



OKLAHOMA
CareerTech

Introduction to Agriscience

Unit 1
Agriscience Opportunities

Student Edition

CIMC

AG3001

Unit 1

Agriscience Opportunities

What do you think of when someone says “agriculture”? Many people envision farms with cattle or crops, not a laboratory with research projects. Agriculture is both—agriculture is a science that involves many different areas. The farmer that grows corn and the scientist that researches new technology for insect resistant crops are both involved in agriculture. Agriculture encompasses a broad range of careers such as marketing and education, crop production, and scientific research. Agriculture has a significant effect on our daily lives—even those who are not employed in agricultural industries are affected by agriculture. Agriculture provides products for consumer goods from food and clothing to building materials. Agriculture is a diversified field and individuals with varying interests and skills can often find a career in agriculture they enjoy.



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OBJECTIVES

1. Explain how agriculture is a science.
2. Discuss how agriculture affects our daily lives.
3. Discuss career opportunities in agriculture.
4. Outline the steps to setting career goals.
5. Explore your interests and skills as they relate to careers.

KEY WORDS

agriculture
agriscience
biofuels
biotechnology
career clusters
career pathways
requirements

Is Agriculture a Science?

Science and technology are fascinating areas that continue to grow through research efforts. New methods and products are continually developed to make our lives easier and safer. Many of the jobs involved in science and technology are part of agriculture. Science is a term that comes from the Latin term *scientia*, which means knowledge. Science encompasses a system that uses observation and experimentation to describe and explain the physical world. Some of the fields of study within science include biology, physics, chemistry and earth science.

What exactly is agriculture and how does it relate to science? **Agriculture** is the production of plants and animals, and related supplies, services, mechanics, products, processing and marketing. Because agriculture continues to expand, the term **agriscience** is often used to describe the application of agricultural principles and new technologies. Many aspects of agriculture involve some type of science—botany, ecology, genetics, organic chemistry, environmental science, geography, hydrology, and meteorology to name a few!



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Growing crops is related to botany, a part of the field of biology. *Botany* is the study of plants. The knowledge gained through botany enable today's producers to grow crops that meet the needs of consumers. Throughout the history of agriculture, producers have selected and cultivated varieties of plants that are able to successfully grow in a region. The science of agriculture also involves *ecology*, the study of interactions of organisms and their environment. Ecology includes the study of environmental problems. Producers today understand the need to protect and care for the environment for agricultural production to remain sustainable.

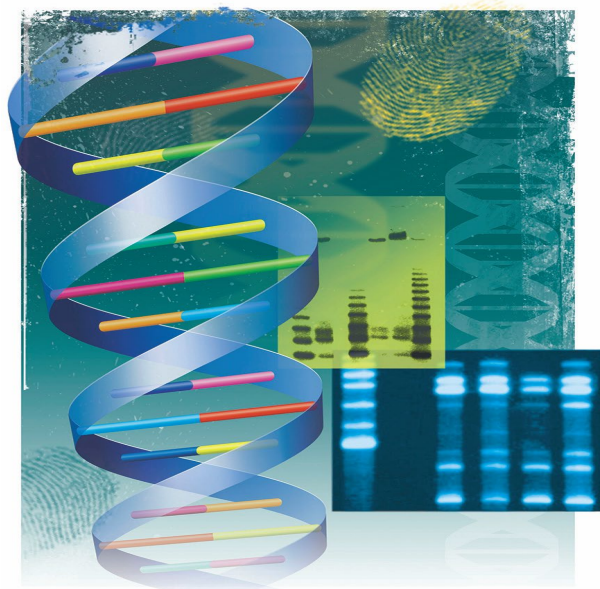
Raising animals is related to zoology. *Zoology* is the study of animals, their behavior, and how they interact with the environment. Producers care about the health and welfare of their animals, and having an understanding of animal behavior is important. Producers today also care about how agriculture affects wildlife and take steps to help wildlife in their area, such as leaving areas near fence lines undisturbed.

From crops to cattle, agricultural producers take into account genetics. *Genetics* is the study of heredity—how characteristics are passed from one generation to another for all living organisms. Livestock breeders select animals to keep as breeding stock because of the characteristics they will pass to their offspring.

What does organic chemistry have to do with agriculture? *Organic chemistry* is the study of compounds that are carbon-based. Knowledge of organic chemistry is needed to develop many of the fertilizers and pesticides used in agriculture.

Agriculture also encompasses environmental science. *Environmental science* is the science of the physical, chemical, and biological aspects of the environment and their effect on organisms. Environmental science also includes the effect that humans have on the environment. Environmental science and ecology are closely related; environmental sciences are viewed as a much broader science. How drought or an unusually wet period may affect various types of plants would be one question an environmental scientist might attempt to answer.

Geography is the science of the earth's surface and how human activity relates to the earth's surface. Agriculture has developed in various regions of the world in large part because of the geographical conditions that made growing possible. Agriculture today makes use of geographical technologies such as geographic information systems (GIS),



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Global Positioning System (GPS), and remote sensing. GIS is a system that is designed to manage spatial and geographical data. GPS is a satellite-based navigation system providing location and time data. Remote sensing obtains information about an area from aircraft or satellites.

Agriculture production is dependent upon water. Producers must use water wisely and also must have practices that help protect water quality. *Hydrology* is the study of water. Agriculture often uses irrigation systems to water crops. Understanding agriculture and the use of water sources is vital for the sustainability of crops in many regions.

Does weather affect agriculture? Weather has a significant impact of many types of agricultural operations. While the weather can't be changed, understanding the weather and how it may affect production is vital for successful agricultural operations. *Meteorology* is the science of the Earth's atmosphere and includes weather forecasting.

Agriculture is a science that overlaps and involves many branches of science. Areas of agriculture today are on the cutting edge of scientific development. Some of the current scientific developments in agriculture are related to biotechnology. *Biotechnology* is the manipulation or genetic engineering of living organisms or their components to create new products. A recent agricultural technology is Arctic apples®, non-browning



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genetically modified apples that were recently approved in the United States. Current research in agriculture that could someday have worldwide effects include engineering rice plants to carry out photosynthesis more efficiently, providing the opportunity to dramatically increase production.

Agriculture is much more than growing crops or raising livestock—those involved in agriculture today must understand the science that accompanies agriculture. Today's agriculture has changed tremendously because of science and will continue to change. Keeping up with those changes is important to be successful in agriculture. Understanding why agriculture is a science is important because all sciences rely on a method when attempting to understand issues.

Just as in other areas of science, research in agriculture follows the *scientific method*. The scientific method uses logical steps and procedures to come to a conclusion.

Scientific Method

1. Ask a question or determine a purpose
2. Conduct background research and observation
3. Construct a hypothesis
4. Perform an experiment
5. Analyze data
6. Come to a conclusion

Agriculture, just like many other sciences, relies on math. The ability to understand and apply math is vital in agriculture and is used for tasks such as figuring fertilizer and pesticide application rates, calculating crop yields, and developing accurate business reports.

Is agriculture a science? Yes! Not only is agriculture a science, but it is a science that our lives depend on for the food that nourishes us.



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Agriculture in Our Lives

How does agriculture affect you? Agriculture affects many areas of our lives—the food we eat, the clothes we wear, and many of the products we use are possible because of agriculture. While food products and cotton clothing are obvious, agricultural products are included in numerous consumer products, such as foods, cosmetics, soaps, cleaners, medicines, pharmaceuticals, leather goods, biofuels, construction and many others. **Biofuels** are fuels, such as ethanol and biodiesel, made from living things.

Soybean Uses

Animal feed (poultry, pork, cattle, other farm animals, and pets)
Food products (oils, margarine, salad dressings, mayonnaise, baked goods)
Biodiesel
Biocomposite building materials
Solvents, cleaners, and paints
Crayons
Candles
Lubricants
Soy ink
Pharmaceuticals
Carpet
Upholstery

Who produces all of the agricultural products we use? Farmers today are responsible for providing agricultural products to a growing population. While farmers represent less than 2% of the U.S. population today, they are more productive than previous generations and produce more, using fewer resources. Today's average farmer produces enough to feed 155 people each year; compared to just 26 people in 1960. Today's agriculture provides 24 million jobs in industries related to agriculture. Farms today vary greatly in size, from small retirement farms to very large family-owned farms and corporate farms. The average farm size is a little over 400 acres. Large farms consist of those over 2,000 acres. One of the largest ranches in the world is the King Ranch in south Texas, with over 825,000 acres!

The United States population is expected to continue to grow—increasing from approximately 320 million today to 438 million in 2050. The world population is expected to continue to increase from 7.3 billion today to 9.7 billion in 2050. Farmers in the United States, and around the world, will have to continue to improve efficiency and produce more food to meet the increasing demands. Research in agriculture, such as improved photosynthesis in rice, along with increasing use of technology, may help farmers meet the increased demand.

As farmers strive to keep up with increasing demand, the predominance of information aimed at consumers continues to increase. Special interests and various organizations attempt to sway consumer opinion about agricultural issues. As consumers, it is important to have consumer awareness and to distinguish fact from fiction. Some of the biggest hot-button consumer issues in agriculture today include the use of genetically

modified organisms (GMOs), hormone and antibiotic use, organic vs. non-organic products, and humane treatment of animals.

GMOs refer to organisms that have been modified by the transfer of genetic material that comes from another organism. Through genetic engineering, the DNA of an organism is changed. Organisms have always undergone modifications in nature; genetic engineering makes these modifications through scientific techniques so they occur faster. GMOs have been approved for use in many different agricultural applications and used in consumer foods since the mid-1990s. GMOs provide farmers with the potential to grow crops that use far less pesticides and provide enough food for an increasing population. Although there has been a recent push against GMOs, they are considered safe and effective. The U.S. agencies with the responsibility of overseeing and approving genetically modified crops include the Food and Drug Administration (FDA), the Department of Agriculture (USDA), and the Environmental Protection Agency (EPA).



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GMOs can help producers increase production of a crop, but they also have consumer benefits. For example, golden rice is genetically modified so that it contains beta-carotene, the source of Vitamin A. Vitamin A deficiency is a significant health concern in many areas of the world, and golden rice is one method of countering the health problems associated with Vitamin A deficiency.

Another issue that has garnered widespread consumer attention is the use of hormones and antibiotics in agricultural production. In the U.S., the use of added hormones is not permitted in poultry or swine. Cattle farmers may use small amounts of hormones to



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increase weight gain, but the concentrations have very strict tolerance levels that are set by the FDA. Antibiotics are used in agriculture to treat, prevent and control diseases, and are also used to promote growth. Antibiotic residues in meat and poultry products are generally very low, if even present.

Are “organic” foods better? The organic vs. non-organic debate is a current issue in agriculture. The USDA National Organic Program is responsible for national standards for organically produced agricultural products. Products that have the USDA organic seal are certified and must meet consistent, uniform standards. Products that are certified by the USDA as organic cannot use synthetic fertilizers, sewage sludge, irradiation, or genetic engineering. Organic foods are produced using methods that differ from producers of non-organic foods. Foods that are organic are produced without most of the conventional pesticides and fertilizers. USDA does not address the nutritional value of organic foods. Both conventional and organically grown foods provide nutrients, and there have

not been conclusive studies indicating organic foods are higher in nutrients. For many consumers, the issue of organic vs. non-organic is a personal preference.

The humane treatment of farm animals is another issue that is often used to sway consumers. There are many different production methods for various animals—however, regardless of the method used producers must address the health and welfare of the animals. For example, pigs today may be raised in an indoor area, often referred to as “confinement.” Confinement allows producers to protect animals from the elements and more easily provide treatment and care. The poultry industry is also often criticized for its production methods. For example, broilers (young meat chickens) are generally raised in large, open structures, not cages. The environment is controlled to provide a comfortable area.



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Every system has its advantages and disadvantages, but producers who do not adequately care for animals are much less likely to be successful. In addition, some major buyers, such as restaurant chains, have put into place policies regarding treatment of animals from suppliers.

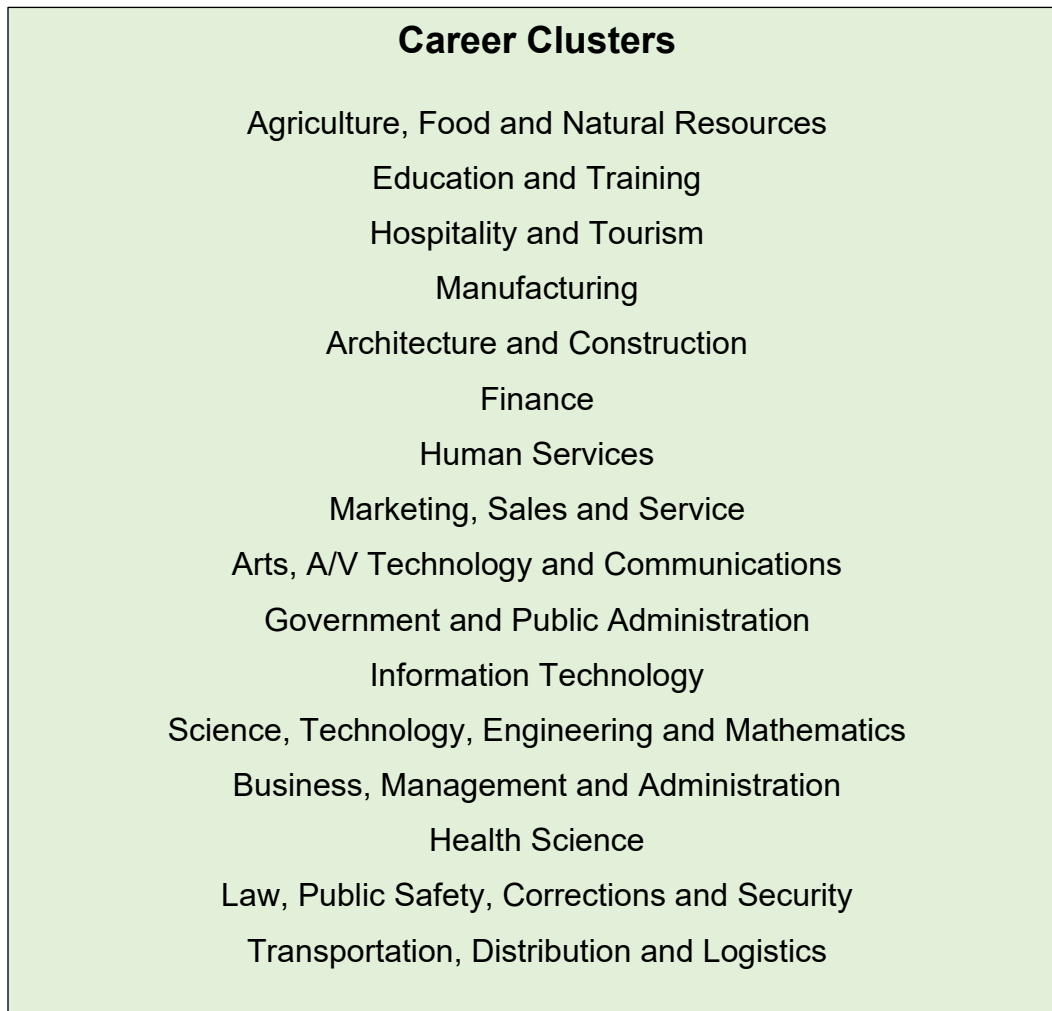
Consumers must realize there are always two sides to any issue—just because someone states something does not mean it is factual. Consumers today must look at the facts, not opinion, and make purchasing decisions that are best suited for them.

Career Opportunities

Since agriculture is all around us, there are many jobs considered to be agriculture that you may not think of. For example, a golf course manager or graphic designer could be considered an agricultural job depending upon the type of work being performed. The opportunities in agriculture are limitless. The key is finding the career suited for you.

Around 1995, the U.S. Department of Education divided all jobs or careers into 16 divisions called **career clusters**. This was completed by looking at the skills and knowledge needed for each career and grouping careers with similar characteristics together. Funding for the program initially began with the U.S. Department of Energy. When those funds ceased, the National Association of State Directors of Career and

Technical Education took over the funding and oversight of the Career Clusters Initiative.



Within each career cluster there is a variety of pathways that further break down careers by skills and knowledge. The Agriculture, Food and Natural Resources cluster has seven **career pathways**. For each of these pathways, dozens of career opportunities exist. There are nearly 22 million jobs in agriculture and related fields in the U.S. today. Fewer than two million of these are traditional farming jobs. Agriculture in the 21st century is based on science and often calls upon the latest in technology.

With the variety of career opportunities available in agriculture, so are the **requirements** or needs for obtaining those jobs. Each pathway includes careers that range from the certification to graduate degree level. Certification may require a few hours, while a graduate degree may take many years to attain. Depending on your goals for salary and standard of living, you will want to consider pursuing a career that will allow you to reach those goals.

Agribusiness and Management

The Agribusiness and Management pathway includes the study of agricultural finance, policy, marketing, farm and agribusiness management, rural sociology, and agricultural law. These areas of study have gained importance as agriculture has matured and has become more diverse.

Agricultural Communications

Careers within the Agricultural Communications pathway include those that report and write agriculture-related news, prepare educational publications for printing, produce radio and television segments and videotapes, or perform marketing and public relations functions.

Agricultural Power, Structures and Technology

Agricultural Power, Structures and Technology has developed in the past century, at first through improved farm equipment. In more recent years, engineers have produced machinery that has been useful in the development of many agricultural fields of study. Agricultural engineering includes work in mechanical, electrical, environmental, and civil engineering; construction technology; and hydraulics.



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Animal Science

Animal Science includes the work to improve the production of a variety of animals used as food and other commodities throughout the world. The sciences include animal physiology, nutrition, breeding and genetics, ecology, and livestock and poultry management. Veterinarians study the health and diseases of animals.

Food Products and Processing

Food Products and Processing are actually a group of sciences and technologies related to the processing, storage, distribution, and marketing of agricultural commodities and by-products. The most significant development in this technology has been genetic engineering, which has used various chemical and biological processes to improve the production of food.



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Natural Resources and Environmental Science

The Natural Resources and Environmental Science pathway includes those careers that work to regulate and preserve resources such as forests, wildlife and water. They also work to take care of the environment through pollution and waste control, soil testing, and education.

Plant and Soil Science

Plant and soil sciences have been important to farmers for generations as they have improved crop management. Modern areas of study include physiology, nutrition, ecology, breeding and genetics, pathology, irrigation, fertility, and weed science. These areas of study have led to modern plant breeding, which has greatly increased the production of food by tailoring crops to the climates of various regions.

Career Goals

The choice of a career is one of the most important decisions you can make. However, career decisions are not easy. They result from careful searching and planning. Success in finding a rewarding career will depend on the work you put into a career search or interest inventory. By determining what your interests are, you will be better able to determine what path to follow when choosing a career. By following the steps in career decision-making and using sources of occupational information such as online databases, career counselors, and teachers, you can create a personal career plan and career goals.



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Step 1: Define your future needs and wants.

Where will you want to live? How much time will you want to devote to your job? How much traveling do you want to do? How much money will you need?

Step 2: Identify possible careers that suit you.

Choose possible careers that match your interests, skills, and personality, as well as your needs and wants. Are you interested in the public sector, private sector, or either? Does being an entrepreneur interest you?

Step 3: Gather career information about each possible career.

Research the employment outlook, job duties, working conditions, education and training requirements, and salary range.

Step 4: Evaluate your choices.

Compare your information from steps 1 and 3. Are your skills and abilities appropriate for the career? Will your personal values agree with the demands of the career? Will the rewards of the career satisfy you?

Step 5: Choose a career path.

You can always revise your plan, or even change your mind!

Step 6: Design a plan to reach your goal.

What is the career path that leads to the career you want? Where can you get needed education and training? How will you afford it? What courses should you take? If you're now in school, what part-time jobs could give you useful education and skills for the career you want? Are internships available?

Step 7: Be flexible.

Have a "plan of action" that you can modify if you change your plans or if the career field changes.

Interests and Skills

Before making a decision about a career, it is important to research it well. Sometimes there is more to a job than you realize. Often people see only the glamorous side of a career and fail to see what goes on behind the job title. Aside from the more typical considerations such as long hours or extensive travel, a job may have health hazards associated with it as well. Researching a career now may save you from unpleasant surprises in the future.



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Besides knowing the degree requirement, possible salary and job availability, you should also know the skills utilized within a career, along with the working conditions. If you enjoy working and visiting with people, there are particular careers that may suit you best. On the other hand, if you enjoy working alone without much social interaction, there are careers available that fit your personality as well.

General skills are often broken into subcategories. These subcategories will help you determine your skill strengths and weaknesses along with your likes and dislikes. Included in each subcategory list are examples of skills you might find on a skill inventory. By determining if you have particular skills or if you like to do particular tasks, you will have a better idea as to the type of job suited for you.



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Interpersonal Relations

- Coordinating work with others
- Speaking in small groups
- Handling complaints in person or over the phone
- Listening carefully and attentively

Technical/Hands-on

- Assembling, installing equipment to meet specifications
- Maintaining, inspecting, repairing
- Operating machines or equipment

Written Communications

- Writing, preparing logically written reports or proposals
- Demonstrate expertise in grammar and style
- Editing and proofreading written material
- Writing poetry, fiction, plays

Organizing/Researching

- Keeping records, cataloging
- Making diagrams
- Planning, making decisions
- Setting up and keeping time schedules

Analyzing/Investigative

- Developing budgets
- Using mathematical reasoning
- Using scientific rules and methods to solve problems
- Analyzing, interpreting, evaluating statistical data

Management/Leadership

- Delegating responsibility
- Increasing productivity and efficiency on budget and time
- Persuading others to change their minds or behavior
- Persuading, negotiating, selling

Create/Innovate

- Drafting, drawing, painting, sculpting
- Performing, creating art
- Expressing ideas or create images through art form
- Creating innovative solutions to complex problems

There may also be specific skills you have such as welding or cutting, taking photos, administering medications to animals, driving a tractor, or identifying plants that would make you more marketable to an employer. The goal is to determine what skills you have and work to develop skills you may need in order to be successful in a particular career.



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UNIT SUMMARY

Agriculture provides consumers products necessary for everyday lives. Behind the breakfast foods and jeans is the science of agriculture. Agriculture involves many different aspects of science such as botany and environmental science. Research in agriculture follows the scientific method, just as research in other fields. Research in

agriculture must have a hypothesis and experiments, and researchers must analyze the data to come to a conclusion. While shopping for products, consumers often do not think of the research or the agricultural production efforts behind their purchases.

Agriculture affects everyone and is much more than food. Agricultural products are included in many items such as clothing, construction materials, biofuels, cosmetics, cleaners, and pharmaceuticals. Farmers today are more efficient and produce more than previous generations. As technology plays a larger role in agriculture, topics such as genetic engineering become much more relevant to agriculture. Consumers today are surrounded by contrasting views of topics such as GMOs, hormone and antibiotic use, and organic vs. non-organic agricultural products. Consumers must become educated and be able to tell fact from fiction.

Agriculture or agriscience has many career opportunities. With the use of career clusters and pathways, you will be better able to match your skills and interests to a particular job area. It is important to set career goals and use a personal career plan when deciding the type of work you like. By using a personal career plan, you can determine the amount of money you would like to make along with the amount of further education needed. For those who choose a career in agriculture, their individual skills and interests will eventually lead them to a productive and rewarding career.

UNIT REVIEW

1. What is the difference between agriculture and agriscience?
2. What is the scientific method and its steps?
3. How many people does the average farmer feed each year?
4. How can GMOs benefit farmers and consumers?
5. Why are antibiotics used in agriculture?
6. What agricultural animals cannot have added hormones?
7. What does the USDA organic seal mean on products?
8. Describe career clusters and career pathways.
9. Name five career clusters other than Agriculture, Food and Natural Resources.
10. What are the pathways within the Agriculture, Food and Natural Resources cluster?
11. Which career pathway deals with animal genetics, physiology, and breeding?
12. What types of careers are within the Natural Resource and Environmental Science pathway?
13. Name the steps to creating a personal career plan.
14. Besides salary, what job characteristics would you need to consider when choosing a career?
15. What skills do you have that would benefit an employer?

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