

Other organic compounds

Take a cheeseburger.... hamburger, covered with American (yellow) cheese on a hamburger bun... yummy! Now, if you made this cheeseburger with Swiss cheese and put it on slices of rye bread, you'd end up with a "cheeseburger" but one that tasted totally different ... you would notice that the substitutions affected the taste... Chemists make similar changes to organic compounds... these changes produce compounds called _____

A substituted hydrocarbon has had one or more of its **hydrogen atoms** or groups of atoms **replaced by atoms** or groups of atoms of other elements.

alcohol is the name of a family of compounds formed when a hydroxyl (-OH) group _____ **one or more hydrogen atoms** in a hydrocarbon.

(ex: thanolis produced by sugar fermenting in corn, grains & fruits)

Structure challenge:

Isopropyl alcohol: The -OH is on the middle carbon of the 3 carbon chain

Propyl alcohol: Has the carbon on the end

a carboxylic acid is formed when a _____ **group is replaced** by a carboxyl (-COOH) group. (The simplest carboxylic acid is methanic acid or formic acid which is made by ants and is injected into your skin when they bite you)

In this group, Nitrogen forms bonds with the carbon and hydrogen. The amine group _____ **replaces the hydrogen** in the hydrocarbon. Mathylamine is the simplest amine. (EX: novicane in the dentist's office, caffeine in soft drinks... are all hydrocarbons substituted with nitrogen)

Example: **Ethylmethylanine:** $\text{CH}_3\text{NHCH}_2\text{CH}_3$

Amino acids have a $-\text{NH}_2$ group along as well as an acid group in it's structure, and is a building block for proteins. They also have both: _____ **groups** (a substituted hydrocarbon and more than one chemical group replacing its hydrogen at one time)

Milk, blood muscle, cassette tapes & athletic shoes are all made of organic compounds with _____ called Polymers. Polymers are made up of smaller organic compounds that are linked together. to form new bonds. Polymers are also found in the biological compounds that make up living things.

Biomolecules: Chemistry of Living Systems

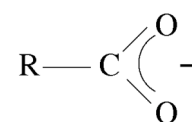
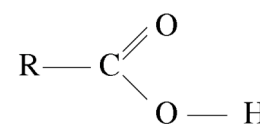
What are Biomolecules?

- _____ compounds are made by living things
- Also called biochemicals Some are very large Biomolecules are based on the most important element to living organisms: _____
- There are thousands of different biomolecules but only 4 categories:

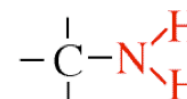
Alcohols
Characterized by the **hydroxyl group**
-OH

Alcohols
Nomenclature:
 CH_3OH
methanol
(methyl alcohol)

Carboxylic Acids
Characterized by the **Carboxyl Group**
 **O
 \parallel
 $-\text{C}-\text{OH}$**



Amino



Amines
Characterized by Nitrogen joined to at least one alkyl group.
 $-\text{NH}_2$
Amino Group

Amino Acid Structure
$$\begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ | \quad | \quad \parallel \\ \text{H}-\text{N}-\text{C}-\text{C}-\text{OH} \\ | \\ \text{R} \end{array}$$

Addition Polymerization
The simplest and most widely used addition polymer is polyethylene
$$\begin{array}{cccccccccccccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ | & | & | & | & | & | & | & | & | & | & | & | & | & | & | & | & | & | \\ -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} \\ | & | & | & | & | & | & | & | & | & | & | & | & | & | & | & | & | & | \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array}$$

4 Biomolecule Categories

1. _____
Sugar
Starch
Cellulose
2. _____
Fats
Oils

3. _____
Made of amino acids
Vitamins & Minerals
4. _____
DNA
RNA

Sweet Crackers Mini Lab: What happened to the taste of the cracker during the time it was in your mouth? _____

1) What does the change in taste tell you about the molecules in the cracker? _____

Carbohydrates

Facts

The _____ biomolecules

Contain 3 elements: _____

•The word carbohydrate comes from the fact that these compounds have many carbon atoms bonded to _____ (OH) groups.

•Serve 2 main functions:

Source of chemical _____ for cells in many living things.

Part of the _____ material of plants

•Come in all sizes, from small rings to long chains

Simple Carbohydrates: Sugar: Break down _____ in the body Provide a quick burst of energy or a “sugar rush”. _____ is the most important & simplest sugar on Earth. Used in cells & created by photosynthesis It comes in many forms.

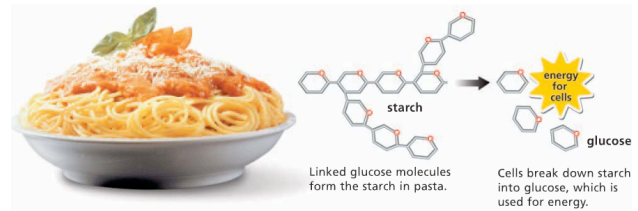
Complex Carbohydrates: _____ Long _____ of of simpler sugars joined together. They’re also called polysaccharides or _____ (“poly” = many).

_____ to break down in the body & provide can energy for a longer period of time than regular sugars.

This is why marathon runners, cyclists, and most athletes

“carbo-load” the weeks before a big event... to store up energy.

Starches are found in corn, potatoes, wheat, pasta, and many other foods.



Cellulose: Unlike animal cells, _____ cells have a cell wall. This cell wall is a tough protective layer made out of cellulose, a _____ (or BIG molecule). The cell wall is a large part of vegetables such as lettuce & celery. It is also what gives stems and wood strength. Like starch, cellulose is made from chains of thousands of glucose molecules, but the difference is in how they’re linked. Because of this small difference, your body _____ digest cellulose the same way it can starches & sugars.

Carbohydrates Summary:

Carbohydrates are organic compounds in which there are _____ as many _____ atoms as _____ atoms.

Like fats, they contain carbon, hydrogen and oxygen. However, in carbohydrates, the hydrogen and oxygen are present in a ratio of 2 hydrogen atoms to one oxygen atom. This ratio is the same as water.

The sugar in blood is called glucose. and has the formula $C_6H_{12}O_6$

Sucrose $C_{12}H_{22}O_{11}$ is also a common sugars. _____ is found in honey and grapes.

Starches are larger molecules that occur naturally in wheat, rice and corn (a natural starch food is pasta and bread!!)

DO BrainPop: Carbohydrates

Lipids Facts: Lipids include: _____ and _____ Like carbohydrates, most lipids are also made of just _____ hydrogen, and oxygen. But unlike carbohydrates, fats are more complex and take much longer to break down. So, fats are _____ molecules that plants and animals use to store energy in reserves for longer periods. Plants store energy in _____ like olive oil or peanut oil. An oil is a fat that is _____ at room temperature. **Lipids Structure:** Fats & oils store energy super-efficiently, 1 gram of fat contains about _____ the energy as 1 gram of carbohydrate. A fat molecule has a 2-part structure. The first part is called _____ Attached to the glycerol are 3 long chains called _____

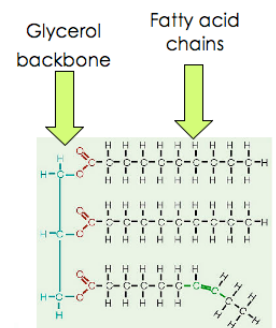
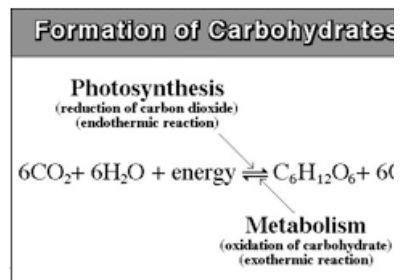
Two Types of Carbohydrates

1. _____

Examples: _____

2. _____

Examples: _____



Lipids:

What do butter, margarine and oil in salad dressing have in common?? They are all lipids. Lipids are organic compounds that and will not dissolve in water (they are insoluble) Fats, oils, waxes, etc., make up this group. Lipids contain the same elements: _____, H, O that carbohydrates do, but they are in different proportions. Lipids are a more concentrated source of energy than carbohydrates. They provide twice as much energy per gram as carbohydrates.

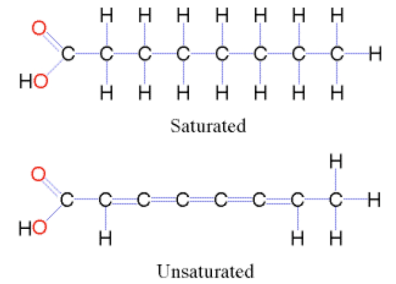
Saturated vs Unsaturated Fats:

Fats and oils are classified as saturated and unsaturated according to the types of bonds in their carbon chains. _____ such as cheese, whipped cream, ice cream only **contain** _____ between carbons.

_____ **contain one or more** _____ between atoms. **Saturated fats:** only _____ bonds in the carbon chain. Most _____ fats "bad" fats. Diets high in saturated fat are linked to heart disease. **Unsaturated fats:** one or more _____ bonds in the carbon chain. Most oils from _____ "good" fats

List 2 examples of Saturated Fats:

List 2 examples of Unsaturated Fats:



Cholesterol

Cholesterol is another lipid in cell membranes It is also needed to make _____ like adrenaline Your body makes the cholesterol that it needs, but it is also found in many foods that come from animals, like meat and eggs. Although you need cholesterol, eating too much of it can block arteries and lead to heart disease.

DO BrainPop: Fats

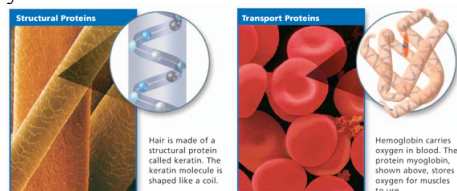
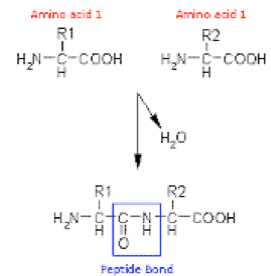
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Video 6: Fueling the Body: Carbohydrates & Fats

1. Carbohydrates, stored in the liver & muscles, are converted into what? _____
2. How many hours of energy does the average person have stored? _____
3. Explain what the video meant by "the body cannibalizes itself". _____
4. Converting fat to fuel requires what? _____
5. Explain how our ancient ancestors affected the way our bodies work today. _____

Proteins (& amino acids)

Proteins are big molecules called _____ Made of smaller molecules called _____ Made of carbon, hydrogen, oxygen, nitrogen, sulfur, & some other elements. There are at least _____ proteins in your body. Each has a different _____ that gives it a specific _____. There are _____ types of structure, including coils & curls. Milk and fish contain protein, a particular kind of hydrocarbon that is necessary for all living cells. Proteins are _____ formed by linking together monomers called _____. Think of proteins as being like a word. Amino acids are the letters in that word. Rearranging the letters makes words with different meanings. Proteins are in your muscles, hair, every living cell in your body. _____ of the _____ **amino acids** used by our bodies are absolutely essential for us to function properly, and our bodies DON'T make them. _____ amino acids are made in our bodies, but the other _____ must be obtained by eating _____ that contain them. It's important to have lots of protein in your diet!



Proteins in foods such as _____ are broken down into amino acids. Without protein, your body can't function perfectly.. This is why it's important for vegetarians to find protein from non-animal sources.



Enzymes Some proteins curl up into a shape like a ball of enzymes. An enzyme is a special protein and a _____ for a chemical reaction in living things. Catalysts speed up the rate of a reaction. Enzymes are needed for many chemical reactions in your body. Without them, these reactions would occur too slowly to keep you alive.

Nucleic Acids

Largest & most complex biomolecule. Includes:

- _____: deoxyribonucleic acid
- _____: ribonucleic acid

Huge, complex carbon-based molecules. Their job: contain information that cells use to make proteins.

Made of carbon, hydrogen, oxygen, nitrogen, phosphorous. Every cell in your body has a complete set of nucleic acids. The process of making proteins from amino acids is called

DNA

Deoxyribonucleic acid. One of the largest molecules. A single DNA molecule has more than _____ atoms. A DNA molecule is a twisted ladder, or a _____. The sides of the ladder is made of 5-carbon _____ molecules called deoxyribose and _____ groups. The “rungs” of the ladder are made of:

_____. The 4 Nitrogen bases in a DNA molecule occur in matched sets:

_____ (A) to _____ (T)
 _____ (C) to _____ (G)

The order of the bases in DNA is the way in which DNA stores instructions for making proteins. (A protein is made of amino acids that have to be linked in certain order) Each of the 20 amino acids is represented by a series of _____ DNA bases.

Vitamins: Most of the chemical needed for life can be made by your own body, like proteins. However, there are certain chemicals that your body does not automatically make. We call these vitamins & _____. The only place to get these: food!!

Vitamin C: _____, also called vitamin C, is needed for several important processes in your brain and nervous system. _____ results from a lack of vitamin C in your diet. It causes of spotting on the skin, spongy gums, and bleeding membranes, and can eventually lead to death. The British Royal Navy were among the first to discover this vitamin deficiency, when they noticed their sailors would get sick without fresh fruits & vegetables.

Review:

1. Carbon’s unique ability to form _____ with other atoms enables it to make a huge number of compounds. The structure of its compound determines its properties in the following ways:

shorter hydrocarbons are _____. In general, they have low boiling points and the evaporate and burn easier. **Longer hydrocarbons** _____ molecules and exist as solids or liquids at room temp

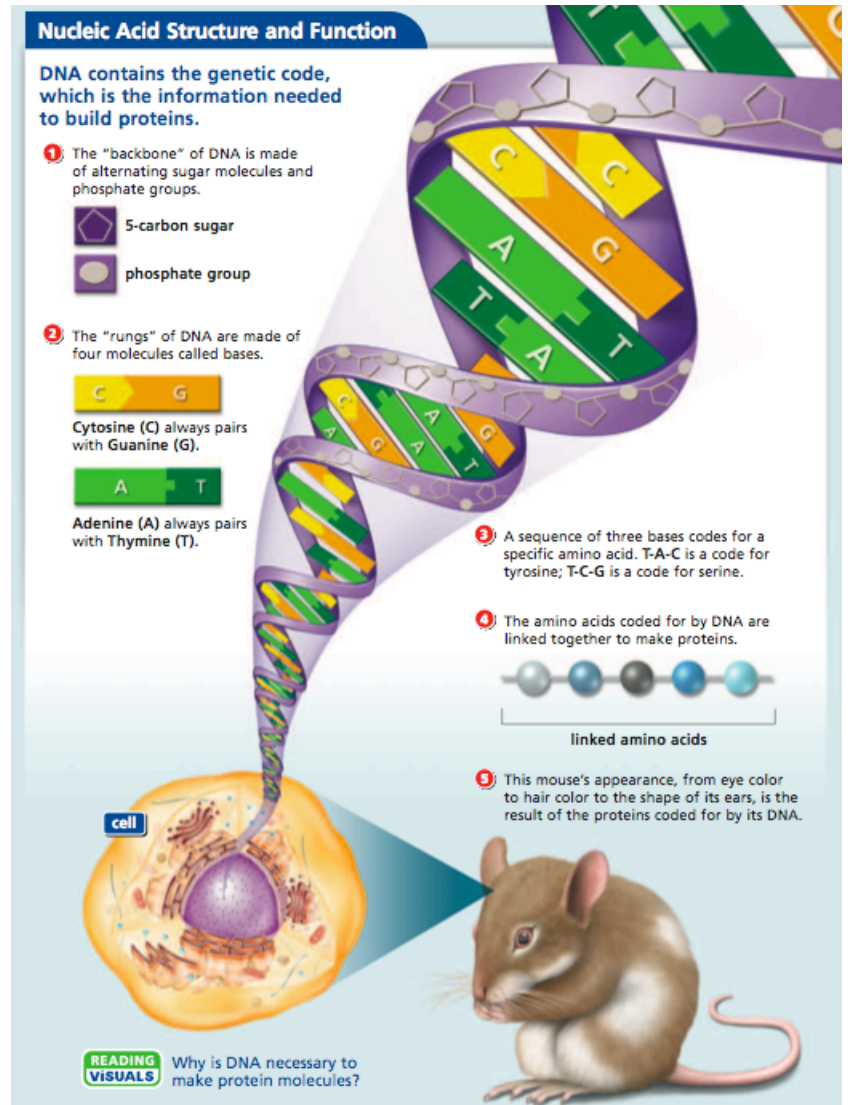
2. Hydrocarbons can be composed of hydrogen and carbon alone, or other chemical groups may be substituted for hydrogen on the molecule to form new compounds, as with vitamin C. Three additional types of _____ include: _____ hydroxyl group (-OH) replaces 1 or more hydrogen atoms, produced naturally by sugar fermentation in fruit and grain. _____: carboxyl (-COOH) replaces a CH₃ group, oxygen double bonds with carbon, and produces a sour taste

_____ :amine group (-NH₃) replaces a hydrogen, found in caffeine, novocaine, and in some vitamins.





3. food providing _____: milk, fish, meat, poultry
 food providing _____: pasta, bread,
 vegetables, sugar

food providing _____ butter, margarine, oils, solid shortening contain carbohydrates in the form of starch

5. What do they do for our bodies: _____ provide growth & renewal _____ provide energy







Brain POP CARBOHYDRATES

- What might happen if you didn't eat enough carbohydrates?
 - Your body wouldn't be able to build muscle
 - Your body wouldn't have enough energy to function
 - You'd develop serious vitamin deficiencies
 - Your bones and teeth would become weaker
- Carbohydrates are to the human body as what is to a car?
 - Transmission fluid
 - Antifreeze
 - Motor oil
 - Gasoline
- What suffix indicates that a chemical is a sugar?
 - ose
 - ase
 - ate
 - ite
- Which of the following contains complex carbohydrates?
 - 
 - 
 - 
 - 
- How is fiber different from most other foods you eat?
 - It doesn't contain any sugars at all
 - Consuming it robs your body of nutrients
 - Your body can't digest it
 - It contains elements of all the major food groups
- Which food contains the most starch?
 - Pasta
 - Broccoli
 - Table sugar
 - Steak
- Where in your body are complex carbohydrates broken down into simple sugars?
 - In your bloodstream
 - In your intestines
 - In your mouth
 - In your liver
- If you're hungry, but don't want your blood sugar to spike, what should you eat?
 - A baked potato
 - An apple
 - Sushi with white rice
 - A candy bar
- Which of the following breads is the healthiest?
 - White
 - Italian
 - Whole wheat
 - Sourdough
- Your body breaks down most complex carbohydrates into:
 - Fructose
 - Sucrose
 - Glucose
 - Starch



QUIZ YOURSELF What is the difference between sugar, starch, and cellulose?


Brain POP FATS

- Why is fat an important part of our diet?
 - Because it tastes good
 - Because it carries so much energy
 - Because it contains nutrients you can't get from anything else
 - Because it contains oxygen atoms
- What do carbohydrates and fats have in common?
 - They're both sources of glucose
 - They're both sources of protein
 - They're both sources of fatty acids
 - They're both sources of glycerol
- What might happen if you didn't get enough fatty acids in your diet?
 - Your brain wouldn't have enough energy
 - Your muscles wouldn't have enough energy
 - Your kidneys and liver might not function properly
 - Your bones might become brittle
- A sedentary lifestyle can cause glucose to turn into body fat. What is the best synonym for "sedentary"?
 - Healthy
 - Hyperactive
 - Sleep-deprived
 - Inactive
- Which of the following items might be high in saturated fat?
 - 
 - 
 - 
 - 
- Why is saturated fat found in so many animal products?
 - Because it's part of the cell membranes of animal tissues
 - Because animals must eat saturated fat in order to survive
 - Because proteins are broken down into saturated fat when animals die
 - Because saturated fat is a key component of animal bones
- If you eat too much saturated fat, cholesterol might build up:
 - In your brain
 - In your liver
 - In your veins and arteries
 - In your bones
- What is a key difference between saturated and unsaturated fats?
 - Saturated fats are usually liquid at room temperature; unsaturated fats are usually solid
 - Saturated fats stay solid at room temperature; unsaturated fats are usually liquid
 - Saturated fats can be found in vegetable oils; unsaturated fats can be found in animal products
 - Saturated fats are healthier than unsaturated fats
- A product that contains lots of hydrogenated oils is probably rich in:
 - Saturated fat
 - Unsaturated fat
 - Monosaturated fat
 - Trans fat
- Why shouldn't you worry about getting enough fat in your diet?
 - Because all fat is bad for you
 - Because it's found in so many foods
 - Because you don't need any fat at all in your diet
 - Because you can take it as a vitamin if you don't eat it

QUIZ YOURSELF: How are lipids different from carbohydrates?

List 3 differences between saturated and unsaturated fats:

- 1 A double helix looks like:**
- A A solid sphere
 - B A hollow tube
 - C A twisting ladder
 - D A pair of cubes
- 2 Which person would have the same exact DNA as you?**
- A Your mother
 - B Your father
 - C Your fraternal twin
 - D Your identical twin
- 3 What can you infer about a DNA molecule from its name**
- A That it's a nucleic acid molecule
 - B That it's a lipid molecule
 - C That it's a carbohydrate molecule
 - D That it contains blood
- 4 DNA can best be compared to:**
- A The bricks that make up a building
 - B An architectural blueprint of a building
 - C The tenants that live in a building
 - D The different apartments and offices in a building
- 5 Which trait is determined completely by your DNA?**
- A Your personality
 - B Your intelligence
 - C Your hair color
 - D Your weight
- 6 Place the following in order from largest to smallest: A) Base pair, B) Chromosome, C) DNA molecule**
- A C, B, A
 - B B, C, A
 - C A, C, B
 - D B, A, C
- 7  How can plants be made harder through genetic modification?**
- A Genes that code for disease resistance can be added to plant DNA
 - B Genes from healthy human beings can be added to plant DNA
 - C Genes from vaccines can be added to plant DNA
 - D Genes from viruses and pathogens can be added to plant DNA
- 8 In the term "nucleic acid," what does the word "nucleic" indicate?**
- A That energy from DNA can be used in nuclear power
 - B That DNA is located in cell nuclei
 - C That DNA molecules are held together by nuclear forces
 - D That splitting DNA molecules results in nuclear reactions
- 9  What is the best definition of a clone?**
- A A child who has no parents
 - B Someone whose DNA is an exact copy of someone else's
 - C Someone who looks exactly the same as another person
 - D Someone whose DNA is similar to someone else's
- 10 Which of these is a true statement about DNA?**
- A Only animals have DNA in their cell nuclei
 - B DNA research is simple and inexpensive
 - C RNA and DNA have nothing to do with one another
 - D The structure of human DNA was not discovered until the 1950s

- 1 Water is the most abundant molecule in the human body. What does "most abundant" mean?**
- A Most useful
 - B Most common
 - C Smallest
 - D Simplest
- 2  What might happen if you did not consume carbohydrates?**
- A Your body would dry out
 - B You would die from a lack of oxygen
 - C You wouldn't get the energy you needed to function
 - D Your body wouldn't be able to build new muscle mass
- 3 The four elements that make up 95 percent of the body's weight are carbon, hydrogen, oxygen, and:**
- A Nitrogen
 - B Nickel
 - C Iron
 - D Calcium
- 4 If the human body were a car, glucose would be:**
- A The engine
 - B The motor oil
 - C The wheels
 - D The gasoline
- 5 What might happen if you didn't consume enough lipids?**
- A You would die of dehydration
 - B Your body might not be able to store energy
 - C You might not be able to go to the bathroom
 - D Your cells would not be able to break down sugars
- 6 What might happen if you consumed too many lipids?**
- A You might develop heart disease
 - B Your cells might swell up with too much water
 - C You might get a very high fever
 - D You might wind up with too much energy
- 7 In your body, where can you find proteins?**
- A Only in your hair and nails
 - B Only within your bones
 - C Only in tissues and cartilage
 - D Just about everywhere
- 8 What are nucleic acids responsible for?**
- A Removing wastes from the body
 - B Providing short bursts of energy
 - C Encoding information used for the body's functions and growth
 - D Delivering chemical messages between the brain and the body
- 9 How would a chemical reaction that includes an enzyme differ from a chemical reaction that takes place without an enzyme?**
- A The reaction with the enzyme would be faster
 - B The reaction with the enzyme would be slower
 - C The reaction with the enzyme would require more energy
 - D The reaction with the enzyme would require less energy
- 10 Why should you eat right?**
- A Because it'll make you thin and good-looking
 - B Because your doctor and parents say so
 - C Because your body will gradually lose water if you don't
 - D To provide your body with the proper raw materials it needs to function