids

**Lipids** are large, **nonpolar** (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**. *Color* the glycerol molecule using the same colors for carbon, hydrogen, and oxygen as you did before. 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. **CIRCLE AND LABEL** the carboxyl groups in the 2 fatty acids on this worksheet. *Color* the fatty acid chains the same colors for carbon, hydrogen, and oxygen as you did before. A special type of lipid called phospholipids help make up the cell membrane.

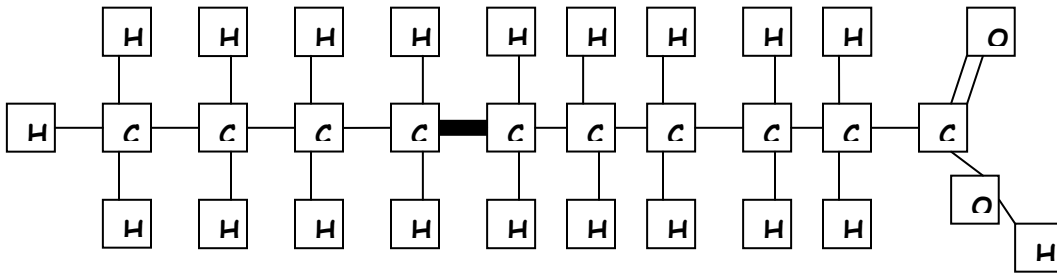
## Glycerol



## Saturated fatty Acid



## Unsaturated Fatty Acid - Double Bond



**Questions:**

20. Lipids are nonpolar. What does this mean?

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

22. Lipids have more \_\_\_\_\_ and \_\_\_\_\_ than they do oxygen atoms.

23. Fats are made of an alcohol called \_\_\_\_\_ and three \_\_\_\_\_ chains. This is known as a \_\_\_\_\_.

24. If there are all **SINGLE** bonds between \_\_\_\_\_ in the fatty acid chain, then it is said to be \_\_\_\_\_.

25. If there is a **DOUBLE** bond between \_\_\_\_\_ in the fatty acid chain, then it is said to be \_\_\_\_\_.

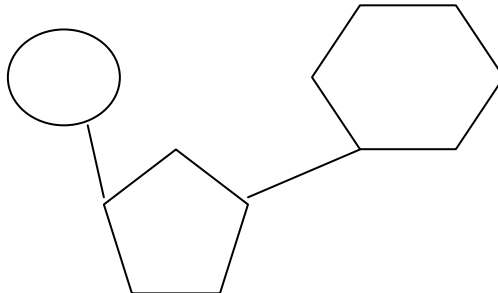
26. The end of the fatty acid that does **NOT** attach to glycerol has what functional group? Write the formula for this group.

**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.



## Nucleotide



### Questions:

27. Nucleic acids carry \_\_\_\_\_ information in a molecule called \_\_\_\_\_ or \_\_\_\_\_ acid.
28. DNA has the instructions for making a cell's \_\_\_\_\_.
29. \_\_\_\_\_ are the subunits making up nucleic acid.
30. The 3 parts of a nucleotide are a 5 carbon \_\_\_\_\_, a phosphate, and a nitrogen \_\_\_\_\_.

### Final Questions:

1. Give the symbols for the elements that make up each of the following:  
\_\_\_\_\_carbohydrates \_\_\_\_\_lipids \_\_\_\_\_DNA \_\_\_\_\_proteins
2. Name the 4 classes of macromolecules & give a function for each.
3. Name the subunits that make up each of the macromolecules.

4. Explain the difference between a disaccharide and a polysaccharide. Give an example of each.

5. What two functional groups are found in amino acids?

6. Name the subunit that makes up fats.

7. What is the difference between a saturated and unsaturated fatty acid?