



SCIENCE

STUDENT BOOK

▶ **6th Grade | Unit 1**

SCIENCE 601

Plant Systems

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SCIENCE 600 SUPPLIES

Many of the things that you will need to perform the experiments in Science 600 can be found around the home. For instance, instead of using test tubes, you may substitute baby food jars and lids. Instead of a beaker, you may use a mayonnaise jar. Some of the things you will need to successfully perform the experiments you will just need to borrow or buy. There are resources in your area where you may be able to find these materials. Your local school may lend you a microscope or perhaps you can buy an older one from them when they purchase new ones. There may be major discount department stores in your area that sell these things for low cost. Ordering science material through the mail or over the Internet is also a possibility. With each complete boxed set of science curriculum, you should receive an order blank from a trusted supplier for science supplies in the sizes and amounts that you will need to successfully perform the experiments.

If you did not receive an order blank, call the Alpha Omega Publications Customer Services Department for more information.

A suggested support item for this course is the 6th Grade Science Experiments video, SD0601. The video includes presentations of many of the experiments in this course. Several of the experiments that require special equipment

or materials are demonstrated on these videos. They can either be used for answering the questions of the lab report or as a demonstration of the procedure prior to performing the experiment. A notice is included with each experiment in the LIFEPAK where the video is available.

Remember, it is the supervisors' or parents' responsibility to make sure that all students follow proper safety procedures for experiments and lab work. Any questions that you have about chemicals or supplies should be directed to the supplier of those materials. It cannot be assumed that all necessary warnings and precautions are contained in this material.

As a Christian school curriculum publisher, we discuss what is taught and believed regarding the creation and origins of life on our planet from the Christian point of view. It is the responsibility of the family to decide what they desire to be learned by their students in the school and the home, and whether or not the biblical view is what they want to be taught. There are a number of Christian websites on the Internet, however, that may be examined to get further information on the origins of life from a biblical point of view. One of them is the Creation Research Institute website.



PLANT SYSTEMS

Introduction

God has created all things that exist (Genesis 1:1). God created both living things and other things that are not living. Plants are some of the living things that God created. He designed plants in great detail and with much beauty. Plants are fascinating to study!

In this LIFEPAK[®], you will learn more about the different parts of plants that make it possible for them to live and grow. You will especially look at the leaves, stems, and roots of plants. You will learn about the complex makeup and interactions going on in each of these parts of a typical plant, including the process of photosynthesis. We call these associated parts “plant systems” because they consist of complex, interacting processes occurring within different parts of the plant. You will also learn how people can artificially regulate plants and become better stewards of God’s gifts on earth.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAK. When you have finished this LIFEPAK, you should be able to:

1. Describe how photosynthesis works in plants.
2. Identify what things affect the rate of photosynthesis.
3. Draw and name the important parts of the leaf “factory.”
4. Describe how roots take in water and minerals.
5. Draw, name, and explain the important parts of a root.
6. Tell how stems transport materials up and down through them.
7. Draw, name, and explain the important parts of a stem.
8. Draw, name, and explain the important parts of a leaf.
9. Describe how chemicals regulate plants naturally.
10. Explain how and why people regulate plants artificially.

1. PHOTOSYNTHESIS SYSTEM

In the beginning, God created a great variety of plants. Genesis 1:11-12 records God's creation of plants upon the earth:

And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after his kind, whose seed is in itself, upon the earth: and it was so. And the earth brought forth grass, and herb yielding seed after his kind, and the tree yielding fruit, whose seed was in itself, after his kind: and God saw that it was good.

In Genesis 1:29-31, God "made" and "gave" plants to human beings and animals as food.

Not only did God create a great variety of plants, but He wisely designed plants with great

complexity. When scientists examine plants and attempt to explain how plants operate, they sometimes name parts of the plants, or the processes going on within the plant, "plant systems."

In this section of the LIFEPAK, you will examine the parts of the plant that are involved in *photosynthesis*. As you might recall from previous science studies, photosynthesis is the process by which green plants take sunlight, water, and carbon dioxide in order to produce oxygen and food (sugars). The parts of plants in this process can be called the "photosynthesis system." You will learn about the location, products, and rate of the photosynthesis system within plants.

Section Objectives

Review these objectives. When you have completed this section, you should be able to:

1. Describe how photosynthesis works in plants.
2. Identify what things affect the rate of photosynthesis.
3. Draw and name the important parts of the leaf "factory."

Vocabulary

Study these words to enhance your learning success in this section.

carbohydrate (kär bōhī drā t). Chemical compound made of carbon, hydrogen, and oxygen (such as sugars, starches, and cellulose). It is mostly formed by green plants.

complexity (kəm plek sə tē). A quality of having a number of related units whose relationship is difficult to understand or imperfectly known.

enzyme (en zīm). Chemical used to help digestion.

fertilizer (fer tə lī zər). Chemicals added to plants to aid growth.

glucose (glü kōs). Sugar made during photosynthesis.

legume (leg yüm). A vegetable with seed pods.

manure (mə nūr). Organic (natural) fertilizer.

palisade layer (pal ə sā d lā ə). Layer of cells near the top surface of the leaf which contains the chloroplasts.

respiration (res pə rā shən). Chemical process of cells doing work; breathing.

spongy (spun jē). Soft, light, and full of holes like a sponge.

starch (stă rch). Many glucose units stacked together.

tundra (tun drə). The treeless Arctic plain where the sub-surface ground is always frozen.

Note: All vocabulary words in this LIFEPAC appear in **boldface** print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.

Pronunciation Key: hat, āge, cāre, fār; let, ēqual, tērm; it, īce; hot, ōpen, ōrder; oil; out; cup, pūt, rŭle; child; long; thin; /FH/ for then; /zh/ for measure; /u/ or /ə/ represents /a/ in about, /e/ in taken, /i/ in pencil, /o/ in lemon, and /u/ in circus.

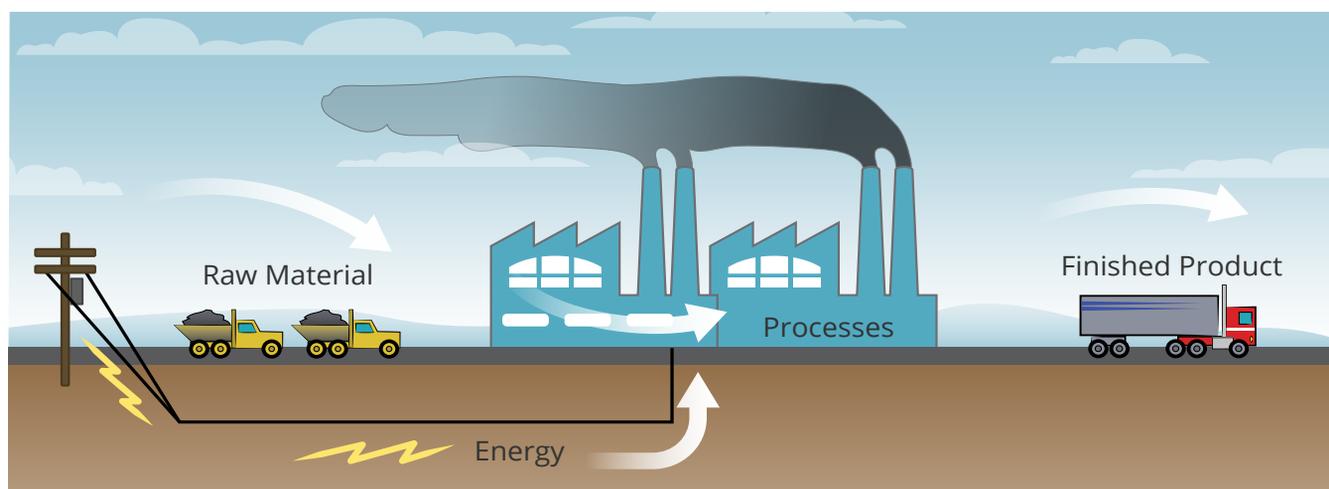
LOCATION OF PHOTOSYNTHESIS

In most plants, the main photosynthesis system is located within the *leaves*. The leaf of a plant works something like a “factory.” Perhaps you have seen a factory in your town or city. A factory is a place where things are made. First, raw materials go into the factory. Then, the factory uses energy to process these materials into usable things. Finally, finished products come out of the factory. The leaf of a green plant works just like that!

In the plant “factory,” the main raw materials going in are water and carbon dioxide. Then, through the process of photosynthesis, the finished products are made into oxygen and food. The food is made in the form of sugars. All green plants make this food (sugars). Although leaves may vary in size, shape, and form, they are all food makers. If it were not for these wonderful

food “factories,” animals and human beings could not live. Let’s study this photosynthesis system in plants (the food factory) to see how it works.

Leaves. Leaves have several important parts. If we cut across a leaf and viewed it under a microscope, we would see something like what is shown in figure 1. Notice that the inside of the leaf consists of two layers: the **palisade layer** and the **spongy** layer. Within the palisade layer, you will notice some oval-shaped cells called *chloroplasts*. As you may have learned in earlier LIFEPACs on cells and plants, the chloroplasts contain *chlorophyll*. Chlorophyll gives leaves and plants their green color. The chlorophyll is used in the photosynthesis process when sunlight shines on it.



| A factory

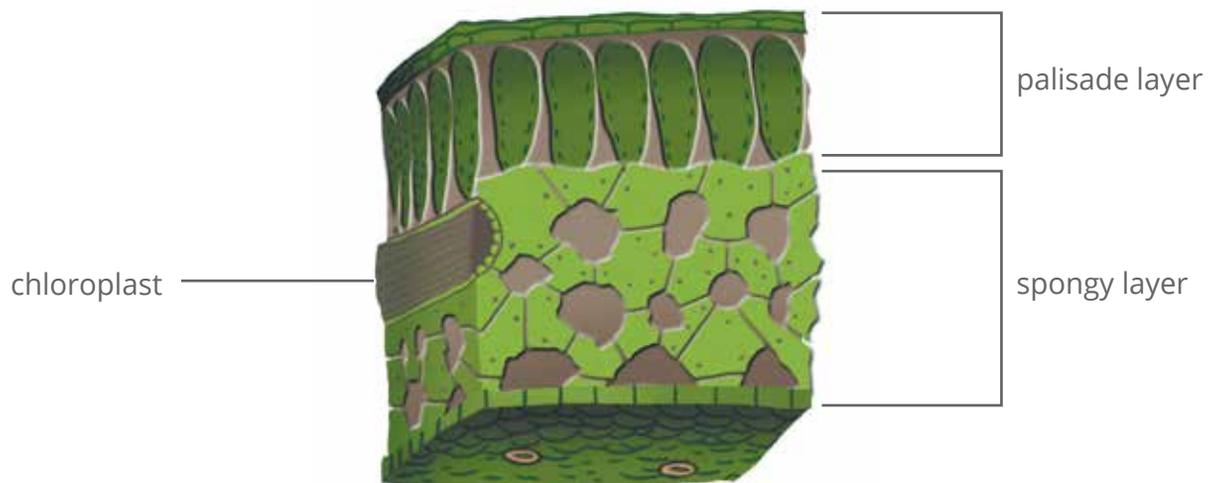


Figure 1 | Leaf Cross Section

In Figure 1, notice that not all of the parts of the leaf are labeled. We will study some of the parts of the leaf because they are used in the photosynthesis system. Other parts of the

leaf will be studied later in this LIFEPAK. Let us conduct an experiment to learn more about the photosynthesis process in plants.



Try this experiment to learn about photosynthesis.



View 601 Photosynthesis Lab, from the Grade 6 SCIENCE EXPERIMENTS Video.

Overview. *Anacharis** is a common freshwater plant that undergoes photosynthesis rapidly. Photosynthesis is the combining of water and carbon dioxide using light energy in the presence of chlorophyll cells to produce sugar and oxygen. Although we cannot observe this chemical reaction as it occurs, we can observe the rate at which it occurs using *Anacharis*. Tiny bubbles of oxygen are given off by the *Anacharis* leaves as it undergoes photosynthesis. We can observe the rate of photosynthesis by observing the rate and amount of oxygen bubbles produced by *Anacharis*.

These supplies are needed:

- A few sprigs of *Anacharis** (also known by its scientific name of *Elodea*).
- Two large test tubes (about 6 inches long) or two large baby food jars.
- Two clear disposable cups with lids or two small clear baby food jars.
- Some kind of larger container that can hold the smaller ones while allowing you to get your hands in and out of it easily.

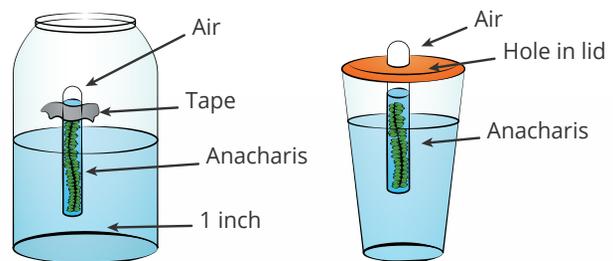
**Note: Anacharis can typically be obtained from a local pet store that has fish and aquarium supplies. However, it may not be available in some states or countries. Cabomba (Carolina Fanwort) is a good alternative but might not be available in some places. Ask the pet/aquarium supply store for another recommendation if neither of these is available where you live.*

Experiment 601.A Photosynthesis Lab

(continued on next page)

Follow these directions carefully. Place a check mark in the box as you complete each step in these directions.

1. Cut a 3-inch piece from the tip of two different Anacharis sprigs. Try to find two 3-inch sprigs that have almost the same size and number of leaves per inch. Gently flatten the leaves of each sprig from the end of the stem to the cut tip, so they will slide easily into the test tube.
2. Fill the two clear cups or jars 3/4 full of water.
3. Fill the test tube full of water and carefully insert one of the Anacharis pieces you cut, tip first, until the end of the stem is even with the bottom of the test tube.
4. Put your thumb over the open end of the test tube to seal a little air in the tube. Tip the test tube upside down and insert it upside down in one of the cups or jars of water before removing your thumb. The test tube should be full of water with only a very small air space at the top. You may have to try this a few times to get it right.
5. If you are using a disposable cup and lid, cut a small circle in the cup lid until it fits tightly over the test tube. Put the lid over the test tube and seal it on the cup. Then, pull the test tube through the lid a little further until the test tube lip is about 1" above the bottom of the cup. The snug-fitting cup lid will hold the test tube in this position. If you are using a jar, hold the test tube about 1" above the bottom of the jar and secure it to the side of the jar in this position with a piece of tape.
6. Repeat steps 3-5 with the other piece of Anacharis, test tube, and cup or jar.
7. Place one apparatus in a dark room or closet where it will not be disturbed. Place the other under a bright lamp. After an hour, observe the Anacharis in both test tubes. Tiny bubbles of oxygen will be observed on the leaves of the Anacharis under the bright light. You may even observe a steady stream of tiny oxygen bubbles rising from the Anacharis. The rate of oxygen bubbles produced indicates the rate of photosynthesis. Now observe the Anacharis in the dark room. Where is photosynthesis occurring more rapidly?
8. After 24 hours, observe both plants again. Does one test tube have a larger air bubble at the end of the test tube? Which one? What does this indicate?



Experiment 601.A Photosynthesis Lab



Complete the following activity based on the photosynthesis experiment.

1.1 Write your report of what happened with the Anacharis and the test tubes of water. _____

Answer the following questions about your investigation.

- 1.2** Did both sprigs of Anacharis produce oxygen? _____
- 1.3** Which produced the most? _____
- 1.4** What is necessary for photosynthesis to occur? _____
- 1.5** What factor affected the rate that photosynthesis occurred? _____

Answer the following questions by reviewing Figure 1.

- 1.6** The green matter in plants that helps photosynthesis occur is called chlorophyll. What are the small oval bodies called that contain the green chlorophyll? _____
- 1.7** What layer contains most of the chlorophyll? _____
- 1.8** Is this layer on the top or the bottom of the leaf? _____

TEACHER CHECK



_____ initials

_____ date

We have now learned that the photosynthesis system needs chlorophyll to work. The chlorophyll is contained in the tiny oval chloroplasts. Leaves also have color in them. In the fall, when the leaves change color, the chlorophyll dies. This lets us see the other colors in the leaves. These colors were there all the time, but the green chlorophyll covered them.

Any factory that makes a product needs energy. Some factories use electrical energy, some use mechanical energy from water, and some use energy supplied by people. The leaf factory also needs energy to operate! In most factories, energy costs money. In the leaf factory, energy is free! Let's see if we can find out how it works in the next experiment.



Try this experiment to learn about seed sprouting.



View 601 Seed Sprouting Lab, from the Grade 6 SCIENCE EXPERIMENTS Video.

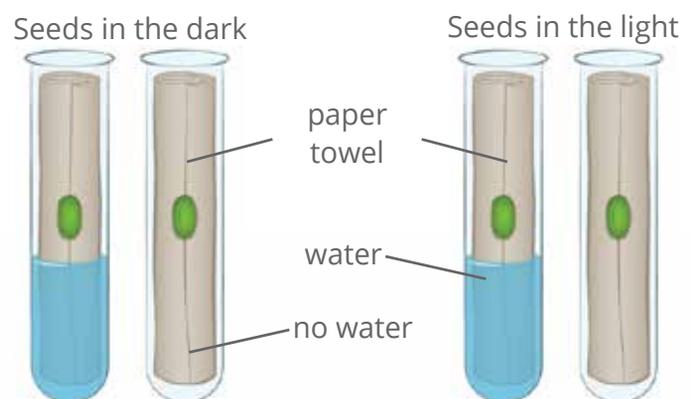
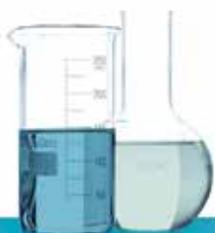
Overview. You will examine the effects of light energy and moisture on the growth of plants. You will also determine the effect of chlorophyll on the growth of plants.

These supplies are needed:

- 4 kernels of corn or beans
- 4 test tubes or four tall slender jars
- 4 paper towels
- water

Follow these directions carefully. Place a check mark in the box as you complete each step in these directions. (Notice that it will take several days to complete this experiment.)

1. Set up the investigation as shown in the illustration below. Place the kernels flat against the glass, held in position by the towel. Keep the towels wet in the wet seed tubes for the whole experiment.
2. Place one tube with water and one without water in a completely dark place.
3. Place one tube with water and one without water in a completely sunny place.
4. In 1.9, record the changes every two days. Continue until the plants are above the growing containers by at least 10 centimeters.
5. While you are doing this experiment, you will have time to prepare a report of about 200 words to describe what your life and life on the earth would be like without plants. Remember what the main by-product of plants is that the rest of life depends upon. Prepare an outline first, then write the report. Hand both in to your teacher with this LIFE PAC study.
6. When you have completed the experiment, clean up and return all materials to their proper places.



Experiment 601.B Seed Sprouting



Complete the following activities based on the seed sprouting experiment.

1.9 Record in the chart the changes you observe.

DATE	SEEDS IN THE DARK		SEEDS IN THE SUN	
	Wet seed	Dry seed	Wet seed	Dry seed

1.10 Which seeds grew the most, wet or dry? _____

1.11 Which seeds grew the most, those in the dark or in sunlight? _____

1.12 What two things does this experiment show that are necessary for plants to grow larger?
 a. _____ and b. _____

1.13 Were the greenest plants in the sunlight or the darkness? _____

1.14 Which had the most chlorophyll? _____

1.15 What must be present for photosynthesis to occur in plants? _____

1.16 What is the source of free energy for the "leaf factory"? _____

1.17 Look again at Figure 1 in this section of the LIFE PAC. What layer contains most of the chloroplasts? _____

1.18 Is this layer near the top or bottom of the leaf? _____

1.19 Why do you think the leaf factory is designed this way? (Hint: Remember this factory needs light energy to work.) _____

TEACHER CHECK



_____ initials

_____ date

SELF TEST 1

Match the following items (each answer, 2 points).

- | | | |
|-------|--|-------------------|
| 1.01 | _____ by-product of photosynthesis | a. starch |
| 1.02 | _____ tiny oval bodies containing chlorophyll | b. electricity |
| 1.03 | _____ many glucose units stacked together | c. carbon dioxide |
| 1.04 | _____ energy used in leaf factory | d. trees |
| 1.05 | _____ by-product of breathing | e. chlorophyll |
| 1.06 | _____ layer containing most of the chloroplast | f. fats and oils |
| 1.07 | _____ single-celled organisms that are unable to carry on photosynthesis | g. chloroplast |
| 1.08 | _____ green matter in leaves | h. oxygen |
| 1.09 | _____ high energy food stored in plants | i. ptyalin |
| 1.010 | _____ enzyme in the mouth | j. protein |
| | | k. palisade |
| | | l. light |
| | | m. bacteria |

Complete the following sentences (each answer, 4 points).

- 1.011 The light color most important to plant growth is _____ .
- 1.012 Starch breaks up into simple units called _____ .
- 1.013 By-products of photosynthesis are glucose and _____ .
- 1.014 A type of fertilizer that recycles natural resources is called _____ .
- 1.015 Four things that affect the amount of photosynthesis a plant can produce are
- a. _____ . b. _____ ,
- c. _____ and d. _____ .
- 1.016 The leaf factory has two layers which have most of the chlorophyll. They are the
- a. _____ and b. _____ layers.

Write the correct letter on the blank (each answer, 2 points).

- 1.017** Iodine solution turns _____ bluish-black
 a. sugar b. starch c. fats d. protein
- 1.018** _____ turns red in a glucose solution.
 a. Paper towel b. Potato
 c. Benedict's solution d. Litmus
- 1.019** The mineral needed for chlorophyll to work is _____ .
 a. water b. nitrogen c. sulfur d. magnesium
- 1.020** When plants and animals die and decay, they become _____ .
 a. useless b. fertilizer c. harmful d. bluish-black
- 1.021** Plants manufacture _____ from glucose.
 a. minerals b. water c. nitrogen d. protein
- 1.022** The color of light least good for growing plants is _____ .
 a. green b. blue c. orange d. red
- 1.023** A plant takes minerals, water, sunlight, and carbon dioxide, and produces glucose and _____ .
 a. methane b. oxygen c. water mist d. ether
- 1.024** An object has the color it does because the color _____ .
 a. bounces back b. is used up c. is soaked up d. spreads out
- 1.025** Most of today's _____ is made in factories from chemicals.
 a. food b. wood c. fertilizer d. protein
- 1.026** A simple plant called _____ carries on photosynthesis in each cell.
 a. cactus b. bacteria c. coleus d. algae

Complete the following activities (each answer, 5 points).

1.027 Describe how photosynthesis works in a plant leaf factory.

1.028 Describe one of the investigations you did in this section.

1.029 In the space below, draw a picture of the inside of a leaf factory. Label the parts we studied in Section 1.

1.030 Imagine you wanted to grow the best plants you possibly could grow. From what you learned in Section 1, explain what you would do.

	SCORE _____	TEACHER _____	initials	date
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