



SECTION:

1

# Agriscience in the Information Age



*Biosphere 2 (Courtesy of Global Ecotechnics Corporation; photographer Gill Kenny)*

## Better Living through Research

**S**cience and technology are modern miracles that have opened up the door to areas of research, turning the dreams of mankind to realities. Space station research, new frontiers to investigate, and our never ending quest for knowledge have exploded into many new and exciting careers.

**Y**ou could become one of the people growing plants or animals in a space station high above the Earth. Or, you might be an engineer who designs the animal or plant-

growing module of the space station, or a molecular geneticist or plant breeder designing new plants to grow well in low gravity, or a food scientist developing packaging for space-grown produce.

**O**ne fast-growing career area is in plant science. As you will learn, plants are “green machines” that capture, package, and store energy from the sun through photosynthesis. They supply food and fiber for animals and humans to help sustain life.

But, human knowledge and energy are required to help plants function in the over-all “green machine” that constitutes our food, fiber, and natural resources system.

**W**hether you choose a job in plant or animal science, sales and marketing, mechanics, or processing, it is sure to be rewarding. By studying agriscience you are opening the door to exciting educational programs and careers that contribute to better living conditions for people everywhere.

# UNIT:

# 1

# The Science of Living Things



## OBJECTIVE

To recognize the major sciences that explain the development, existence, and improvement of living things.

## COMPETENCIES TO BE DEVELOPED

After studying this unit, you should be able to:

- define agriscience.
- discover agriscience in the world around us.
- relate agriscience to agriculture, agribusiness, and renewable natural resources.
- state the major sciences that support agriscience.
- describe basic and applied sciences that relate to agriscience.

## MATERIALS LIST

- ✓ writing materials
- ✓ newspapers and magazines
- ✓ encyclopedias
- ✓ Internet connection

## SUGGESTED CLASS ACTIVITIES

1. Invite a retired farmer to be a guest speaker on the topic of improvements or advances in the science and technology of agricultural production that he or she has experienced during his or her career. Have the students make a list of the agricultural technologies that are discussed. Speculate on new agricultural technologies that the students may experience during their careers.
2. Obtain a copy of the application process for the National FFA Agriscience Student Award. This award offers excellent scholarship opportunities to students who plan and carry out agriscience research projects. Discuss some local agricultural problems that might be addressed by students who express interest in planning a research project in agriscience.

## TERMS TO KNOW

agriscience  
agriculture  
agriculture/agribusiness and  
renewable natural resources  
agribusiness  
renewable natural resources  
technology  
industrial technology  
high technology  
aquaculture

agricultural engineering  
animal science technology  
crop science  
soil science  
biotechnology  
integrated pest management  
organic food  
water resources  
environment  
turf

biology  
chemistry  
biochemistry  
entomology  
agronomy  
horticulture  
ornamentals  
animal sciences  
agricultural economics  
agricultural education

**L**ife in the United States and throughout the world is changing every moment of our lives. The space we occupy as well as the people we work and play with may be constant for a brief time. However, these are quick to change with time and circumstances. The things we need to know and the resources we have to use are constantly shifting as the world turns around us.

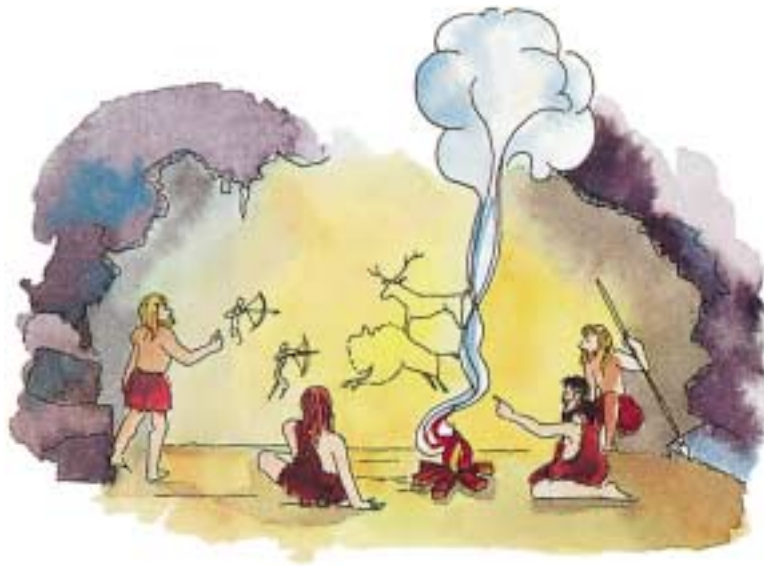
Humans have the gift of intelligence—the ability to learn and know (Figure 1–1). This permits us to compete successfully with the millions of other creatures that share the Earth with us (Figure 1–2). In ages past, humans have not always fared well in this competition. Wild animals had the advantages of speed, strength, numbers, hunting skills, and superior senses over humans. These superior senses of sight, smell,



**FIGURE 1–1** Humans have the gift of intelligence and the ability to learn and know. (Courtesy USDA/ARS #K-3414-1)



**FIGURE 1-2** The gift of intelligence has permitted humans to compete with and benefit from animals even though most animals are superior to humans in other ways. (Courtesy USDA/ARS #K-4703-12)



**FIGURE 1-3** Early humans had to rely on natural settings to shield them from danger and the elements.

hearing, heat sensing, and reproduction all helped certain animals, plants, and microbes to exercise control over humans in order to meet their own needs.

The cave of the cave dweller, lake of the lake dweller, and cliff of the cliff dweller indicate human reliance on natural surroundings for basic needs (food, clothing, and shelter) (Figure 1-3). Those early homes gave humans some protection from animals and unfavorable weather. However, they were still exposed to disease, the pangs of hunger, the sting of cold, and the oppression of heat.

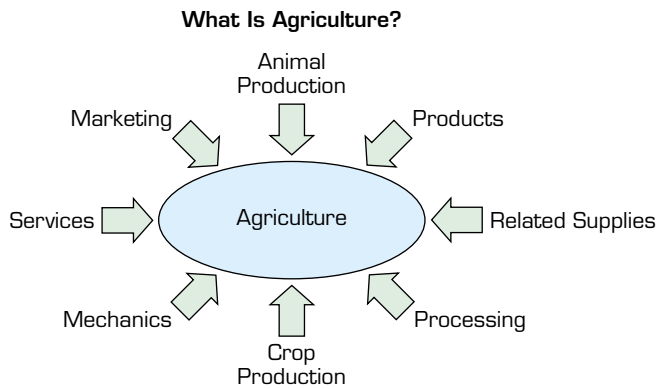
The world of agriscience has changed the comfort, convenience, and safety of people today. In the United States, we spend only 11 percent of our wages to feed ourselves (Figure 1-4). People in many nations spend more than half of their incomes for food. The agriscience, agribusiness, and renewable natural resources of the nation provide materials for clothing, housing, and industry at an equally attractive price.



**FIGURE 1-4** Americans spend only 11 percent of their incomes on food. (Courtesy USDA/ARS #CS-1081)

## AGRISCIENCE DEFINED

Agriscience is a relatively new term that you may not find in your dictionary. **Agriscience** is the application of scientific principles and new technologies to agriculture. **Agriculture** is defined as the activities concerned with the production of plants and animals, and related supplies, services, mechanics, products, processing, and marketing (Figure 1-5). Actually, modern agriculture covers so many activities that a simple definition is not possible. So, the U.S. Department of Education has used the phrase “**agriculture/agribusiness and renewable natural resources**” to refer to the broad range of activities in agriculture. Agriculture generally has some tie-in or tie-back to animals or plants. However, production agriculture, or farming and ranching, accounts for only one-fifth of the total jobs in agriculture (Figure 1-6). The other



**FIGURE 1-5** Agriculture consists of all of the steps involved in producing a plant or animal and getting the plant and animal products to the people who consume it.



**FIGURE 1-6** Farming and ranching account for approximately one-fifth of the agricultural jobs in the United States. (Courtesy USDA/ARS #K-4320-9)

four-fifths of the jobs in agriculture are nonfarm and nonranch jobs. **Agribusiness** refers to commercial firms that have developed with or stemmed out of agriculture (Figure 1-7).



**Internet Key Words:**

renewable, natural resources

**Renewable natural resources** are the resources provided by nature that can replace or renew themselves. Examples of such resources are wildlife, trees, and fish (Figure 1-8). Some occupations in renewable natural resources are game trapper, forester, and waterman (someone who uses boats and specialized equipment to harvest fish, oysters, and other seafood).

**Technology** is defined as the application of science to solve a problem. The application of science to an industrial use is called **industrial technology**. Hence, agriscience was coined to describe the application of high technology to agriculture. **High technology** refers to the use of electronics and state-of-the-art equipment to perform tasks and control

## HOT TOPICS *in Agriscience*

### Feeding A Hungry World

It is estimated that the world population of humans will reach 7 billion people by the year 2010 and 9 billion in 2030 in comparison with approximately 6 billion today. During the same period, the amount of land and fresh water per person will decrease. Food production will have to become much more efficient if the people of the world are to have enough food to eat. During the past 50 years, food production has increased at a rate that is greater than the increases in population. Agricultural research has resulted in greater productivity of food, plants, and animals, and new technologies have made it possible for farmers to perform their work with greater efficiency. The key to an adequate food supply for the growing human population in the new millennium will be agricultural research. New agricultural technologies that lead to the development of more efficient plants and animals and more efficient agricultural machinery will be needed. In addition, we will need to discover new food sources as the human population approaches 10 billion people.



**FIGURE 1-7** Agribusinesses are important to the life of most communities. (Courtesy USDA/ARS #K-567-13)



**FIGURE 1-8** Mature trees provide renewable sources for wood products. Young trees of most species begin to grow after mature trees are harvested, allowing sunlight to penetrate the forest floor.

machinery and processes (Figure 1-9). It plays an important role in the industry of agriculture.



**FIGURE 1-9** Technology is used in agriscience for such purposes as testing feeds for nutrient content and testing food for purity from chemicals. (Courtesy USDA/ARS #K-3396-6)

Agriscience includes many endeavors. Some of these are aquaculture, agricultural engineering, animal science technology, crop science, soil science, biotechnology, integrated pest management, organic foods, water resources, and environment. **Aquaculture** means the growing and management of living things in water, such as fish. **Agricultural engineering** means the application of mechanical and other engineering principles in agricultural settings. **Animal science technology** refers to the use of modern principles and practice for animal growth and management (Figure 1-10). **Crop science** refers to use of modern principles in growing and managing crops. **Soil science** refers to the study of the properties and management of soil to grow plants. **Biotechnology** refers to the management of the genetic characteristics transmitted from one generation to another and its application to modern living. It may be defined as the use of cells or components of cells to produce products and processes (Figure 1-11).

The phrase **integrated pest management** refers to the many different methods used together to control insects, diseases, rodents, and other pests. **Organic food** is a term used for foods that have been grown without the use of chemical pesticides. **Water resources** cover all aspects of water conservation and management. Finally, **environment** refers to the space and mass around us. This generally means air, water, and soil.



**FIGURE 1-10** Veterinarians use animal sciences to help keep our pets and production animals healthy. *(Courtesy USDA/ARS #K-4807-1)*



**FIGURE 1-11** Genetic engineering and other forms of biotechnology have developed into one of the most important priorities in research today. *(Courtesy USDA/ARS #K-5011-19)*

## AGRI-PROFILE

### Career Area: Agriscientist

In recent years science has played an increasing role in the lives of plants and animals and the people around them. These living bodies include plants ranging in size from microscopic bacteria to the huge redwood and giant sequoia trees. They include animals from the one-celled amoeba to elephants and whales.

Only recently has science identified the nature of viruses and permitted humans to observe the submicroscopic world in which they exist. The electron microscope, radioactive tracers, computers, electronics, robots, and biotechnology are just a few of the developments that have revolutionized the world of living things. We call this the world of science. Agriscience is a part of this world. Through agriscience, humans can control their destinies better than at any time in known history.

Agriscience spans many of the major industries of the world today. Some examples are food production, processing, transportation, selling, distribution, recreation, environmental management, and professional services. Studies and experiences in a wide array of basic and applied sciences are appropriate preparation for a career in agriscience.



Students experience the wonder of living things. *(Courtesy USDA/ARS #CS-0146)*

## AGRISCIENCE AROUND US

Agriscience and technologies have helped humans change their living conditions from dependance on hand labor to a highly mechanized society. In the process, food and fiber production have become much more efficient. Many members of American society have become free to pursue new careers in business, industry, or the arts, because they are no longer required to spend all of their time finding or producing food for themselves and their families. Fewer than 2 percent of the people in America are farmers. On average, each farmer produces enough food for approximately 135 people. In fact, the large surplus of food that is produced in the United States is shipped to many other countries in the world.

Whether you live in the city, town, or country, you are surrounded by the world of agriscience. Plants use water and nutrients from the soil and release water and oxygen into the air. Animals provide companionship as pets and assistance with work. Both plants and animals are sources of food. Many microscopic plants and animals are silent garbage disposals. They decay the unused plant and animal remains around us. This process returns nutrients to the soil and has many other benefits to our environment and well-being.

Agriscience encompasses the wildlife of our cities and country, and the fish and other life in streams, ponds, lakes, and oceans. Plants are used extensively to decorate homes, businesses, shopping malls, buildings, and grounds. When one crop is used less, another takes its place. This occurs even where land changes from farm use to suburban and urban uses.

Corn has long been referred to as king among crops in the United States. Yet, in one state, turf grass recently replaced corn as the number one crop. **Turf** is grass that is used for decorative as well as soil-holding purposes. This change has occurred as more land is being used for roads, housing, businesses, institutions, recreation, and other nonfarm uses (Figure 1–12).



**FIGURE 1–12** Turf has become an important crop, especially in areas near population centers. (Courtesy USDA/ARS #CS-0311)

Many of the flowers used by florists in the United States come from Colombia, South America, and other foreign countries. Bulbs come from Holland and meat products are imported from Argentina. Lumber is shipped from the United States to Japan, only to return in the form of plywood and other processed lumber commodities. A drop in the price of soy bellies or an unexpected change in the price of grain futures in Chicago can affect business and investment around the world (Figure 1-13).

The great water-control projects on the Colorado River have permitted the transformation of the American Southwest from a desert to irrigated lands. This is now an area of intensive crop production that has stimulated national population shifts. Water management has transformed the great dust bowl of the American West into the “bread basket” of the world.

Agriscience enterprises extend beyond farming to such fields as journalism and communications. Agricultural publications such as magazines, journals, and newspapers provide information to farmers, helping to make farm production more efficient. Radio and television programs provide similar services to agriculture. They provide a communications link among such people as agricultural specialists, agricultural extension educators, wildlife biologists, and others to communicate the latest information to farmers and other managers of natural resources. Such subjects as plants, animals, wildlife, market reports, gardening, and lawn care are popular “Saturday morning” topics.

#### Internet Key Words:

agriculture  
journals  
biology  
chemistry

## AGRISCIENCE AND OTHER SCIENCES

Agriscience is really the application of many sciences. Colleges of agriculture and life sciences do research and teach students in these sciences.



**FIGURE 1-13** Marketing in agriscience has become big business. (Courtesy National FFA; FFA # 18)

# SCIENCE CONNECTION

## The Agriscience Project

The scientific method is an excellent and widely used method for systematic inquiry and documentation of new findings. The agriscience student is encouraged to learn and use the scientific method for classroom, laboratory, and field studies. The following procedures will guide you in your quest for new knowledge in agriscience.

### Step 1. Identify the Problem

Decide precisely and specifically what it is that you wish to find out. For example, "How much nitrogen fertilizer is needed to grow healthy corn plants?" Be careful to limit your topic to a single researchable objective. Your teacher can suggest other topics that could be researched.

### Step 2. Review the Literature

This simply means read up on and become well informed about the topic. See what is already known about it. Magazines, newspapers, reference books, encyclopedias, trade journals, computer information systems, television, cooperative extension meetings, teleconferences, and personal interviews may be sources of appropriate information. Be sure to seek information on appropriate ways to conduct research on the type of problem you have chosen.



The written report completes the research project and enables others to benefit from the new knowledge. *(Courtesy USDA/ARS D27)*



#### Internet Key Words:

entomology  
agronomy  
animal science

**Biology** is the basic science of plant and animal life. **Chemistry** is another basic science that deals with the characteristics of elements or simple substances. It includes the behavior of substances when combined with other substances. **Biochemistry** focuses on chemistry as it applies to living matter. These three are referred to as basic sciences. One must understand the basic sciences to work in the applied sciences.

Applied sciences utilize basic sciences in practical ways. For instance, **entomology** is the science of insect life. A knowledge of biology and chemistry is fundamental to entomology and the understanding of insects.

**Agronomy** is the science of soils and field crops, while **horticulture** is the science of fruits, vegetables, and ornamentals. **Ornamentals** are plants used for their appearance. Examples are flowers, shrubs, trees, and grasses. **Animal sciences** are applied sciences that involve animal growth, care, and management. They include veterinary medicine, animal nutrition, and animal production and care.

**Agricultural economics** addresses the management of agricultural resources, including farms and agribusinesses. Farm policy and international trade are important components of agricultural economics. **Agricultural education** covers teaching and program management in agricultural

**Step 3. Form a Hypothesis**

After learning as much as you can about the topic, develop a hypothesis or statement to be proven or disproven, which will solve the problem. For example, “Trout grown in 60° F water will grow faster than trout grown in 75° F water.”

**Step 4. Prepare a Project Proposal**

Prepare a proposal outlining how you think the project should be done. Include the timelines, facilities, and equipment required, as well as anticipated costs and a description of how you will do the project.

**Step 5. Design the Experiment**

Considering the information gathered in Step 2, develop a plan for carrying out the project so you can test the hypothesis. This is the most critical step in your research project. If this isn't done correctly, you may invest considerable time, work, and expense and end up with incorrect or invalid conclusions. The method or procedure should be carefully thought out and discussed with your teacher or other research authorities. This is to be sure that your design will actually measure what you are testing.

**Step 6. Collect the Data**

In this phase you actually conduct the experiment. Here you test and/or observe what takes place and record what you measure or observe.

**Step 7. Draw Conclusions**

Summarize the results. Make all appropriate calculations. Determine if the information allows you to accept or reject the hypothesis, or if the information is inconclusive.

**Step 8. Prepare a Written Report**

The written report provides you, your teacher, and other interested parties with a permanent record of your research. From this you can report to your peers, get course credit, and possibly apply for awards. Perhaps you can use a computer and hone your word-processing skills. For scientists, the written report becomes a permanent document that is kept by the research institution and becomes the basis for articles in research publications for all the world to see. The results become part of the “literature” on the topic.



**FIGURE 1–14** There are plenty of good jobs for agricultural graduates whether at the technical degree, bachelor degree, or graduate degree levels of education. (Courtesy USDA/ARS #K-4604-1)

endeavors. Agricultural communications, journalism, extension service, and community development are also components of agricultural education. These and other disciplines are part of agriscience.

## A PLACE FOR YOU IN AGRISCIENCE

What about career opportunities in agriscience? By the year 2000, the nation's agricultural colleges experienced the strongest demand for graduates in a decade. A U.S. Department of Agriculture (USDA) study group forecasted a national shortage of 4,000 agricultural and life sciences graduates per year. The shortage became reality in the early 1990s. Employers are offering higher salaries and more job variety to agriscience college graduates than ever before. Career opportunities continue to be strong in these fields, and they also extend into technology as it relates to agricultural systems. Consequently, graduates of high school agricultural, horticultural, or other agriscience programs can obtain good jobs and have rewarding careers (Figure 1–14). These are described in later units in this text. By studying agriscience, you open the door to exciting educational programs and careers that bring life and prosperity.

## STUDENT ACTIVITIES

1. Write the Terms to Know and their meanings in your notebook.
2. List examples of animals that have better senses than do humans. Indicate the sense(s) along with the animals.
3. Write a paragraph or two on (1) cave, (2) lake, and (3) cliff dwellers. Explain how the types and locations of their homes provided protection from (1) animals and (2) unfavorable weather. An encyclopedia would be a good resource for this activity.
4. Ask your teacher to assign you to a small discussion group to talk about the responses to Activity 3.
5. Place a map of your school community on a bulletin board. Insert a colored map pin in every location of a farm, ranch, or agribusiness in your school community.
6. Talk to your County Extension Agent or another agricultural leader regarding the importance and role of agriscience, agribusiness, and renewable natural resources in your county.
7. Select one of the sciences mentioned in this unit. Prepare a written report on the meaning and nature of that science. Report to the class.

## SELF EVALUATION

### A. Multiple Choice

1. Humans have the ability to learn and know. This is known as
  - a. achievement.
  - b. intelligence.
  - c. intuition.
  - d. spontaneity.
2. The percentage of an average U.S. worker's pay used for food is
  - a. 11 percent.
  - b. 14 percent.
  - c. 50 percent.
  - d. 74 percent.
3. The best term to describe the application of scientific principles and new technologies to agriculture is
  - a. agribusiness.
  - b. renewable natural resources.
  - c. farming.
  - d. agriscience.
4. Harmful insects, rodents, and diseases are all referred to as
  - a. animals.
  - b. plants.
  - c. pests.
  - d. parasites.
5. Agriscience encompasses
  - a. wildlife and fish.
  - b. ornamental plants and trees.
  - c. farms and agribusinesses.
  - d. all of the above and more.
6. Irrigated lands are generally used for
  - a. intensive crop production.
  - b. wildlife refuges.
  - c. forests.
  - d. boating and fishing.
7. An example of a basic science is
  - a. agronomy.
  - b. aquaculture.
  - c. horticulture.
  - d. chemistry.

- 8.** An example of an applied science is
- a. animal science.
  - b. biochemistry.
  - c. biology.
  - d. chemistry.
- 9.** One relationship of agriscience with many other sciences is that
- a. agriscience is the application of many other sciences.
  - b. agriscience is entirely different from all other sciences.
  - c. agriscience is an old term and an old science.
  - d. agriscience is a very narrow science and easily defined.
- 10.** The career and job outlook in agriscience is
- a. a strong demand for college graduates.
  - b. a shortage of 4,000 trained workers per year.
  - c. higher salaries are being offered.
  - d. all of the above.

### B. Matching

- |                                    |  |
|------------------------------------|--|
| _____ <b>1.</b> Aquaculture        | a. Commercial firms in agriculture       |
| _____ <b>2.</b> Renewable resource | b. Electronics and ultramodern equipment |
| _____ <b>3.</b> Agribusiness       | c. Growing in water                      |
| _____ <b>4.</b> Chemistry          | d. Basic science of plants and animals   |
| _____ <b>5.</b> High technology    | e. Can replace itself                    |
| _____ <b>6.</b> Biology            | f. Characteristics of elements           |
| _____ <b>7.</b> Organic food       | g. Space and mass around us              |
| _____ <b>8.</b> Environment        | h. Grown without chemical pesticides     |

### C. Completion

- 1.** Integrated pest management refers to the use of many different methods used together to \_\_\_\_\_.
- 2.** The transformation of the American Southwest from desert to irrigated lands was made possible, in part, by water-control projects on the \_\_\_\_\_ river.
- 3.** By studying agriscience, you open the door to exciting educational programs that may lead to \_\_\_\_\_.