

## Biomolecules Review

Place your answers on the right side. To study fold in half and quiz yourself or others.

Organic molecules are the molecules which exist in all living things. They are life's building blocks. All things are formed from these organic molecules. There are four categories of organic molecules: Carbohydrates, lipids, proteins and nucleic acids.

1. **How are organic molecules related to all living things?**
2. **Name four categories of organic molecules which form the basis of all living things.**

Organic molecules have four common characteristics. First, they are all carbon based, meaning they all contain carbon. They are formed from just a few elements which join together to form small molecules which join together, or bond, to form large molecules. The third characteristic of all organic molecules is that each kind of organic molecule is built from a single type of building block. For example, the building block of carbohydrates is sugar, the building block of lipids is fatty acids, the building block of protein is amino acids and the building block of nucleic acids is the nucleotide. When these building blocks are joined together, they form a large molecule (polymer), just as bricks joined together form a wall. For example, sugars join together form a carbohydrate.

The last common characteristic of all organic molecules is that their form determines their function. That means that their shape determines how they will behave and how they will react with other molecules. For example, the order of amino acids in a protein will determine the shape and function of the protein just as the order of words in a sentence shapes the meaning of the sentence.

3. **What determines how organic molecules will look and behave?**
4. **What are the four common characteristics of all organic molecules?**

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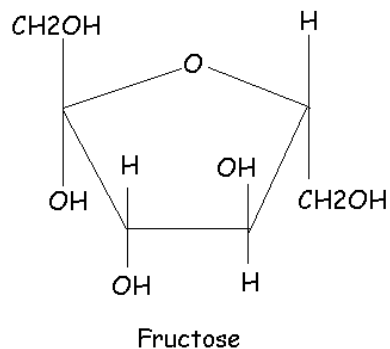
## Carbohydrates

Carbohydrates are the most common organic molecule because they make up most plant matter. They are made from carbon, hydrogen and oxygen. Their building block a single sugar called a monosaccharide. Sugars (monosaccharides) consist of carbon rings. When two monosaccharides, or sugars, combine, they form a disaccharide (di = two). When more than two monosaccharides join together, a polysaccharide (poly = many) is formed.

5. What are the elements contained in carbohydrates?
6. What is the building block of carbohydrates?
7. What is a monosaccharide?
8. What does a monosaccharide look like?
9. What is a disaccharide?
10. How does a polysaccharide differ from a disaccharide?

There are three classes of carbohydrate polysaccharides. The first is starch. Starch is a carbohydrate used in food storage in plants. Potatoes, pasta and rice are rich in starch. Starches are very valuable because they provide a quick form of energy for the body. The second is glycogen. Glycogen is used for food storage in animals. The third is cellulose. Cellulose is used for structural support in plants (stems, leaves).

11. What are the three classes of carbohydrates?
12. Which involves food storage in plants?
13. Which involves food storage in animals?
14. What is cellulose used for?
15. Why would an athlete have a big pasta dinner the night before a race?



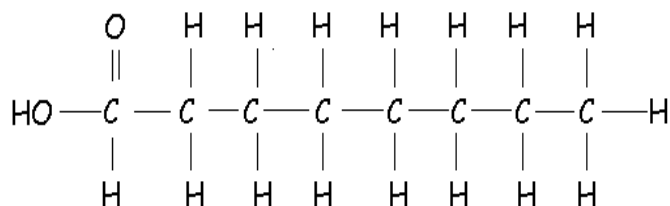
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Sugars can be detected in foods through a simple lab test. To find out if a food contains starch, iodine (a reagent) is placed on the food. A food containing starch will turn black when in contact with iodine. A test for simple sugars involves mixing the food with a liquid blue reagent called Benedict's solution and then heating the mixture. If the food is positive for simple sugars, the heating process will cause the benedict's solution to turn red, orange, or green.

### Lipids

Lipids are a class of organic molecules which includes fats and oils, and has the function of long-term storage of energy in the body. The building block of lipids is the fatty acid, which is a chain of carbons with hydrogen attached to each side. Saturated fats have two carbons attached to each carbon (except the one at the end). Saturated fats are unhealthy fats like butter and Crisco. Unsaturated fats are missing at least one hydrogen and are kinked in shape. The unsaturated fats are healthy, and include oils.



16. What is the building block of lipids?

17. Name examples of lipids

18. Describe the structure of a fatty acid.

19. What is a saturated fatty acid?

Lipids are soluble (dissolve) in oil but are insoluble (don't dissolve) in water. When mixed with water, the lipid will float on top to form a separate layer. To test for the presence of lipids in food, the sample is placed on a piece of brown or newspaper, and then the paper is held up to the light. A test that is positive for lipids will have a oily spot that is translucent, or clear, on the paper.

20. Explain the solubility of lipids.

21. How would you test for lipids, and what is a positive results?

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### Proteins

Proteins are organic molecules that form muscles, transport  $O_2$  (hemoglobin), and act as hormones and enzymes. Most importantly, proteins determine how our bodies look and function. Their building block is the amino acid. Proteins are made of amino acids combined through a dehydration link called a peptide bond. When groups of amino acids are joined together, a protein is formed.

**22. What are some of the functions of proteins?**

**23. What is the building block of proteins?**

**24. What is the name of the bond that joins amino acids?**

There are about 20 different kinds of amino acids. These amino acids consist of five separate parts. The first is a central carbon atom. Second is a carboxyl group ( $-COOH$ ). Third is an amino group ( $-NH_2$ ). Fourth is a hydrogen. The fifth group is a variable 'R' group. The only difference in the 20 kinds of amino acids is the "R" group. Some "R" groups are very small, others are large, and even others form chains and rings. The sequence and shapes of the "R" groups control the shape and function of the protein.

**25. How many different amino acids are there?**

**26. What part of the amino acid varies from one amino acid to another?**

**27. What determines the shape and function of a protein?**

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## Nucleic Acids

The fourth class of organic molecules is the nucleic acids. This class involves the genetic materials, DNA and RNA. DNA is the blueprint of life because it contains instructions on how to make proteins in the body. Each individual's DNA is unique, which means that each individual has a unique set of proteins. That is why each of us looks and behaves differently. RNA is a copy of DNA. Because DNA can't leave the cell's nucleus, and because proteins are constructed outside of the nucleus in the cytoplasm, the RNA is necessary to carry the instructions from DNA to the cytoplasm where the protein is made.

28. What are the two types of nucleic acids?

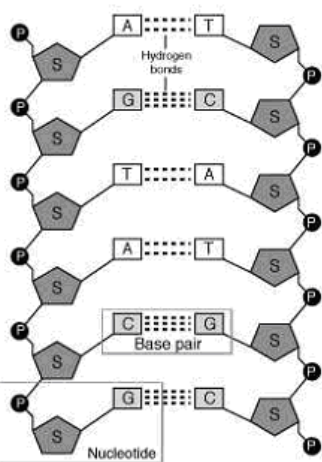
29. What is the role of DNA?

30. How does the role of RNA differ from that of DNA?

The monomer of nucleic acids is the nucleotide. All nucleic acids are formed from a series of these nucleotides. Nucleotides consist of three parts: a five-carbon sugar, a phosphate group and a nitrogen base.

31. What is the building block of nucleic acids?

32. What are the three parts of this monomer?



The structure of DNA resembles that of a twisted ladder. This twisted ladder of DNA is called a 'double helix.' The rails of the DNA ladder are made from alternating sugars and phosphates (sugar-phosphate-sugar-phosphate-sugar...). In DNA, the sugar is called deoxyribose. The rungs of the ladder are made of four different kinds of bases, with one base hanging off of

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the *sugar* portion of each rails. The four bases are *A*, *T*, *C* and *G*. The rails of the ladder are held together because the bases from one rail bond to the bases from the other rail to form rungs. The bases from one side of the ladder attach to the bases hanging from the other rail. This keeps the ladder together. The bases attach to one another in a very specific way: '*A*' bases always attach to '*T*' bases, and '*C*' bases always attach to '*G*' bases.

**33. Describe the structure and shape of DNA.**

**34. What are the rails of the ladder made of?**

**35. How are the rails of the ladder kept together?**

**36. What are the four different DNA bases?**

**37. What part of the ladder do these bases form?**

**38. 'A' always pairs with what base?**

RNA is very similar to DNA in all ways except for a few differences. First, where the sugar in DNA is deoxyribose, the sugar in RNA is ribose. Second, where DNA is a double helix, RNA has just one strand. Third, where the bases in DNA are *C*, *G*, *A* and *T*, in RNA the bases are *C*, *G*, *A* and *U*. The *U* in RNA takes the place of the *T* in DNA. Fourth, DNA cannot leave the nucleus of the cell and RNA can.

**39. List four differences between DNA and RNA.**

**40. List three similarities between DNA and RNA.**

**Summary: In 5 Sentences, summarize what the structure and function of biomolecules are.**

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