

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 also bond to other carbon molecules forming **double, triple or quadruple bonds**. Organic compounds also contain **hydrogen**. Since hydrogen only has 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, oxygen, hydrogen, nitrogen, and phosphorus (**CHON P**).

The body also needs trace amounts of other elements such as calcium, potassium, and sulfur for proper functioning of muscles, nerves, etc.

Questions:

1. Name the 4 main elements that make up 95% of an organism.
 - a.
 - b.
 - c.
 - d.
2. Name the 4 types of bonds that carbon can form.
 - a.
 - b.
 - c.
 - d.
3. What are macromolecules?
4. Name the 4 classes of macromolecules.
 - a.
 - b.
 - c.
 - d.
5. Give 2 examples of nucleic acids
 - a.
 - b.

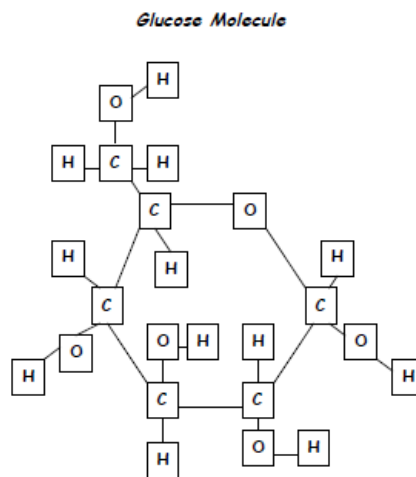
6. What elements make up carbohydrates and lipids?
7. What are 2 elements your body needs in trace amounts?
- a.
 - b.

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 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 (monomers) 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).

Questions:

8. Color code the glucose molecule below (carbon-black, hydrogen-yellow, oxygen-red).



9. Macromolecules are also known as _____.
10. If all of the macromolecules are made mainly of the elements CHO, how are they different?
11. Name 2 ways your body uses carbohydrates.
- a.
 - b.

12. What are the subunits that make up carbohydrates?

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

14. Name 3 monosaccharides.

a.

b.

c.

15. Monosaccharides are _____ sugars.

16. What are disaccharides?

17. Long chains of sugars are _____.

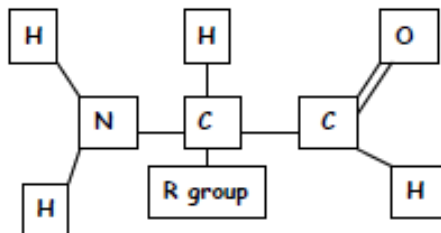
Proteins are made of subunits called **amino acids** and are used to build cells and do much of the work inside organisms. They also act as **enzymes** helping to control metabolic reactions in organisms. Amino acids contain two **functional groups**, the **carboxyl group (-COOH)** and the **amino group (-NH₂)**.

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

Questions:

18. Color code the amino acid below (carbon-black, hydrogen-yellow, nitrogen-blue, and oxygen-red).

Basic Structure of Amino acid



19. Circle the carboxyl group in the amino acid above.

20. Draw a box around the amino group in the amino acid above.

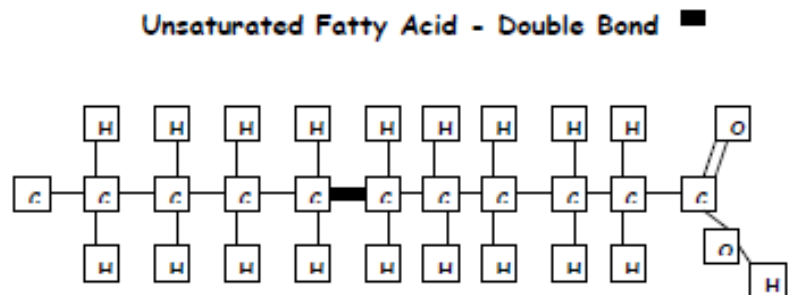
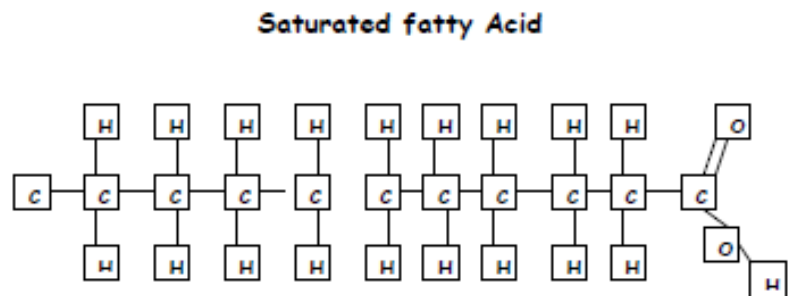
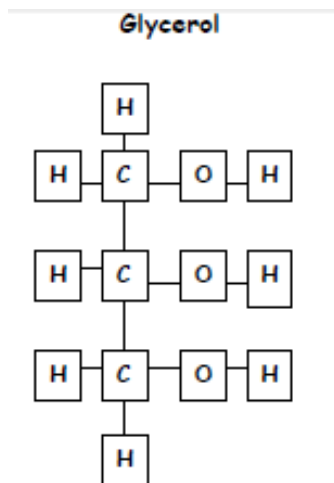
21. What subunits make up proteins?

22. Proteins also act as _____ in cells to control cell reactions.
23. Name the 2 functional groups in amino acids.
- -
24. Amino acids are linked together to make proteins by removing a molecule of _____ in a process called _____.
25. Chains of amino acids make _____ which can join together to make a _____.
26. _____ bonds form when water is removed to hold _____ acids together.

Lipids are large, **non-polar** (won't dissolve in water) molecules. **Phospholipids** make up cell membranes. Lipids also serve as waxy coverings (**cuticles**) on plants, **pigments** (chlorophyll) and **steroids**. Lipids have **more carbon and hydrogen atoms** than oxygen atoms. Fat are made of **glycerol** (alcohol) **three fatty acid chains**. The 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 the glycerol. A special type of lipid called phospholipids help to 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.

Questions:

27. Color the glycerol and fatty acid molecules using the same code as before (carbon-black, hydrogen-yellow, oxygen-red).



28. Lipids are non-polar. What does this mean?

29. _____ make up the cell membrane.

30. Name a waxy lipid covering plants.

31. Plant pigments like _____ are also _____.

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

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

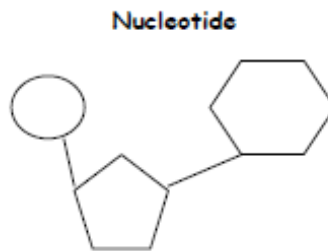
34. If there are all SINGLE bonds between _____ in the fatty acid chain, then it is said to be _____.

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

Nucleic Acids carry the genetic information in a cell. **DNA or deoxyribonucleic 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**.

Questions:

36. Color and label the parts of the nucleotide below. (Sugar-green, phosphate group-yellow, and nitrogen base-blue).



37. Nucleic acids carry _____ information in a molecule called _____.

38. DNA has the instruction for making a cell's _____.

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

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

Summary Questions:

Fill in the chart below:

	Macromolecule	Subunit (monomer)	Function	Example
41.				
42.				
43.				
44.				

45. What process is used to link amino acids together?

46. Name the bonds found between amino acids in a polypeptide chain.

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

48. What are the two functional groups found in amino acids?

49. What alcohol is found in a triglyceride?

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