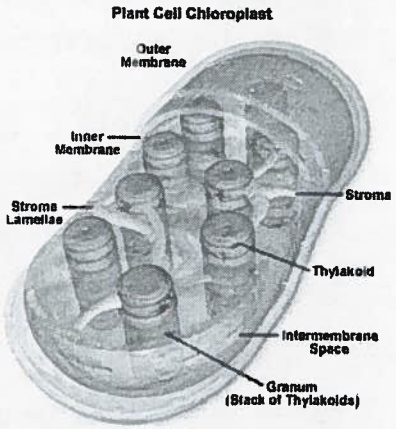
Name_____ Date_____ Period_____

Photosynthesis: Making Energy

Objective: Describe what happens during photosynthesis.

Chloroplasts



Photosynthesis is a process in which sunlight energy is used to make glucose. The site of photosynthesis is in the **chloroplast** – an organelle found in the leaves of green plants. The main functions of chloroplasts are to produce food (**glucose**) during **photosynthesis**, and to store food energy. Chloroplasts contain the pigment, *chlorophyll*. Chlorophyll absorbs most of the colors in the color spectrum, and reflects only green and yellow wavelengths of light. This is why we see leaves as green or yellow – because these colors are reflected into our eyes.

1. What is photosynthesis? Photosynthesis is a process in which sunlight energy is used to make glucose.
2. Where does photosynthesis occur? The site of photosynthesis is in the chloroplast
3. What are chloroplasts and where are they found? An organelle found in the leaves of green plants.
4. What are the two main functions of chloroplasts? produce food (glucose) + store food (energy)
5. Why do most leaves appear green? chlorophyll reflects only green + yellow wavelengths of light
6. What is the primary pigment found in the chloroplast? Chlorophyll

Photosynthesis

Glucose is another name for sugar. The molecular formula for glucose is $C_6H_{12}O_6$. Plants make sugar by using the energy from sunlight to transform CO_2 from the air with water from the ground into glucose. This process, called photosynthesis occurs in the chloroplast of the plant cell. During this process, oxygen (O_2) is created as a waste product and is released into the air for us to breath. The formula for photosynthesis is:

(reactants) (products)

$$CO_2 + H_2O + \text{sunlight} \longrightarrow C_6H_{12}O_6 + O_2$$

This formula says that carbon dioxide + water molecules are combined with the energy from sunlight to produce sugar and oxygen. The reactants in photosynthesis (what is used) are CO_2, water and sun. The plant gets water from the ground through its roots. The plant collects carbon dioxide from the air. Much of the carbon dioxide comes from living organisms that exhale (breath it out) it, but some also comes from factory smokestacks and car fumes.

7. What is the formula for photosynthesis? $CO_2 + H_2O \xrightarrow{\text{sunlight}} C_6H_{12}O_6 + O_2$

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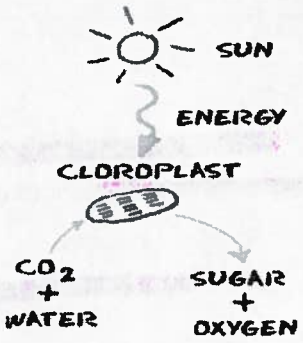
8. What three things are used to make glucose in photosynthesis? _____
   $CO_2 + H_2O$ + Sunlight (carbon dioxide + water + sunlight
9. Where does the water come from? The ground
10. Where does the water enter the plant? from the ground through the roots.
11. Name 3 some sources of CO_2. air, living organisms, factory smokestack
12. What type of energy does the plant use to convert CO_2 and H_2O into sugar? sunlight

The products are **glucose** and **oxygen**. The glucose produced is used by the plant for energy and growth. We also use this glucose by eating plants. The oxygen produced is released into the air for us to breath. Photosynthesis is essential for all life on earth, because it provides food and oxygen. Plants are considered autotrophs because unlike us humans, they can make their own food using this process.

13. What is produced in photosynthesis? glucose and oxygen
14. What is the glucose used for? for energy and growth
15. What is the oxygen used for? for heterotrophs to breath.

16. Here are three different ways to visualize the photosynthesis reaction: Is it easier for you to understand the reaction by using pictures, words, or symbols (see above)? Why?
Using pictures because it provides a visual model of reactions.

Photosynthesis in pictures	Photosynthesis in words	Photosynthesis in symbols
	Carbon dioxide and water combine with sunlight to create oxygen and glucose.	light $CO + H_2O \rightarrow C_6H_{12}O_6 + O_2$

Essential Question: Describe, using scientific terms, how plants turn sunlight into energy? Make sure to refer to the chemical equation to photosynthesis and discus the reactants and products.
Plants convert sunlight into usable energy through the process of photosynthesis. Light energy from the photons strikes the chlorophyll in the leaves which causes a chemical reaction between the chlorophyll, carbon dioxide and water creating $C_6H_{12}O_6$ or sugar
Photosynthetic equation.
$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ - The reactants are $CO_2 + H_2O$ and the products are $C_6H_{12}O_6 + O_2$.

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Cellular Respiration: Breaking down Energy

Objective:

Describe what happens during cellular respiration

Mitochondria are known as the powerhouses of the cell. They are organelles that act like a digestive system that takes in nutrients, breaks them down, and creates energy for the cell. The process of creating cell energy is known as cellular respiration. Most of the chemical reactions involved in cellular respiration happen in the mitochondria. A mitochondrion is shaped perfectly to maximize its efforts. Remember they have inner membranes to increase chemical reactions!

1. What process happens in the mitochondria?

They break down nutrients through cellular respiration to release energy for the cell to use.

2. What is the purpose of the process in #1 (what does it create)?

Energy is released for the cell to use.

Introduction to Cellular Respiration

Organisms, such as plants and algae, can trap the energy in sunlight through photosynthesis and store it in the chemical bonds of carbohydrate molecules. The principal carbohydrate formed through photosynthesis is sugar. Other types of organisms, such as animals, fungi, protozoa, and a large portion of the bacteria, are unable to perform this process. Therefore, these organisms must rely on the carbohydrates formed in plants to obtain the energy necessary for their life processes. This means they must eat plants and other animals in order to gain energy.

4. Some organisms perform photosynthesis to produce energy. Other organisms cannot do photosynthesis. What can they do in order to generate energy? They must eat plants and other animals in order to gain energy.

5. Animals and other organisms obtain the energy available in carbohydrates through the process of ***cellular respiration***. What is the purpose of cellular respiration? Cellular respiration uses oxygen to release the energy captured through photosynthesis to be used by organisms to maintain life.

Cells take the carbohydrates into their mitochondria, and through a complex series of metabolic processes, they break down the _____ and release the energy. The energy is generally not needed _____; rather it is used to combine adenosine diphosphate (ADP) with another phosphate to form adenosine triphosphate (ATP) molecules. The energy can then be used for processes in the cells that require energy, much as a battery powers a mechanical device. During the process of cellular respiration, carbon dioxide is given off. Plant cells can use this carbon dioxide during photosynthesis to form new carbohydrates.

6. What happens to carbohydrates during cellular respiration? They are broken down into CO_2 and H_2O and releasing the energy.

7. What is the chemical energy in the cell called? ATP

8. What does ATP stand for? Adenosine Triphosphate

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9. What is one product of cellular respiration? Carbon dioxide

10. How do animals get rid of the carbon dioxide? breathing out What body system is involved with removing this waste? respiratory

Also in the process of cellular respiration, oxygen gas is required to serve as an acceptor of electrons. This oxygen is identical to the oxygen gas given off during photosynthesis.

11. (Circle one) Oxygen is a PRODUCT OR (REACTANT) of respiration? (In other words, is it needed or released?)

Energy-producing process	Reaction	Location in cell
Photosynthesis	12. $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$	**Chloroplast**
Cellular respiration	$C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,H_2O + 6CO_2 + \text{energy}$	13. Mitochondria

Reflection Question: Explain the relationship between photosynthesis and cellular respiration. Be sure to include the main purpose of both and where they occur inside the cell.

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HUMANS AND PLANTS

Humans need plants. All animals do. Humanity's relationship with plants has actually made it possible for us to have a civilization. Before we had cities, humans went around in little packs and were hunter-gatherers. We ate rats, birds, berries, and whatever food we could find. It wasn't very efficient. One day someone had the bright idea to plant the plants we like to eat. When humans did that, they were able to stay in one place full time. Then came the cities and a huge system of agriculture to support millions of people.

HUMANS CULTIVATE PLANTS FOR MANY USES BEYOND FARMING AND FOOD

BIG TIME FARMING

As time has passed, we have taken farming to new levels. We have manipulated species to create big apples and large ears of corn. The plants would never have done it in the wild. It took man to change the plants. We are also moving toward the **genetic alteration** of plants. We're trying to make plants that are resistant to disease and bugs. These stronger plants will allow our crops to give us more food from the same amount of space.

1. Genetic alteration probably refers to altering what.... _____ (found in the nucleus)