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SCIENCE

STUDENT BOOK

8th Grade | Unit 9

Alpha Omega PUBLICATIONS

SCIENCE 809
Balance In Nature

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Balance In Nature

Introduction

If you could step away from earth for a moment, as the astronauts have done, you could easily see that the earth is an isolated planet. This planet can function only if all its systems are kept in balance. The sun is the only source of energy entering the system. Plants capture solar energy and convert carbon dioxide and water into food. This food supplies animals who digest it and give off carbon dioxide. Great advances have been made in agriculture that would startle the food gatherers of the past.

The elements of the earth are constantly recycled. Each element is part of a system and is used over and over again. Nitrogen, water, carbon, and oxygen are elements in the main endless cycles that insure a constant supply for plant growth and animal nutrition. The decay cycle involves the breakdown of organic matter and prevents dead organic matter from stockpiling in the earth.

Natural controls keep animal and plant populations in balance. Humans have brought pressure on both the environment and the natural resources. They are the only species able to control the environment and to make decisions that will affect the future. Scientists and concerned citizens are searching for answers, and the Bible declares (Proverbs 29:18), “Where there is no vision the people perish....”

Objectives

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

1. Explain the leaf structures involved in photosynthesis.
2. List the nine requirements for plant growth.
3. Write a balanced equation for photosynthesis.
4. List the three major advances of modern agriculture.
5. Describe the hybrid plants and tell why they are so important.
6. Tell why some people are hungry and what can be done to help solve the problems of hunger.
7. Describe the relationship between Rhizobium bacteria, legume plants, and soil fertility.
8. Name the two important groups of decomposers and tell two values of decay.
9. Describe how water is recycled through precipitation, ground water, and transpiration.
10. Describe how the carbon dioxide of animal respiration and the oxygen of photosynthesis are involved in a cycle.
11. Define ten ecological terms.
12. Cite four human pressures on the environment and give an example of each.
13. List eight natural resources and give one way of conserving each resource.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. PHOTOSYNTHESIS AND FOOD

The earth is an isolated planet. Energy comes from the sun, but nothing else enters or leaves planet *Earth.* Plants are basic to the existence of animals. Plants can use the energy from the sun and can produce complex molecules that serve as food for all animals. Plants also provide a constant source of oxygen for animal respiration.

Great advances in agriculture have been made since ancient people gathered berries and roots for survival. Today food production has increased with the use of machinery, farm chemicals, and **hybrid** plants. Scientists are constantly searching for improved techniques. Not all nations share equally in this new technology.

SECTION OBJECTIVES

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

1. Explain the leaf structures involved in photosynthesis.
2. List the nine requirements for plant growth.
3. Write a balanced equation for photosynthesis.
4. List the three major advances of modern agriculture.
5. Describe hybrid plants and tell why they are so important.
6. Tell why some people are hungry and what can be done to help solve the problems of hunger.

VOCABULARY

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

catalyst (kat′ u list). A substance that brings about a change without being altered.

chlorophyll (klôr´ u fil). The green pigment found in most plants.

chloroplast (klôr´ u plast). A special cell body containing chlorophyll.

epidermis (ep′ u dėr′ mis). The outer layer of cells on the leaf.

glucose (glü′ kōs). The simple sugar formed during photosynthesis.

guard cell (gärd sel). A special cell that regulates the stomata.

hybrid (hī′ brid). The result of a cross between two unlike animals or plants.

photosynthesis (fō′ tu sin′ thu sis). The process of plants converting carbon dioxide and water into glucose and oxygen.

protein (prō′ tēn). An organic molecule containing nitrogen.

starch (stärch). A chain of simple sugar units.

stoma (plural stomata) (stō′ mu). Small pore in a leaf.

sugar (shu̇g' ur). A simple organic compound of carbon, hydrogen, and oxygen such as the glucose molecule produced in photosynthesis.

trace elements (trās el' u munts). A group of elements that are needed in very small amounts for plant growth.

transpiration (tran' spu rā' shun). The loss of water through stomata.

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: h**a**t, **ā**ge, c**ã**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u̇**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /*ŦH*/ for **th**en; /*zh*/ for mea**s**ure; /*u*/ represents /*a*/ in **a**bout, /*e*/ in tak**e**n, /*i*/ in penc**i**l, /*o*/ in lem**o**n, and /*u*/ in circ**u**s.

PHOTOSYNTHESIS

Photosynthesis is a complex chemical reaction that takes place mainly in the leaves of plants. Special bodies called **chloroplasts** contain the **chlorophyll** necessary for energy absorption.

The Structure. The leaf is the basic center for photosynthesis. Most leaves are flat with a large surface area. Leaves are also often oriented to the sun to capture available light. The surface, or **epidermal** layer, of leaf cells is covered with a waxy layer that reduces water loss. Photosynthesis occurs in the inner cells of the leaf where the chlorophyll is found.

Chlorophyll is the green pigment found in the interior cells of most leaves. It acts as a **catalyst** during photosynthesis. A catalyst is a substance that changes the rate of a reaction without being altered itself. Chlorophyll is responsible for absorbing energy from light and passing it through a cycle. This cycle converts the energy into a form the plant can use and store. Chlorophyll is located in small cell bodies called chloroplasts. Chloroplasts are found in the interior cells of leaves and in one type of surface cell.

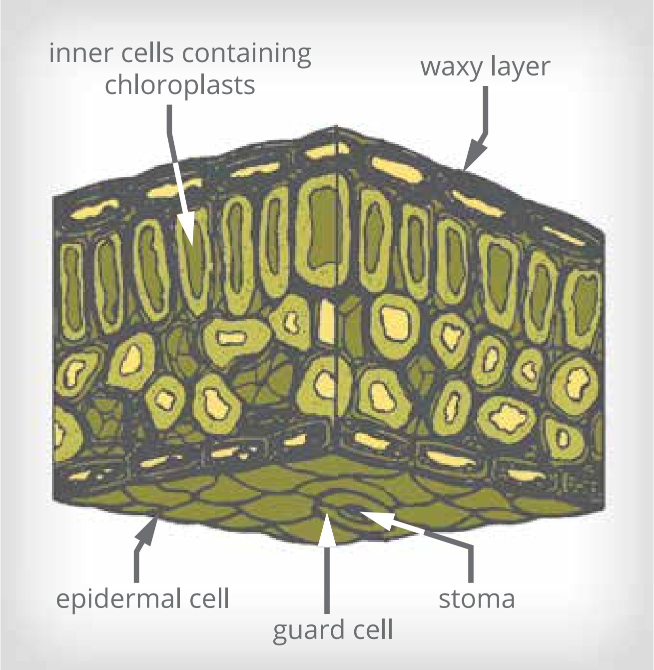

Figure 1 | Cross Section of a Typical Leaf

Plants can also have orange and yellow pigments. In the autumn chlorophyll is no longer produced by the leaf; therefore, the yellow and orange pigments show through. Some leaves also produce a red pigment under cool fall conditions. This pigment gives the typical red autumn color of maples and sumacs.

Try this investigation.

These supplies are needed:

- eye dropper
- microscope
- leaves from two unlike plants
- new single-edged razor blade
- cover slip
- glass slide
- water

Follow these directions and complete the activities.
Put a check in the box when each step is completed.

☐ 1. Roll a leaf lengthwise into a tight roll.

☐ 2. Carefully cut thin slices of the leaf roll. Make some slices so thin that you almost end up with nothing.

☐ 3. Mount the thinnest pieces in water. Drop on the glass slide and cover with a cover slip. The leaf sections should look like tiny threads. If they are larger, keep slicing until you have thinner pieces.

☐ 4. Search through the microscope until you find a section that looks like Figure 1.

1.1 In the space provided, Leaf 1, draw what you see.

☐ 5. Repeat Steps 1 through 4 using a leaf from another type of plant.

1.2 Draw the second leaf in the space, Leaf 2, provided.

Leaf 1

Leaf 2

TEACHER CHECK ______ initials ______ date

Leaf Structure Experiment

Complete these sentences.

1.3 Leaves have a waxy coating to ____ .

1.4 Chlorophyll is found in small packets called __________________________ .

1.5 Plant pigments can be of four colors: a. _________________ , b. _________________ ,
c. _________________ , and d. _________________ .

Stomata (singular: stoma) are openings in the leaf surface, mainly on the underside. Carbon dioxide enters the leaf through the stomata, and water and oxygen escape through the stomata. A leaf may have 300,000 stomata. Two special cells called **guard cells** control the size of the opening. Unlike other leaf epidermal cells, guard cells do have chlorophyll. When light strikes the chloroplasts of the guard cells, the cells bow and an opening develops (Figure 2). Carbon dioxide can now enter the cell and photosynthesis occurs. When the light is gone, the guard cells shrink and come together. The stoma is now closed. The stomata also closes when conditions are dry.

Water vapor escapes from the leaf also through the stomata. This water loss is called **transpiration**. On a warm day a corn plant loses as much as two liters of water. Evaporation of the water provides a cooling system for the plant. The plant may die if high temperatures continue for long or if no soil moisture is available to replace lost water.

Desert plants have a variety of adaptations to combat the loss of water through transpiration. Desert shrubs have small leaves with few stomata. Other desert plants form leaves only when sufficient moisture is available for growth. They drop their leaves when the soil becomes dry. Cacti have only spiny leaves and carry on photosynthesis in their thickened stems.

Plants need light, water, carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, and about ten other chemical elements. The carbon comes from the carbon dioxide of the air.

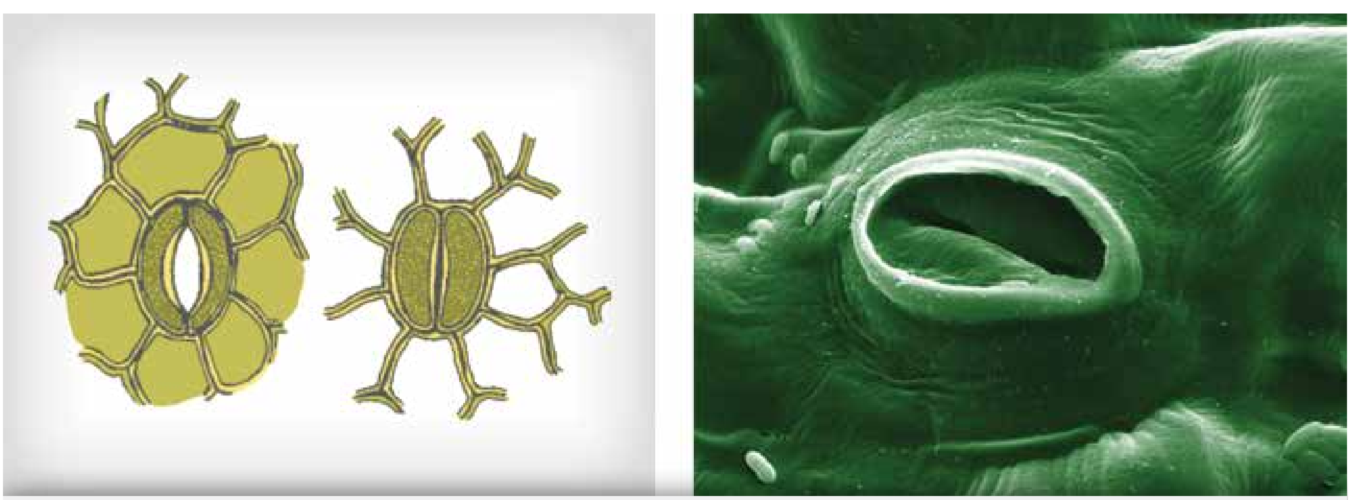

Figure 2 | Guard Cells

Oxygen comes both from the atmosphere and from the water molecule. Hydrogen is obtained from water; and nitrogen, from compounds produced by soil bacteria. Phosphorus and potassium are found in the soil along with the ten other elements. The ten additional elements are only needed in trace amounts and are called **trace elements**. Most soils are not lacking in trace elements.

The three elements commonly lacking in cultivated soil are nitrogen, phosphorus, and potassium. These three elements are added to the soil by using artificial fertilizer. Nitrogen, phosphorus, and potassium are always listed in the same order on any fertilizer package. A label that lists 30-19-11 means that the product contains 30 percent nitrogen, 19 percent phosphorus, and 11 percent potassium. The consumer is expected to know the order of the elements and that the numbers indicate percent. Nitrogen is necessary for green foliage and rapid plant growth. Phosphorus encourages strong roots and stems. Potassium aids the plant in disease resistance.

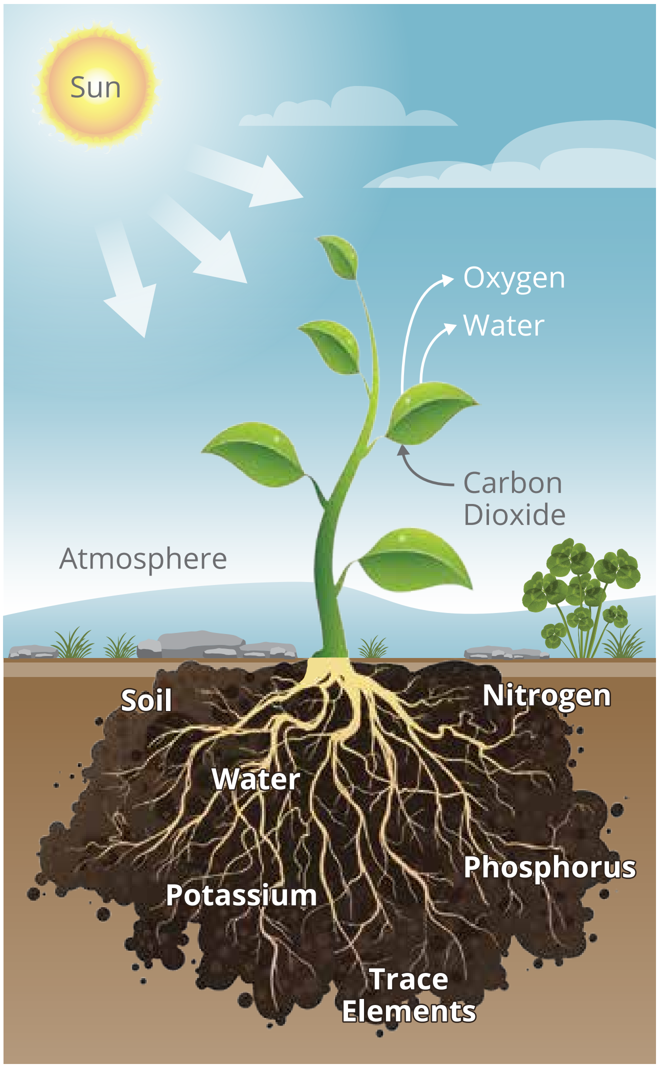

Figure 3 | Plant Needs

Try this investigation.

These supplies are needed:

- 250-milliliter beaker of freshly picked leaves
- clear plastic bag to hold the leaves
- fastener

Follow these directions and answer the questions. Put a check in the box when each step is completed.

☐ 1. Place the leaves in the plastic bag and close securely.

☐ 2. Place the bag in the light but not in the hot sun.

☐ 3. Observe at the end of twenty-four hours.

1.6 What happened inside the bag? ______________________________

____

1.7 What plant process does this change demonstrate? ______________________________

1.8 How did the water escape from the leaves? ______________________________

____

1.9 What result would you have expected if you had put a cactus plant in the bag? ______________________________

____

1.10 Why are cacti adapted to low water loss? ______________________________

____

Transpiration Experiment

Answer this question by matching the following items. Where do plants obtain these requirements?

1.11 _______ carbon
1.12 _______ hydrogen
1.13 _______ oxygen
1.14 _______ nitrogen
1.15 _______ trace elements
1.16 _______ water
1.17 _______ light

a. sun
b. precipitation
c. carbon dioxide
d. bacterial action in soil
e. carbon dioxide and atmosphere
f. water molecule
g. soil
h. chlorophyll

Answer these questions.

1.18 Where are stomata found? ____

1.19 What cells regulate the opening and closing of the stomata? ____________________
____

1.20 What may happen if plants have no soil moisture? ____________________
____

1.21 What is the purpose of stomata? ____________________
____

1.22 How do cacti survive in the desert? ____________________
____

1.23 Three elements are commonly found in bags of fertilizer. What are they and what does each do for the plant.

a. ____

b. ____

c. ____

Complete these sentences.

1.24 Water escaping from a leaf through the stomata is called ____________ .

1.25 Elements that are needed by a plant in very small amounts are called ____________________________ .

1.26 The common green pigment found in plants is called ___________________ .

1.27 Leaves are usually thin and flat to provide ___________________ .

1.28 Desert shrubs' leaves are adapted to the dry climate by having very few ___________________ .

The chemistry. For centuries no one understood photosynthesis. People assumed that plants grew by extracting material from the soil. The first scientific experiment to investigate plant growth was done by Van Helmont (1577-1644) in the early seventeenth century. He potted a young willow in a container of soil after carefully weighing the tree and the soil. For five years this Belgian scientist faithfully cared for the willow. He gave it only rain water. Five years later Van Helmont removed the willow from the soil and reweighed the tree and the soil. The willow had gained 72 kilograms but the soil had lost .057 kilograms. The loss by the soil was not enough to account for even a fraction of the increase in willow. Van Helmont incorrectly assumed that the increase in plant material came from the rain water. This experiment was a start in the search for an explanation of plant growth.

Scientist are still studying the chemistry of photosynthesis, but the general framework is understood. Plants convert carbon dioxide and water into a simple **sugar** using light as the energy source and chlorophyll as the catalyst.

Six molecules of carbon dioxide from the air are combined with twelve molecules of water. Light acts as the energy source, and chlorophyll is the energy absorber for the formation of one molecule of **glucose** (a simple sugar) and six molecules of oxygen. The oxygen is considered a waste product and leaves the plant through the stomata, see Equation 1.

Photosynthesis occurs in two steps. The first step requires light and is often called the *light phase*. When light strikes a molecule of chlorophyll, the molecule is changed slightly. This changed molecule is able to split water into hydrogen and oxygen. Ions are atoms or groups of atoms that have lost or gained electrons which gives the particles an electric charge. A new form of energy is produced that can be stored later in the reaction. When the water molecule is split, the oxygen is released from the plant; but the hydrogen remains. This oxygen is very important to the animal life of our planet. Plants are the only common source of atmospheric oxygen on our planet.

The second step of photosynthesis does not require light and is called the *dark phase* even though it can and does also occur in the light. The energy has already been absorbed by the chlorophyll. The reaction can continue whether or not light is currently available. The stored energy from the first step now allows the carbon dioxide to react with the hydrogen ions to form glucose and water. Water is the waste product of the second step and escapes from the plant through the stomata. The carbon dioxide in the atmosphere is a product of animal respiration. Plants could not live without animals to produce the carbon dioxide.

Equation 1: Total Photosynthesis

$$6\ CO_2 + 12\ H_2O \xrightarrow[Chlorophyll]{Light} C_6H_{12}O_6 + 6\ O_2 + 6\ H_2O$$

Equation 2: The Light Phase

$$2\ H_2O \xrightarrow[Chlorophyll]{Light\ activated} 4\ H^+ + O_2$$

Equation 3: The Dark Phase

$$6\ CO_2 + 24\ H^+ \rightarrow C_6H_{12}O_6 + 6\ H_2O$$

Photosynthesis

Glucose is a simple sugar that is easily converted to **starch**. Starch is a long chain of these simple sugar units. Starch is stored in the leaf temporarily. In the dark phase starch is converted back into glucose and is transported to the storage areas of the plant.

A variety of plant parts serve as storage areas. Roots, leaves, stems, fruits, tubers, flowers, and seeds can all be used by the plant as reservoirs of food. Glucose can be converted to other compounds in the final storage area.

Starch is a common storage chemical of vegetables such as potatoes and corn. A complex sugar called *sucrose* is abundant in sugar cane, where it is concentrated in the stem. In sugar beets sucrose is formed and stored in the root. These two plants are used as commercial sources of common table sugar. Many ripe fruits contain sucrose and other sugars, which give them their sweet taste.

Seeds and nuts were highly prized by ancient people as well as by modern man. Seeds and nuts are high in **protein**, fats, and oils. Proteins are organic molecules containing nitrogen. Animals need protein to build their own cells and must obtain their protein requirements from plants or other animals. Fats and oils are high in energy. They yield about twice as much energy by weight as sugars or starches yield.

Complete the chart. Use a dictionary or ask your parent. Each of the following plants stores food that is used as food by humans. Put a check in the column that indicates what part of the plant is served as food.

1.29

	leaf	fruit	seed	stem	flower	root	tuber
a. carrot							
b. cabbage							
c. cauliflower							
d. coconut							
e. rhubarb							
f. beet							
g. artichoke							
h. wheat							
i. cherry							
j. corn							
k. sugar cane							
l. spinach							

1.29

	leaf	fruit	seed	stem	flower	root	tuber
m. yam							
n. radish							
o. asparagus							
p. broccoli							
q. pea							
r. potato							

Complete these activities.

1.30 Pretend that you are the engineer appointed to design a spaceship that will be gone from the earth for twenty years. Food will have to be grown on the ship. No supplies can be brought to the ship once it leaves the earth. The spaceship will be completely sealed so that you will have to provide carbon dioxide, oxygen, and water. In your best English write a 500-word theme about your design.

TEACHER CHECK ____________ ____________
initials date

Match these items.

1.31 ________ fruit
1.32 ________ nuts and seeds
1.33 ________ vegetables
1.34 ________ fats and oils
1.35 ________ dark phase
1.36 ________ light phase
1.37 ________ starch
1.38 ________ glucose
1.39 ________ sun
1.40 ________ oxygen
1.41 ________ carbon dioxide

a. oxygen released
b. source of all energy
c. simple sugar
d. complex sugar
e. high energy
f. epidermal waxy coat
g. source of starch
h. oils, fats, and proteins
i. source of carbon in photosynthesis
j. a chain of simple sugar units
k. necessary for animal respiration
l. water released

Complete this activity.

1.42 Complete this equation and balance it.

$$\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_ \xrightarrow[\_\_\_\_\_\_\_\_]{\_\_\_\_\_\_\_\_} C_6H_{12}O_6 + \_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_$$

Answer these questions.

1.43 What is the source of the carbon in glucose? ________________

1.44 What is the energy source for photosynthesis? ________________

1.45 Why are animals so important to plants? ________________

1.46 Where does the carbon dioxide in the air come from? ________________

____

1.47 What would happen to plants if all of the animals in the world should die? ________

____

1.48 What two things would happen to animals if all the plants in the world should disappear?

a. ________________________________

b. ________________________________

FOOD

In the past, food was often scarce and of poor quality. Ancient people had to spend much time and energy avoiding starvation. Modern agriculture has solved the food problems in advanced countries. Inventors and scientists have developed machines, chemicals, and **hybrid** plants that make food production more efficient. Unfortunately, these advances have not spread to all nations.

Food production in the past. At the Creation, God provided food for mankind and animals. He gave the green plants for their food (Genesis 1:29, 30). In the Garden of Eden, food was plentiful and easily obtained. After sin entered the world, the ground was cursed, thorns and thistles grew, and people would have to work hard to get their food (Genesis 3:17-19). Cain was a tiller of the ground, and Abel kept a flock of sheep, possibly for sacrifices.

After the Flood, in addition to plants for food, God also gave the people meat (Genesis 9:2-4). Animals, birds, and fish became fearful of people. Human beings could grow fruit and vegetables in their own fields and hunt animals for food. Animals were domesticated and raised for food.

In some areas people had to move often in search for food. Some people settled near rivers and lakes because fish were easier to catch and were a more reliable food source than animals.

Although most plants store food somewhere in their tissues, the food is not always in a form usable by humans. The cell walls of plants cannot be digested in the human stomach. Grass is often abundant, but it is not a human food for this reason.

Food gathering and ancient farming could not support many people. The basic principles of plant and animal breeding and agricultural practices were not known until the late nineteenth and twentieth centuries. Farmers could only use trial and error in choosing which animals to pick for reproduction.

Complete this chart. Compare your life with the life of someone of your own age who lived in ancient times.

		You	Ancient Friend
1.49	dinner	a.	b.
1.50	clothing	a.	b.
1.51	education	a.	b.
1.52	recreation	a.	b.
1.53	possessions	a.	b.
1.54	transportation	a.	b.
1.55	health	a.	b.

Food production today. The Industrial Revolution of the nineteenth century brought about a major change in agriculture. Crop production was slow and depended upon heavy hand labor. Beginning in the 1860s, machines such as McCormick's reaper were invented. That machine did the work of eight people. Soon other machines were developed for almost every aspect of agriculture. Farmers could cultivate and harvest larger fields in a fraction of the time formerly required.

Trains could transport machines from factories to the farms. Crops could be quickly transported back to the cities. Now cattle and crops could be raised in suitable areas miles away and be brought into the populated areas to be sold. Farming changed from being a family growing food only for home use into a larger business operation. Then a family might sell the entire crop or herd each year and consume only a small portion of the harvest on the farm.

Today, the farmer has an array of chemicals that can kill insects (insecticides), kill weeds (herbicides), and supply nutrients to the crops (fertilizers). The wise use of chemicals can greatly increase crop yields.

Before modern agriculture the only way to grow more food was to put more land into cultivation. The development of machinery, chemicals, and hybrid plants meant that fewer people could grow more food in less time without needing any additional ground.

The role of the scientist in food production. Gregor Mendel, an Austrian monk, carried out extensive plant breeding experiments in the 1860s. He used garden peas to investigate the laws of inheritance. People had always thought that all plant characteristics always showed up in the plant. Mendel showed that this hypothesis was wrong by crossing two garden pea plants. He used one plant that produced green peas and another that yielded yellow peas. All

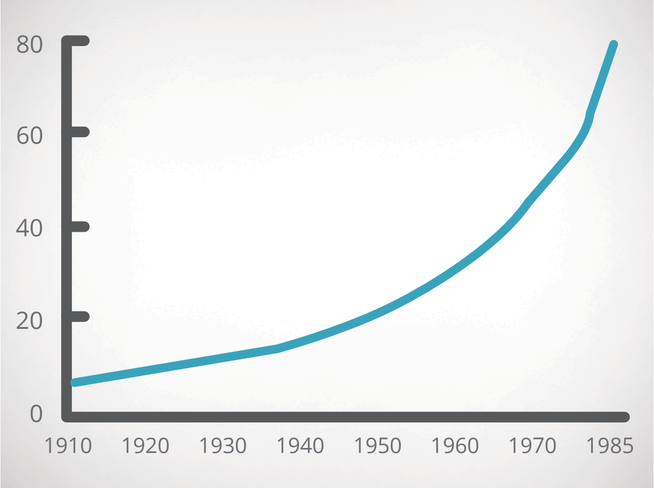

Figure 4 | The Number of People Fed by One United States Farmer

the resulting plants had yellow pea seeds. Now he crossed two of these new plants and found that their offspring varied. Three-fourths of the plants had yellow peas and one-fourth of the plants had green peas. Somehow the factor for green peas had been hidden in the yellow peas for generations. This experiment showed that plants could carry characteristics that were not apparent in the plants. Unfortunately, Mendel's work remained unknown and undiscovered until about 1900.

Luther Burbank (1849-1926) was a devoted plant breeder whose efforts gave the world over eight hundred new varieties of plants. He was not a trained scientist, but he did use basic scientific principles. The findings of Mendel were not available to him when he started his work. Burbank was born in Massachusetts, and his first plant success was a new potato. He sold the seeds of this potato to finance his move to California. There he operated a research farm at Santa Rosa. He hybridized thousands of plants. Burbank once selected 30,000 plum trees from which 113 were worthy of further investigation. One of his unusual accomplishments was a plum without a pit.

Complete this activity.

1.56 Look up Luther Burbank in the encyclopedia and make a list of five plants that he developed. Write them in the space provided.

a. ______________________ b. ______________________

c. ______________________ d. ______________________

e. ______________________

A plant geneticist works with plants in an effort to develop new varieties. Usually these plants are hybrids, which are the result of crossing two different strains. Such plants often are stronger and more vigorous than the scientist expected them to be. This extra quality is called *hybrid vigor*. This phenomenon cannot be explained but does result in plants that are stronger, give better yields, and are more disease resistant. New seeds must be purchased each year. A hybrid is a cross between two known, but unlike, strains; therefore, the seeds produced by the hybrid plant would be either self-pollinated or of unknown pollination. The added cost of new seed each year is worth the expense because the hybrid plant produces a larger crop per acre.

Geneticists breed animals as well as plants. In both cases geneticists are looking for one or more of three objectives. *First,* in almost every case the scientists are striving for a greater yield of edible food. In plants a greater yield could mean larger fruit or more seeds. In animals more meat or eggs are sought. *Second,* improvement in quality is a goal. Farmers and consumers hope for more tender beef or sweeter fruit. *Third,* each plant has some special characteristic that the geneticist hopes to incorporate. Perhaps the crop grows well in a certain area, but frost in that area kills the plant before the crop can be harvested. The search is then begun for a variety that will mature faster. Sometimes an area is infested with a plant disease, and a variety must be found that is resistant. At times researchers develop some unusual plants or animals. Argentine plant breeders claim to have developed a strain of corn that has such bitter-tasting leaves that grasshoppers refuse to eat the plant.

The development of hybrid corn is a plant success story. Corn is native to the New World. Ancient corn was a tiny cob of just over two centimeters with about forty or fifty tiny kernels. Indian farmers selected the best ears for use as seed and, by the time Columbus arrived, corn was ten centimeters long. Columbus took samples back to his queen, but she was not interested.

Farmers did try raising the new crop, and eventually it spread around the world. By the early 1920s farmers in the United States were harvesting 25 bushels per acre. After hybrids were developed, the yield jumped to 50 bushels and then to 70 bushels. Corn yields have increased more than 300 percent per acre since the 1930s.

The original wheat of the Tigris River area was nothing more than a wild grass. Kernel production was low and the wheat easily fell off the plant. Farmers selected plants at random to use as seed for the next crop. Production did increase, but still the seeds fell off shortly after the grain ripened. Farmers planted no more wheat than the family and hired workers could harvest in the few short days. McCormick's reaper increased the amount of wheat that could be harvested in a short time. Today new hybrids of wheat are available that hold the grain more firmly to the stalk until harvesting.

The International Rice Research Institute in the Philippines has led the way in the search for hybrid rice. Rice is the basic food of Asia and is commonly eaten in Africa and South America. Besides searching for hybrids that will give greater yields, researchers are looking for a plant that is shorter and stiffer. Current crops are often lost when winds blow the plants over to the ground. Some experimental plots using hybrid rice plants, fertilizer, and insecticides have given yields four times greater than was possible with old strains and methods.

Complete these activities.

1.57 Many religious and governmental groups are involved in providing food for the hungry. Some groups deal with local hunger; others, with problems abroad. Find out about one group that helps the hungry. Share your findings with five classmates. Lead a short discussion about hunger and what Christians can do to help.

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initials date

1.58 List the three common goals of plant- and animal-breeding experiments.

a. ____

b. ____

c. ____

1.59 List two special characteristics that scientists could look for in breeding plants.

a. ____

b. ____

The problems of world food production. The amount of food produced on our planet has remained rather stable in recent years, but our world population has soared. Two babies are born every second. Most of these babies are from underdeveloped lands where food production is low. Africa, Asia, Central and South America are not self-sufficient. They must rely on imports to fill their food needs. Food is being constantly shipped in from stockpiles in developed nations. A drought, flood, or other disaster in the food-producing nations could cause a major problem in food distribution. Each country must work to become self-sufficient. Our responsibility is to share the Gospel with the world (Matthew 28:19, 20). Our earthly goods are to be shared with fellow Christians. “But whoso hath this world’s goods, and seeth his brother have need, and shutteth up his bowels of compassion from him, how dwelleth the love of God in him” (1 John 3:17).

In many underdeveloped countries, agricultural practices have been the same for hundreds of years. Education is necessary to show people how to use the appropriate fertilizers, pesticides, and hybrids suitable for their crops, climate, and soil. In desert regions, wells and irrigation are needed to supply water before crops can be grown at all. Insects, plant disease, and rats are estimated to ruin one-third of the harvest in some areas. Other lands have been farmed for centuries and the soil nutrients are gone. Proper fertilization and hybrid plants could easily multiply crop yields.

Most world crops are composed mainly of starch and sugars. These foods provide calories, vitamins, and minerals; but humans also require protein. Beans, nuts, and seeds provide protein; but animal foods are the most complete source. When grain is scarce, there is wisdom in feeding it to people and not to animals. Fifteen pounds of plant material is required to produce one pound of beef. A ten-acre plot could support eight people if the land were used to raise beef; twenty people could be fed if corn were planted; and thirty-five, if rice were grown. Many more people can be fed if land is planted in grains that are eaten directly by people even though protein from animals is important for good health. You have probably seen pictures of children with swollen stomachs, thin arms, and discolored hair. They are suffering from a lack of protein. This condition often results in mental retardation. The children are so weakened that any illness or infection can be fatal.

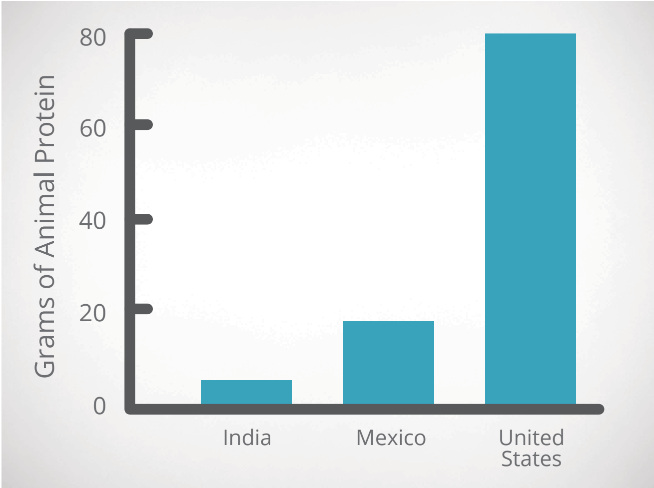

Figure 5 | Animal Proteins in Diet

Answer these questions.

1.60 Where was Gregor Mendel born? ______________________________

1.61 When did Mendel make his study? ______________________________

1.62 What natural laws did Mendel investigate? _________________________________

1.63 Why was one of Burbank's plums unusual? _________________________________

1.64 What is a hybrid? ____

____

1.65 Why must new seeds be purchased each year if a farmer wishes to grow hybrid grain crops?

____

____

1.66 Why was wheat grown only in small amounts before machinery and hybrid seed?

____

1.67 How did machinery and hybrid seeds help increase wheat production?

____

1.68 What is happening to the world population? ______________________

____

1.69 What has been happening to world production? ____________________

____

1.70 How many babies are born each second? ______________

1.71 What must be done to soil that is not fertile? ______________

1.72 What items are often needed before crops can be grown in the desert lands?

a. ____

b. ____

1.73 Why is meat an important part of the diet of a human? ________________

____

1.74 What are the symptoms that develop when a person has not been eating sufficient protein? List four.

a. ____

b. ____

c. ____

d. ____

1.75 What amount of the crop is destroyed in some countries before it can be consumed by the people? ______________

Complete these activities.

1.76 Discuss the problems that your answers to Questions 1.68 to 1.75 are causing in the world.

____

____

____

____

____

____

1.77 On a separate sheet of paper draw both ancient and modern corn, life size. Use these sizes:

Ancient corn, 2 centimeters;
Corn that Columbus saw, 10 centimeters; and
Modern corn, 20 centimeters.

TEACHER CHECK __________ initials __________ date

1.78 Complete this chart.

Acres Farmed	Number of people that could be fed
10 acres used for beef raising	a.
10 acres planted in corn	b.
10 acres planted in rice	c.

Answer these questions.

1.79 Most world crops are of what two types of food? a. ______________ and b. __________________ .

1.80 What do they (1.79) provide? a. ___________ b. ____________ c. ____________

1.81 What basic human requirement do starches and sugars not provide in a complete form?

____

Review the material in this section in preparation for the Self Test. The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.

SELF TEST 1

Write true or false (each answer, 1 point).

1.01 ____________ Stems are the basic center for photosynthesis.

1.02 ____________ Photosynthesis occurs in two steps.

1.03 ____________ Transpiration is water loss through the root.

1.04 ____________ The formula for glucose is $C_6H_{12}O_6$.

1.05 ____________ When food is scarce, grain should be fed to animals and then the meat can be eaten.

1.06 ____________ Carbon dioxide is the waste product of photosynthesis.

1.07 ____________ Animals are the only common source of oxygen for plants.

1.08 ____________ Mendel studied the law of inheritance.

1.09 ____________ Protein is commonly lacking in the diet of underdeveloped nations.

1.010 ____________ Chlorophyll is located in chloroplasts.

Match these items (each answer, 2 points).

1.011 ________ chlorophyll

1.012 ________ stomata

1.013 ________ starch

1.014 ________ cacti

1.015 ________ carbon dioxide

1.016 ________ fertilizer

1.017 ________ Mendel

1.018 ________ dark phase

1.019 ________ guard cell

1.020 ________ hybrid

a. regulates opening
b. cross between two unlike varieties
c. no leaves
d. source of carbon for plant
e. McCormick reaper
f. water released
g. green pigment
h. pea plants
i. pores in leaf
j. nutrients added to soil
k. chain of glucose units

Write the letter of the correct choice (each answer, 2 points).

1.021 The two waste products of photosynthesis are ________ .
- a. water and oxygen
- b. oxygen and hydrogen
- c. carbon dioxide and water
- d. glucose and oxygen

1.022 A typical leaf does *not* contain ________ .
- a. chloroplasts
- b. epidermal cells
- c. guard cells
- d. hybrids

1.023 Stomata are *not* used for ________ .
- a. escape of water
- b. escape of glucose
- c. escape of oxygen
- d. carbon dioxide collection

1.024 Plants need to be provided with all of the following items *except* ________ .
- a. starch
- b. trace minerals
- c. light
- d. water

1.025 The major elements found in commercial fertilizer are ________ .
- a. oxygen, nitrogen, and carbon
- b. phosphorus, hydrogen, and oxygen
- c. nitrogen, potassium, and oxygen
- d. nitrogen, phosphorus, and potassium

1.026 Stomata are found mainly on the ________ .
- a. top of leaves
- b. bottom of leaves
- c. surface of all plant parts
- d. bottom of all stems and roots

1.027 Plants are *not* good sources of ________ .
- a. complete protein
- b. complex sugars
- c. starch
- d. fats and oils

1.028 Hybrid plants are bred for ________ .
- a. greater yields, taller stems, disease resistance
- b. early maturity, better leaves, larger fruit
- c. greater yield, increased quality, special characteristics
- d. more seeds, increased quality, more tender beef

1.029 Most underdeveloped nations do *not* need ________ .
- a. increased food production
- b. hybrid plants
- c. agricultural education
- d. drought or flood

1.030 You could feed the most people if you used your land for ________ .
- a. beef cattle
- b. corn
- c. rice
- d. chickens

Complete these activities (each answer, 3 points).

1.031 Write the complete balanced equation for photosynthesis.

a. ____________ + b. ____________ c. ____________ → ____________ d. ____________ + e. ____________ + f. ____________

1.032 List the three major contributions to modern agriculture.

a. ________________________ b. ________________________

c. ________________________

1.033 List the nine major requirements for plant growth.

a. ________________________ b. ________________________

c. ________________________ d. ________________________

e. ________________________ f. ________________________

g. ________________________ h. ________________________

i. ________________________

1.034 Name five plant storage organs and give an example of each.

a. ____

b. ____

c. ____

d. ____

e. ____

93/116 **SCORE** ____________ **TEACHER** ____________ ____________
initials date

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