

SCIENCE 701: GOD-DESIGNED PLANT SYSTEMS

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PRODUCTS

We have already discovered two products made as a result of photosynthesis. The leaf factory made oxygen and starch. Plant leaves are also the beginning of many other important foods. Let's see if we can discover how plants can make fats, oils, proteins, and vitamins.

Direct. Some of the leaf factory products are made directly from photosynthesis. Carbohydrates are some of them. Carbohydrates include all sugars and starches. We have learned that starch reacts with an iodine solution and turns blue-black in color.

If you were to moisten a soda cracker and add some drops of iodine you would see the cracker turn blue-black. That means there is starch in the cracker.

Try this . . . Chew up a soda cracker and hold it in your mouth for a minute. Do you notice a change in its flavor? Does it taste sweet?

If you were to check the chewed-up cracker with Tes Tape, you would find its color turn dark green. An enzyme in your mouth has changed the starch to sugar (**glucose**).

Sugar is a simple carbohydrate and starch is a complex carbohydrate.

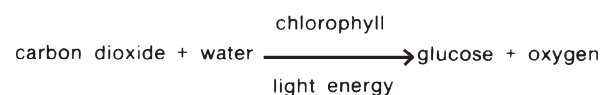


Put a circle around the best answer.

- 1.21 When you chew up a cracker, the starch changes to _____.
a. sugar b. protein c. carbohydrate
- 1.22 Tes Tape is a test for a simple sugar called glucose. The darker the green color of the tape, the more glucose is in the substance being tested. What would Tes Tape show in a chewed-up cracker test?
a. glucose increased b. glucose decreased c. glucose stayed same

The saliva in your mouth contains a chemical called an **enzyme**. Its name is *amylase* (am' uh laez). Amylase has the ability to break starch into a simple sugar **called glucose**. **Plants and animals use** glucose for energy to do work. We know it saves space to stack blocks neatly together. It is also easier and more efficient to stack glucose together as starch until the energy is needed. As many as one thousand glucose units can be stacked together to form one starch unit. When we tested the leaf factory, we found starch. The leaf actually makes glucose first and then stacks up the glucose to save room. Our leaf

factory could more accurately be stated:



Indirect. Glucose can be used by plants to make many other foods. One example of these foods is fats and oils. Some of the most important foods are oils from olives, coconuts, peanuts, and cotton. Often, the fats and oils are stored in the seeds. This high-energy food is used by the seeds at germination time. This use is the Creator's way of making sure that each seed has enough food energy to grow until the new plant can produce its own food.

Proteins are also made from simple glucose. The making of proteins is very complex. Some types of plants are very good protein makers. They have a special bacteria in the roots to help them get the raw materials for the protein. This family of plants is called **legumes**. Beans, peanuts, alfalfa, and soybeans are common examples of legumes. Plants like these are very important in helping us meet our world hunger problems. They provide a nearly

balanced diet.

Plants are excellent sources of vitamins. Unlike animals, plants can make and store **vitamins**. **Green, leafy vegetables** are very good for our diet because of the vitamins. Vitamin A is found in sweet potatoes, carrots, and lettuce. Vitamin B is found in seeds from grain such as wheat, oats, and barley. Citrus fruits and fresh vegetables have a lot of vitamin C.



Complete this chart to show which foods supply vitamin A, B, and C.

1.23

Vitamin	Food Source
A	
B	
C	



Match these items.

- | | | | |
|------|-------|-----------------------------------|-------------|
| 1.24 | _____ | changes starch to sugar | a. starch |
| 1.25 | _____ | plants use glucose to manufacture | b. protein |
| 1.26 | _____ | glucose units stacked together | c. olives |
| 1.27 | _____ | chemical in saliva | d. enzyme |
| 1.28 | _____ | bacteria in roots form | e. legumes |
| 1.29 | _____ | a food rich in oil | f. vitamins |
| | | | g. amylase |

RATE

The rate of speed at which photosynthesis takes place is determined by a number of things just as is the number of cars that come off an assembly line in a day. For example, if the iron and steel are not available, the car body cannot be made. If the

electricity goes off, the machines cannot work. When the workers are gone, no machines will operate. If the raw materials are lacking, no cars can be produced.

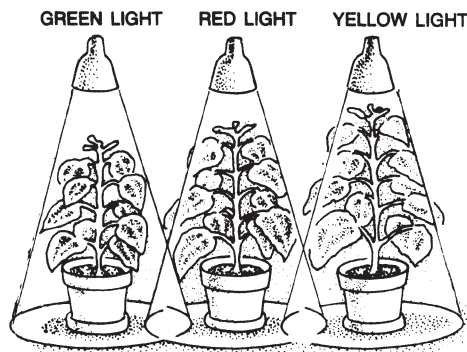
Our leaf factory works the same way. Without the raw materials, no photosynthesis occurs. Let's investigate several ideas scientists have discovered about what determines how fast glucose is made by plants.

Light. We found earlier in this **LIGHTUNIT** that light is necessary to give energy for our leaf factory. Does just any color of light work? The following activity will help answer this question.



Complete the activities by studying the following picture.

DIAGRAM 4



Each of the plants was grown the same way except under different colored lights.



Write your answer on the line.

- 1.30 Which light grows the tallest plant? _____
- 1.31 Which light grows the shortest plant? _____
- 1.32 Which light would you predict to produce the most glucose?

- 1.33 If you were the owner of a greenhouse, which color of light would you use?

- 1.34 Which light would you predict to produce the greenest plant?

- 1.35 We see color of objects because that color bounces off the object and back to our eyes. We see a person's shirt as red because the red color bounces off the shirt and back to our eyes. The other colors are absorbed or soaked up by the shirt like a sponge. Why do you think plants appear green? _____

- 1.36 Which color of light would cause the plant to absorb the least amount of light? _____

Check your answers by the answer key for activities 1.20 through 1.36. If you missed any answers, try to determine why. If you don't understand the key answer, ask for help from your teacher.

Other raw materials. We have found in this **LIGHTUNIT** that carbon dioxide is necessary for plants to grow. Let's see what other raw materials are needed by our leaf factory. For your body to grow strong and healthy, you must eat a variety of foods. **Just candy or potatoes or meat will not** provide you with all the energy, vitamins, and minerals you need. Plants also must have a variety of foods to make them healthy. Minerals and water are taken up through the roots of the plant. The most important minerals are nitrogen compounds, magnesium, calcium, potassium, and phosphorus. Plants need these minerals for the cells to work. The leaf factory cannot produce glucose and oxygen without them. Chlorophyll, for example, must have magnesium before photosynthesis can take place.

Fertilizers added to the soil contain these minerals. Farmers and gardeners use fertilizer to help their crops grow. Most fertilizers are made in factories. Some fertilizer comes from dead plants and animals that have rotted and decayed. **Manure**, the waste product of animals, is a valuable natural fertilizer. Natural fertilizers that come from living things are called *organic* fertilizers. When these fertilizers put minerals back on the soil, they become a form of recycling of natural resources.

Before 1850 (about the time of the Civil War), nearly all fertilizers were organic. Now most fertilizers are factory-made from chemicals. Some scientists are urging farmers and gardeners to return to more organic fertilizers because of the harmful effects

from chemicals. Some cities are selling their waste and sewage to farmers for fertilizers. This type of recycling helps to solve part of the pollution problem and puts natural resources back into use.

Plants do not all need the same amounts of minerals. A farmer or gardener must know much about the plants raised in order to provide the right diet for each plant. **Legumes**, such as alfalfa and soybeans need no soil nitrogen because they can get their nitrogen from the air. Corn needs much nitrogen. You know the difference between the appearance of a cactus and a pine tree. Their needs also differ. Consider the difference between a tropical forest and the **tundra** of the Arctic Circle. The different climates and growing conditions affect the mineral needs of plants. God in His wisdom has created plants to fit these great differences in environment. His creation allows plants to grow wherever animals need food to eat. What a marvelous arrangement!

Yes, leaves are a creation of God. The paper-thin plant tissue could not work like it does without an all-wise Creator. This amazing little chemical factory can, with sunshine and chlorophyll, break carbon dioxide and water apart and make oxygen and sugar. This efficient little factory then goes on to take water and minerals to produce enough living tissue to feed the whole world. Some leaves can even make complex things like gums, waxes, and scents. Other leaves close down their factories for winter, transfer their food to the stem or trunk, and die. In the spring new leaves form to carry on this marvelous work. The leaves of some plants like the chestnut,

oak, and elm are arranged in spirals so each leaf can get the most sunlight. When some leaves get too much sunlight, they fold up or turn away from the sun. God's wonderful leaf produces our food, cleans our air, and gives us a miracle to watch.

A more complete formula portraying photo-

synthesis follows:

carbon dioxide + water + light + minerals $\xrightarrow{\text{chlorophyll}}$ starch + oxygen

The rate at which this takes place is determined by the available amount of sunlight, water, carbon dioxide, and minerals.



Use an encyclopedia to complete the following activities. Answer in complete sentences.

1.37 List three differences between a tropical forest and a tundra that you think would make the mineral needs of the plants different in each climate.

- a. _____

- b. _____

- c. _____

- 1.38 a. What is organic fertilizer? _____
- b. Four things which determine the amount of photosynthesis that can take place in a green plant are the available amount of _____, _____, _____, and _____.
- c. Plants manufacture fats, oils, and protein from _____.



Match these items.

- | | | |
|------|--|------------------------|
| 1.39 | _____ natural fertilizer from animal waste | a. magnesium |
| 1.40 | _____ needed by chlorophyll | b. corn |
| 1.41 | _____ plants not needing soil nitrogen | c. minerals and water |
| 1.42 | _____ needs much nitrogen | d. organic |
| 1.43 | _____ factory fertilizers | e. legumes |
| 1.44 | _____ taken in by plant roots | f. made from chemicals |
| | | g. cactus |



Can you do this photosynthesis puzzle?

- 1.45 P _ _ _ _ _
 _H _ _ _ _ _
 _ _ _ _ O _ _ _ _ _
 _ _ _ T _ _
 _ _ _ _ O _ _
 S _ _ _ _
_ _ _ _ _ Y _ _ _ _ _
 _ _ _ N _ _ _ _ _
 _ _ _ _ T _
 H _ _ _ _ - _ _ _ _ _
_ _ _ _ E _
 S _ _ _ _ _
 _ _ I _ _
 S _ _ _ _ _
1. Food-making process in green plants.
 2. Green matter in plants.
 3. Gas resulting from respiration.
 4. One of the four things which affect rate of photosynthesis.
 5. Another name for simple sugar.
 6. Can change from starch back to this.
 7. Includes sugars and starches.
 8. Nitrogen, magnesium, calcium, potassium
 9. Source of energy in photosynthesis.
 10. Fats and oils are what kind of foods?
 11. A vital gas; by-product of photosynthesis.
 12. Tiny openings on underside of leaf.
 13. Glucose can be used by plants to make fats and ____ ?
 14. Formed from glucose units; by-product of photosynthesis.



Review the material in this section to prepare for the Self Test. The Self Test will check your understanding of this section. Any items you miss on this test will indicate specific areas you need to restudy.