AgriScience

Sixth Edition

Teacher's Manual

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PEARSON

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TO THE TEACHER

AgriScience is often considered to be the nation's leading teaching and learning approach for science-based agricultural education. The first five editions have filled prominent roles throughout the nation in grades 9 and 10. Now, the Sixth Edition will increasingly serve a major role in those classes with high expectations for student mastery. The new edition offers expanded and updated content based on local school courses of study, state education agency curriculum guides and standards, and the national standards. It will serve to develop a strong foundation for student success in more-advanced high school agriculture classes and postsecondary agriculture classes.

The Sixth Edition of ***AgriScience*** integrates and promotes achievement of the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards, released in complete form in 2009 by the National Council for Agricultural Education (**www.teamaged.org/councilindex.cfm**). The authors carefully considered the standards and structured content to promote correlation with the standards. No doubt, the use of ***AgriScience,*** Sixth Edition***,*** will assure extensive student development of the standards, particularly those in Level I.

The AFNR Career Cluster Content Standards are organized around the eight career pathways within the AFNR cluster. The pathways are (1) Agribusiness Systems, (2) Animal Systems, (3) Biotechnology Systems, (4) Environmental Service Systems, (5) Food Products and Processing Systems, (6) Natural Resource Systems, (7) Plant Systems, and (8) Power, Structural, and Technical Systems. These pathways are briefly listed and described in the textbook. The terminology has been changed to simplify concepts and make it easier to understand the pathways.

What changes make this edition better? Many content changes have been made in ***AgriScience,*** Sixth Edition. Several areas of existing content have been reorganized to better serve needs in teaching and learning. New chapters have been added to better cover the essential content. New chapters focus on veterinary science, plant production, and biotechnology. The book now has 30 chapters. Overall, the changes focus on the following:

- New approaches in biotechnology are included. These focus on genetically modified organisms, including stacking of genetic traits.
- A chapter has been added on veterinary science. The goal is to better acquaint students with the high interest area of animal care. Practices in veterinary medicine from the standpoint of a veterinary assistant are introduced.
- Increased emphasis has been given to the role of research and development in AFNR.
- The content on consumers and agricultural economics has been expanded.
- Information on genetics has been expanded to incorporate molecular approaches.
- Increased emphasis has been included on the role of computer technology in AFNR.
- New sections have been added on forestry and wildlife management.

- New sections on water systems and internal combustion engine maintenance have been added to the chapter on agricultural mechanics.
- Additional content has been included on practices in field crop production.
- The content on plant growth structures, particularly greenhouses, has been expanded.
- Many new illustrations have been added. The emphasis is on illustrations that have high appeal to students. Further, these illustrations are intended to promote the expanding diversity of human population in the United States.
- Emphasis on safety and safe practices continues, including the operation of motor vehicles that transport plant and animal products.

Emphasis on science principles in agricultural education has markedly changed the curriculum. Standards developed in many states to guide local programs speak to this science emphasis. The instruction focuses on the principles of science that provide a foundation in plant and animal production. Further, this applies to horticulture, forestry, natural resources, wildlife, environmental science, agricultural supplies and services, and products and processing. Instruction in agriculture entails using a science-based approach. The approach not only results in quality agricultural education but also motivates students.

AgriScience, Sixth Edition, is a textbook that stresses the fundamentals of science. The book is intended to be a teacher- and student-friendly text. It is supplemented with a Teacher's Manual, an Activity Manual, an Instructor's Guide to the Activity Manual, and other materials, such as a computer-based test bank and PowerPoint presentations to facilitate teaching and learning.

Beginning with the First Edition, this textbook has involved getting student and teacher input, using research findings and industry information, and field-testing procedures. Observations were made in agriculture classrooms throughout the United States. Standardized testing in agriculture was used to associate high student test score results with characteristics of the learning environment. Students in classes where textbooks were used scored 12 to 13 percent higher than students in classes where textbooks were not used.

Both content and procedures advocated in ***AgriScience*** have been tested in agriculture and science instructional programs. Further, the content contains many of the science concepts that are required so that agriscience classes can be used as laboratory science classes in the high school curriculum. No agriscience book can better fulfill this need than ***AgriScience,*** Sixth Edition.

PURPOSE

This Teacher's Manual for ***AgriScience,*** Sixth Edition, is designed to help the teacher provide instruction in the science and technology of agriculture. National and state standards have been integrated, as appropriate, in preparing this edition. Emphasis is on using a systematic approach to science-based instruction in agriculture. The manual includes an overview of the contents of the book, as well as suggestions for teachers in providing the instruction. Suggested teaching strategies include the use of motivational approaches and the application of the content in supervised experience programs.

Professional preparation of agriculture teachers has increasingly focused on the strategies and learning theories suggested in the Teacher's Manual. The newly released book ***Foundations of Agricultural Education*** (Pearson Education, Inc., 2014) is a professional preparation book for teachers. The book stresses approaches used in this teachers manual and in ***AgriScience***. A wide range of resources can be

used to enhance instruction. Local community resources, as well as those in the school facilities, are suggested. Collaboration with science teachers may be practical, depending on the situation. The agriscience teacher may choose to use the facilities in the science department of the school. Or, in other situations, the agriscience teacher may collaborate the science teacher to provide some of the instruction. Regardless, the approach used is intended to be easy for teachers to follow in providing quality instruction.

FORMAT OF THE TEACHER'S MANUAL

This Teacher's Manual uses a format that is common in agricultural education. The format is easy to follow in planning and delivering quality, systematic instruction. The Teacher's Manual is divided into various sections that will help the teacher in gaining student interest, providing the instruction, reviewing and re-teaching the concepts, evaluating achievement, and incorporating hands-on experiences into science-based agriculture.

The Teacher's Manual is divided into 30 chapters corresponding to the chapters in ***AgriScience,*** Sixth Edition. Each chapter is further divided into several sections:

1. **Chapter Summary—**This section contains a short summary of the chapter in the book. Additional information helpful to the teacher may be included.
2. **Instructional Objectives—**The objectives for each chapter are stated in measurable and observable terms from the perspective of the teacher. These objectives are the behaviors that learners should have upon completion of the instruction.
3. **Interest Approach—**This section presents a possible motivational interest approach based on the introduction to each chapter. Teachers are encouraged to relate the information to situations in the local area. Personalizing the interest approach will make it more effective with the learners.
4. **Instructional Strategies and Teaching Plans—**This section presents possible teaching strategies to achieve the objectives. The suggestions include strategies that can be used both with the book and with the Activity Manual. Pointers that may help in achieving equity in diverse student populations are also given. In addition, approaches for the integration of mathematics and communication skills are suggested. Strategies for higher-order thinking and problem-solving skills are often recommended. Cognitive, affective, and psychomotor strategies are included.
5. **Review and Evaluation—**Procedures for reviewing and evaluating the achievement of the objectives are given for each chapter. Re-teaching suggestions are also included, if re-teaching is needed.
6. **Safety—**Some activities could present special concerns about student safety. These concerns are mentioned, as appropriate, and reinforced in the Activity Manual. Safety concerns may also focus on the environment and with animals.
7. **Additional Resources—**This section contains references and other materials that the teacher may find useful in providing the instruction.
8. **Answers to Questions—**The answers to the review questions and the "Evaluating" section at the end of each chapter in the book are presented here.

OVERVIEW OF STUDENT EDITION

***AgriScience**,* Sixth Edition, presents the fundamental content for science-based instruction in agriculture. It explains the broad nature of science in agriculture and relates agricultural practices to various areas of science, including biological science, earth science, and physical science. The agricultural mechanics chapter has been expanded to include sections on water systems (both supply and wastewater) and on maintenance of small internal combustion engines. Mathematics, as the science of computation, is integrated throughout the book. Several appendixes presenting formulas and applications in agriculture are at the back of the book. New content on veterinary science has been included. Greater emphasis has been placed on the useful and important role of technology, with a "Technology Connection" in each chapter.

A companion publication to ***AgriScience*** is the Activity Manual. This student-centered manual is designed to reinforce the major concepts in the book as well as provide valuable hands-on learning of science principles. Maximum learning will result when the teacher uses both the book and the Activity Manual. The Activity Manual is divided into 30 chapters that are parallel with those of the student edition.

In both publications, to the extent possible, the reading level has been kept at or below ninth grade, making the text most appropriate for use in upper junior high/middle school or high school grades. Hundreds of photographs and line-art illustrations have been used to enhance the content. Many focus on youthful models and subjects of interest to students. Spacious layout and design enhance student and teacher use of the materials.

Emphasis is on practical, real-world experiences in agriscience and technology. Students are encouraged to carry what they learn beyond the classroom and laboratory into supervised experience activities and FFA participation through career development events, proficiency awards, or other areas.

AgriScience is divided into eight parts, or units. The 30 chapters are clustered into these eight parts. This structure is convenient for students and teachers in systematic instruction and learning. Teachers may sequence the instructional areas to best meet the needs of their students. In curriculum or instructional planning, the parts may be treated as instructional areas. The parts and chapters are:

Part One: The World of AgriScience

Part One introduces students to the meaning and importance of the Agriculture, Food, and Natural Resources Career Cluster. It lists and explains the eight commonly accepted career pathways. It also introduces important concepts of horticulture, forestry, and the modern agricultural industry. Emphasis is on a sustainable approach in using all natural resources. Part One has been revised to contain a chapter on Success and Safety in Careers. This part has three chapters:

Chapter 1—Science and Technology in Agriculture
Chapter 2—The Agricultural Industry
Chapter 3—Success and Safety in Careers

Part Two: Science in Agriculture

Part Two provides fundamental information on the meaning and importance of science in agriculture. It includes information on Earth's living things and how these

relate to nonliving resources. It also shows the relationship between all living things and the processes that are involved. The new domain approach to the classification of living organisms is included. Genetics and biotechnology are covered in Part Two. This part has five chapters:

Chapter 4—Science Relationships
Chapter 5—Living Things
Chapter 6—Classifying and Naming Living Things
Chapter 7—Genetics Applications in Agriculture
Chapter 8—Biotechnology in Agriculture

Part Three: Plant Science

This part includes the basics of plant biology and applications to gain products needed by human life. It presents the basic principles of plant and soil science as well as the procedures in culturing crop and ornamental plants. Culural practices with key crops are presented. A section on home vegetable gardening is included. The content is the perfect background for classes in horticulture, forestry, or crops. The chapters are:

Chapter 9—Plant Structure and Growth
Chapter 10—Reproducing Plants
Chapter 11—Plant Growth and Culture
Chapter 12—Plant Health
Chapter 13—Soil and Land Science
Chapter 14—Plant Production

Part Four: Animal Science

Part Four includes the fundamentals of animal biology, with emphasis on the major livestock, poultry, and aquaculture species. This part contains information on the biology of animals and general cultural practices. It contains information on veterinary science, with information useful to students who may be thinking of veterinary medicine as a career or pursuing another animal health career. The content provides a good foundation for advanced courses in animal production, veterinary science, companion (small) animals, animal wildlife, and related areas. The chapters are:

Chapter 15—Animal Biology
Chapter 16—Animal Nutrition and Feeding
Chapter 17—Animal Breeds and Breeding Systems
Chapter 18—Promoting Animal Health
Chapter 19—Animal Care and Well-Being
Chapter 20—Veterinary Science

Part Five: Natural Resources and Earth Science

This part covers the role of earth science in agriculture. Basic natural resources and environmental science information, is included. The two chapters should provide a strong background for advanced classes in environmental science, forestry, or natural resources. The content also integrates effectively with academic courses, including those dealing with meteorology and weather. The chapters are:

Chapter 21—Natural Resources and the Environment
Chapter 22—Earth Science

Part Six: Physical Science and Technology

This part includes fundamental content on chemistry and physics in agriscience. Important chemistry and physics concepts are presented and applied to agriculture. The content on physics includes simple machines and their applications in agriscience. The

chapter on agricultural mechanics introduces important knowledge and skill areas. New information is in Chapter 25 on water supply and wastewater systems and on the maintenance of small internal combustion engines. The chapters are:

Chapter 23—Chemistry in AgriScience
Chapter 24—Physics in AgriScience
Chapter 25—Mechanics in AgriScience

Part Seven: Consumers and Products

Part Seven stresses the processes involved in moving food, fiber, and forestry products from the producer to the consumer. It begins with background information on economics and economic systems, free enterprise, and business ownership. It describes supply-and-demand factors, including the interaction of the supply-and-demand curve. The emphasis is on the technology in the processes to meet consumer demand. The two chapters are:

Chapter 26—Agricultural Economics: Management and Marketing
Chapter 27—Processing Agricultural Products

Part Eight: AgriScience Education and You

This part introduces the importance of work and careers. It covers how to go about gaining the education and experience for success in the agricultural industry. Supervised experience, FFA, and leadership are covered. Special emphasis is placed on being a capable leader in the agricultural industry. This part has three chapters:

Chapter 28—Education and Experience in Agriculture
Chapter 29—Student Organizations
Chapter 30—Leadership Development

GENERAL CHAPTER FORMAT

Each chapter begins with a short introduction that provides background information for the chapter. This is followed by a list of objectives and a list of important terms in the chapter. The content follows, with sections based on the objectives. Important terms are in colored bold italics. A summary reiterates the main ideas at the end of the contents of each chapter. Review questions, which follow the summary, are designed to help both the teacher and the students review the chapter content and to help the teacher reinforce and re-teach, as necessary. A short evaluation section is included. Hands-on “Exploring” activities are suggested at the end of each chapter in the text.

Local situations and needs may dictate the sequence and depth of instruction in the instructional areas. Teachers can vary these to suit individual preferences and student motivations.

Appendixes

The textbook contains appendixes filled with mathematical conversions, equivalents, and formulas. Practical examples of approaches in calculating volumes, areas, and other agriscience work are included. Weights and measures as commonly used in agriculture have been included. The formulas for board foot calculations and temperature conversions have useful applications in agriscience.

CLUSTER AND STANDARDS

The States’ Career Clusters Initiative (SCCI) and the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards are having an impact on

the organization and structure of programs and instruction in agricultural education. These are national efforts that states turn to for guidance in the delivery of agricultural education. Local programs of agricultural education are being influenced by these efforts.

CAREER CLUSTERS

The States' Career Clusters Initiative was launched over a decade ago (2002). It is an effort established under the National Career Technical Education Foundation (NCTEF). The goal is to provide career clusters as a tool for seamless transition from education to careers. The SCCI has materials available to aid in the implementation of the career clusters as the structure of curriculum planning and delivery. (For more details, go to **www.careerclusters.org/**.)

All occupations have been divided into 16 career clusters. One of the career clusters is AFNR. Within the clusters, further divisions are made into pathways. Pathways reflect similar knowledge and skill within a career cluster. AFNR has eight pathways. The pathways are briefly summarized in the accompanying table. Chapter 1 of the textbook has some detail appropriate for student use. (Note: All materials of the SCCI are protected by copyright. Information presented here is a summary and paraphrased to assure appropriate use.)

A Summary of AFNR Career Pathways

Animal Systems—This pathway deals with the production and care of animals and their products, such as those used for food, clothing, and companionship. Examples of occupations include poultry scientist, fish nutritionist, beef cattle producer, dairy farmer, veterinarian, small animal breeder, and sheep rancher.
Plant Systems—This pathway addresses the production and care of plants and their products, including those used for food, clothing, shelter, and beautification. Examples of occupations include wheat producer, tree surgeon, forester, agronomist, greenhouse grower, floral designer, cotton farmer, and grain inspector.
Power, Structural, and Technical Systems—This pathway deals with the use of machinery, power, fuels, and other inputs for production in AFNR, including agricultural mechanics areas, such as wood construction, metals fabrication, and electricity. Examples of occupations include tractor mechanic, farm equipment operator, poultry house builder, agricultural engineer, remote-sensing specialist, and agricultural welder.
Biotechnology Systems—This pathway was added by the agricultural education profession. It was not provided as an AFNR pathway by the SCCI. The pathway deals with the use of organisms and their processes to achieve products and gain important benefits; genetics, molecular biology, and various technologies are used in the cluster. Examples of occupations include soybean geneticist, agricultural molecular biologist, plant biotechnology technician, animal disease researcher, and corn breeder.
Agribusiness Systems—This pathway addresses the application of business principles and practices in AFNR; emphasis may be on nonfarm applications. Examples of occupations include agricultural economist, chemical sales representative, agricultural accountant, commodity broker, and farm loan officer.
Food Products and Processing Systems—This pathways focuses on the application of science and technology to develop, prepare, preserve, and otherwise improve human food materials and processes. Examples of occupations include milk sampler, meat grader, produce buyer, cannery manager, quality control specialist, food safety biologist, and frozen-food plant manager.
Natural Resources Systems—This pathway deals with the use and protection of natural resources to assure sustainability in meeting future human needs. Examples of occupations include wildlife specialist, soil conservationist, ecologist, water quality technician, range manager, mine specialist, and fishing guide.

Environmental Service Systems—This pathway deals with the use of technologies in assuring a quality environment, including providing for human needs and managing wastes. Examples of occupations include wastewater technician, solid-waste technician, landfill manager, recycler, hazardous materials specialist, toxicologist, and air quality control specialist.

STANDARDS

The agricultural education profession set about to develop curriculum content standards through the National Council for Agricultural Education in the early 2000s. Collaboration of all professional components in agricultural education and the National FFA Organization helped move standards development through a highly rigorous process of industry, educator, and scientist involvement and validation. The final version of the AFNR Content Standards was released in early 2009 by The Council. The standards development work was carried out by the Center for Agricultural and Environmental Research and Training (CAERT), Inc., under contract with the National Council for Agricultural Education.

The standards are organized by career pathway and in three levels of educational attainment. The levels of educational attainment are: Level I—comparable to introductory high school; Level II—comparable to upper high school; and Level III—comparable to advanced high school, postsecondary, or college knowledge and skill. Further, the AFNR validated standards were aligned with national academic standards in four areas: science, mathematics, social studies, and English language arts. This alignment increases the utility of the standards in local schools seeking integration of academic content into agricultural education classes.

The contents of ***AgriScience***, Sixth Edition, will promote achievement of many of the Level I standards. For example, one of the standards in the Animal Systems pathway is: "AS.02.01.02.a. *Identify major animal species by common and scientific names.*" This standard is met by ***AgriScience***, Sixth Edition, in Chapter 6. Since these standards are copyright protected, you should gather the complete standards for your individual professional use at the following Web site: **www.teamaged.org/councilindex.cfm**. The standards in the eight career pathways have been carefully written, authenticated, and validated for use in agricultural education.

In recent years, the Common Core State Standards (CCSS) have begun to have a substantial impact on the delivery of academic education in a number of states. The National Association of State Directors of Career Technical Education and the Association for Career and Technical Education have attempted to address the CCSS by setting forth a document promoting better understanding of the role of career and technical education with the CCSS. As a part of Career and Technical Education, agricultural education has a substantial role in promoting academic achievement. More information is available in *Common Core State Standards & Career and Technical Education: Bridging the Divide between College and Career Readiness*, (2012). Individuals desiring more information can access this publication online at: http://www.achieve.org/files/CCSS-CTE-BridgingtheDivide.pdf.

An initiative in agricultural education that some schools and teachers are using is known as CASE: Curriculum for Agricultural Science Education. With CASE, individuals are setting a relatively consistent curriculum nationwide. Participation in CASE requires considerable financial investment by schools. Teachers must attend inservice education to qualify as a CASE teacher. Science and mathematics are areas of emphasis. For more information, go to: www.case4/learning.org/.

INSTRUCTIONAL PLANNING

Instructional planning philosophies and approaches in agricultural education vary in the United States. The direction offered by states varies. Some states have specific curriculum guides and standards that are to be followed in all local schools. Other states

allow local schools and teachers considerable flexibility in program planning. Regardless, teachers have increasing accountability in the educational process.

As Talbert, Vaughn, Croom, and Lee state in their book entitled *Foundations of Agricultural Education* (2014; Pearson Education, Inc.), "Increasing pressure is felt from parents, the private sector, and government agencies for schools, programs, and teachers to be accountable for student learning." They explain that "accountability means that the school, program, or teacher is held answerable or responsible for student learning and achievement" (page 142). They further present several curriculum models that may be useful in planning a local program of agricultural education. Course content, sequence, and expectations are felt to be important in student achievement. Using local advisory groups and following state guidelines can be very useful in having accountability in agricultural education.

Talbert, et al., continue in their book with instructional resource needs, such as laboratories, materials, and instructional resources. They indicate, "Achieving goals in education requires resources just as much as making achievements in other areas of our lives and society" (page 181). Schools vary in the instructional resources provided. How does the lack of adequate instructional resources play into accountability? How can a teacher be held accountable when the needed resources are not available?

Many schools have found that providing modern student-focused materials and allowing teachers to provide on-task instruction promotes student mastery as assessed on standardized tests. Fortunately, agricultural educators often have laboratory facilities to give meaning to the content through hands-on participation.

INSTRUCTIONAL INTERACTIONS

Highly important instructional interactions occur in an agricultural education classroom and laboratory. These interactions are built upon the planning that has gone into developing the program and delivering the instruction. They reflect the standards for agricultural education as developed at the state and local levels as well as national input into occupational competencies and guidelines for instruction. Funding to local schools for agricultural education may be associated with the classes offered, curriculum outline, and achievement of students on standardized tests in agricultural education.

The instructional interactions reflect a contract between the teacher and the learners. Each learner's participation and perceptions vary depending on past experiences and values toward education. The strength of the contract depends on the commitment of each to the learning interactions. Teachers are there to teach; learners are there to learn. Both must exert effort for a transaction (learning) to occur. A teacher has the responsibility of promoting an efficient interaction even with a student who may not always be committed to the process.

A short summary of proven teaching strategies is presented here. For more details, teachers should refer to *Foundations of Agricultural Education,* Second Edition, cited earlier.

TEACHING AND LEARNING

Two major interactions occur in agriscience instruction: teaching and learning. ***Teaching*** is directing the learning process of others. A wide variety of strategies and resources are available. Teachers must select those that have the greatest return in terms of student achievement.

Learning is acquiring information, skills, or attitudes so that future responses are different from those of the past. "Learnings" vary widely. They may involve, among other things, the ability to read and comprehend information, to carry out a demonstration, or to perform a skill related to a process.

The ultimate goal of all teaching is to facilitate learning. The learning process must be so managed that the student efficiently and maximally acquires the desired learnings. The focus must be on the student.

Teachers who are not familiar with current learning theories may wish to familiarize themselves with those summarized in the book *Foundations of Agricultural Education,* by Talbert, et al. Behaviorism is still prominent but is being enhanced with the cognitive and brain-based theories. Constructivism is a learning theory that focuses on how students process new information and skills. Each learner has a guide, abstract though it may be, that organizes experiences and concepts in the learning process. The newer theories well accommodate the "learning by doing" philosophy that is so important in agricultural education.

STUDENT-FOCUSED TEACHING

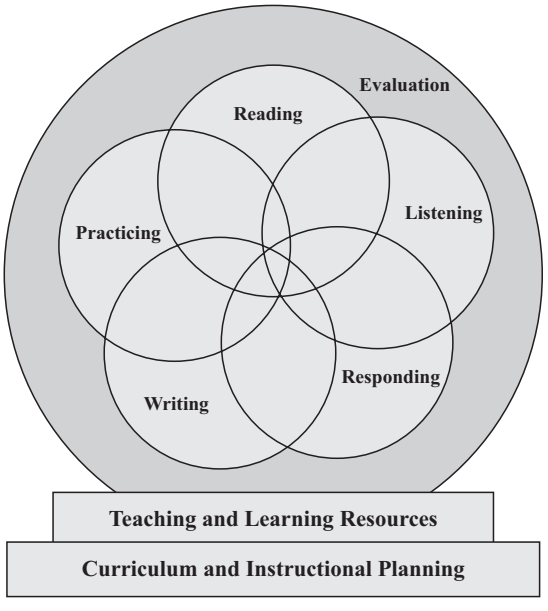
Student-focused teaching is instruction that actively involves students in the teaching-learning interaction. It is a directive process but allows flexibility for student and situation differences. Students may need to be taught how to benefit from student-focused teaching. Contrast student-focused teaching with teacher-focused teaching, in which only the teacher has learning materials and is the sole source of information.

The teaching strategy for student-focused teaching in agriscience is RLRWP-E. The model is supported by planning and resources. Planning includes both curriculum and instructional areas. Resources include those used by both students and the teacher. RLRWP-E is a process of student involvement that uses continual student assessment and feedback. The process is carried out with teacher involvement and learner direction. Both teachers and students are active.

Here is the meaning of RLRWP-E:

R—Reading
L—Listening
R—Responding
W—Writing
P—Practicing
E—Evaluation

Student-Focused Teaching Model Using RLRWP-E



All stages of RLRWP-E engage students in meaningful activity directed toward mastering agriscience content objectives. Repetition using varied student roles and sensing receptors (eyes, ears, etc.) enhances learning. The stages do not necessarily fall in a specific sequence, though some sequence is inherent in RLRWP-E. Students can read, listen, respond, write, and practice at various times throughout a lesson. Teachers can enrich the process with locally relevant examples, applications, and instructional resources.

Reading

Students learn by reading. Students also increase their ability to read and expand their vocabulary by reading. Reading should be carefully directed by the teacher on content that promotes achievement of the instructional objectives. Reading involves visual acuity. The sense of vision detects codes, known as letters, that are used to form words. The reader derives meaning from the words and supporting illustrations. Student-friendly textbooks are essential. That is why ***AgriScience,*** Sixth Edition, was so carefully designed. It has appropriate terms, is well illustrated, and provides for the needs of the teaching-learning interaction. The textbook is written at the appropriate reading level. Reading may be assigned as homework, be included in supervised study, or be done aloud in class.

When combined with listening, responding, writing, and practicing, directed reading helps produce strong learning results.

Listening

Listening uses the sense of hearing. Students hear words and subjects discussed. Some students may lack the ability to listen. If so, the ability to listen may require some skill development by speaking and having students respond orally and by rote with information that was spoken.

Listening helps students internalize information and become articulate in the content they have read. The teacher may use realia (real things) in presentations to help students make connections between what they hear and technical content. Realia include models, specimens, demonstrations, experiments, supervised experience, audiovisual media, and other enriching resources. The use computer-based and online learning approaches is enhancing sensory involvement in agricultural education. Such learning opportunities should be carefully chosen and reviewed by the teacher within local school policies.

Responding

Responding requires an active role by students. They are expected to speak or otherwise communicate the information involved in the teaching-learning interaction. Responding may involve students answering questions, providing oral reports, and discussing content topics. Other approaches with student response include having students prepare computer-based presentations, develop posters, or build displays.

Responding can follow reading. As some students respond, others are listening and hear content information being spoken. Responding may also raise the need for additional reading to prepare a report or to carry out an activity or practice. How the teacher directs the process involves continual assessment of student engagement, mastery, and participation.

Writing

Writing further reinforces terms, meanings, processes, diagrams, and other content-oriented information. It also promotes reading, spelling, and communication skills. Writing involves having students record key concepts from their reading, listening, and responding.

The writing stage is recording information in notebooks. The information is often that which was summarized on the writing surface by the teacher. This may be partially accomplished by having students answer questions and define terms from the textbook or do the activities in a lab or activity manual. Students may prepare written reports on field trips, resource-person presentations, or other observations or feelings about subjects related to the class. In some cases, laptop computers may substitute for paper notebooks.

Practicing

Practice is a major way of reinforcing student mastery and providing meaning to abstract concepts. Examples of practice are performing experiments, conducting demonstrations, doing skill-oriented activities, and manipulating various devices.

Practice is often carried out in the school laboratory but may be done elsewhere in other ways. Supervised experience is an excellent opportunity for practice in a real-world setting. FFA activities also promote practice in career development events, proficiency awards, and leadership development events.

Practice activities should be selected to support the instructional objectives. Choosing activities that are not related to the objectives is contrary to the notion of systematic instruction.

Many resources are available to help with practice. One example is the student activity manual. Often referred to as a lab manual, this item integrates review and enhancement of basic information with hands-on learning. Many of today's textbooks have activity manuals that are directly correlated with the content of the textbooks.

Evaluation

Evaluation is a continuing process. Teacher observation of the extent to which students focus on achieving the objectives is ongoing. Student participation and response in RLRWP-E is the basis of evaluation. The "Evaluating" section at the end of each chapter is useful but is only the beginning of continual student assessment, feedback, re-teaching, and other teacher functions to assure learning. Teacher-made tests, as well as test banks, activity manual results, and actual performance, are important in evaluation.

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The next section of the Teacher's Manual is organized by chapters parallel to those in the student edition of ***AgriScience.***

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Note: It is essential that each student have a copy of ***AgriScience,*** Sixth Edition, issued to him or her. At the time of issuance, it will likely be a good idea to go over the book briefly with the students while emphasizing content and organization. The students need to appreciate that ***AgriScience*** is an integral learning resource for their use. Throughout the class, strive to assist students in understanding how to use a textbook as a quality learning tool. The RLRWP-E model will certainly promote the goal of student mastery.

PART ONE: THE WORLD OF AGRISCIENCE

1

SCIENCE AND TECHNOLOGY IN AGRICULTURE

CHAPTER SUMMARY

Agriscience education is the study of science principles in producing food, fiber, and wood products. In agriscience, the application of science is often viewed interchangeably with technology. Technology is the application of science through inventions and other means. Only appropriate technology should be used; it is the technology that best meets the needs of people in a practical way.

Instruction in agriscience is organized around the Agriculture, Food, and Natural Resources (AFNR) Career Cluster and the eight pathways. The pathways are animal systems; plant systems; power, structural, and technical systems; biotechnology systems; agribusiness systems; food products and processing systems; natural resource systems; and environmental service systems.

AFNR promotes activities that meet human needs. Basic human needs are for food, fiber, and shelter. Throughout history, these needs have been met in different ways. Early humans hunted for plants and animals. Gradually, the plants and animals were domesticated to make it easier for humans to obtain needed food, fiber, and shelter. Many changes have occurred over the centuries in how people meet their needs.

Modern agriculture provides for these needs by incorporating science and technology to produce quality products that are convenient to use. The notion that agriculture is hard-labor farming has changed; agriculture is now high technology that involves the most sophisticated scientific practices.

Agriculture is the science of growing crops and raising animals. Many inventions, supplies, and services from off the farm have increased productivity. Marketing and processing provide the products in convenient and wholesome forms. Together, these comprise the agricultural industry.

In addition to meeting food, fiber, and shelter needs, the agricultural industry deals with the areas of ornamental horticulture, renewable natural resources, and outdoor recreation. Pets and exotic plants and animals are also a part of the agricultural industry. The use of animals in competitive events, such as rodeos and racing, has expanded.

Many career opportunities are found at all levels in the agricultural industry. The education and experience of the people who work in these careers are important. Nearly 20 million people are employed in the broad agricultural industry in the United States. With only 2 million of these people working in production agriculture, the greatest number of opportunities are in the supplies and services, marketing, and processing areas.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the broad nature of the modern agricultural industry and the interdependence of the nations of the world.

Upon completion of Chapter 1, the student will be able to:

1. Define and relate the meaning of science and technology in agriculture.
2. Explain the meaning and importance of AFNR.
3. Identify career pathways in AFNR.

4. Explain the importance of AFNR in human needs.
5. Discuss the economic impact of agriculture in the United States.

INTEREST APPROACH

Many approaches are available to teachers to stimulate interest and to motivate students as Chapter 1 is taught. Much of this rests with the creativity of the teacher. Teachers usually have techniques that are suited to their particular situations and student needs. One approach is given here.

After the students have read the introductory part of the chapter, ask them to name their favorite foods. List these on the writing surface. Ask the students to compare their preferences with those of people in other areas of the world. Move from the interest approach to the food needs of people, as presented in the first part of the chapter. Teachers may also wish to review the objectives at this time. This may involve referring students to the list in the book, having the students read the objectives aloud, reading the objectives to the students, or using prepared electronic presentation materials. Regardless, students need to know that the major headings in the chapter correspond to the objectives at the beginning of the chapter.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

After the interest approach, the teacher may use a variety of techniques. Activities in the Activity Manual will help reinforce major terms and concepts as well as provide hands-on learning opportunities. Students may complete the activities in the Activity Manual after the chapter content has been covered. The Activity Manual may be assigned as homework or may be completed during supervised study or laboratory time during the regular class period.

One strategy is to have the students read the chapter outside of class or to have them read sections in class during supervised study. This should be done deliberately and in a sequence that best meets instructional needs. Reading is followed by a general presentation and discussion of the chapter content so the RLRWP-E model is implemented. Major concepts or points are listed on the writing surface. Students are asked to provide the information to cover the concept. The key words are written underneath the major concepts on the writing surface. Each student should participate orally and should keep an agriscience notebook in which salient information is recorded. The major headings (corresponding to objectives) are at the top of a page in bold type and with a line above and below. These headings may be "readable amounts" for students.

Careful class discussion and review may be appropriate for the career cluster and pathway information. In some schools, students may be responsible for developing career cluster plans of study. These plans are intended to connect student studies in school with future career entry and advancement. As content on the career pathways is being discussed, the concepts of plans of study may be introduced.

The questions at the end of the chapter can be used to structure the discussion or to review the content. Most teachers find it best to use classroom presentation to cover the content and the questions to review or evaluate learning.

Techniques of teaching should include relating the information in the chapter to agriculture in the local area. A local historian could be asked to serve as a resource person to describe how agriculture has changed. Another technique would be to have a resource person from another country describe food, fiber, and shelter uses and preferences in that particular region. In some cases, exchange students may be enrolled in the class and can assist with international understanding.

A part of the chapter focuses on helping students identify possible careers of interest. Students could interview people who work in the agricultural industry or invite resource people to the class. Students could prepare written or oral reports. In some cases, students could complete one or more of the "Exploring" activities at the end of the chapter. This discussion can be combined with discussion of the economic impact of agriculture in the United States. Additionally, this can be related to states and local area communities.

The Career Profile, AgriScience Connection, Technology Connection, Internet Topics, and Academic Connection can be used as best fits the instructional sequence, available time, and student needs and interests. These can be used to enrich, motivate, or otherwise create interest.

The introductory part of the Activity Manual (prior to Chapter 1) could be covered here to introduce students to laboratory safety and procedures. This will enhance the emphasis on science in the agriculture program.

REVIEW AND EVALUATION

After covering the chapter objectives, review achievement and assess each student's mastery of the

content. This can be accomplished in several ways. Some teachers prefer having students explain each of the objectives and terms at the beginning of the chapter. Other approaches include using sections in the Activity Manual and written or oral testing. Teachers can use tests they have developed or select questions from the computer test file. In addition, they can assess achievement through the responses of students in supervised practice activities, science activities, and other activities. Computer test banks and online testing may be used in some schools.

The "Evaluating" section at the end of the chapter can be used as appropriate for completion during supervised study or as homework. Follow-up class discussions are ideal with this activity to reinforce student learning and mastery.

SAFETY

The objectives of this chapter do not include learning outcomes that would pose safety hazards. Safety should always be an integral part of instruction even if hazards unique to a particular chapter or lesson are not present.

The Activity Manual has an introductory section on safety in the laboratory. Covering this part of the Activity Manual can help students understand the importance of safety and the safety codes that are used.

ADDITIONAL RESOURCES

The additional resources that would be most appropriate here are reports of agricultural information for the local area and state. Statistical information on production, the number of farms and agribusinesses, and the kinds of employment opportunities would be useful.

The division of agriculture at any college or university will likely have excellent materials for the area it serves. Some materials may be available online through the Web site maintained by the land-grant college or university in your state.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, or other details in the answers.

1. What is agriscience? What is the distinction between applied and basic agriscience?

Agriscience is the use of science principles in producing food, fiber, and wood products (often used for shelter). Applied agriscience is the use of knowledge in the production of plants and animals. Basic agriscience deals with how a process works though the information may appear to have little practical value.

2. What is technology?

Technology is the practical application of science through inventions or research and development.

3. What is AFNR? Why is it an important career cluster?

AFNR is the abbreviation for Agriculture, Food, and Natural Resources. It is an important career cluster because it deals with meeting the fundamental needs of human life.

4. What is a career pathway?

A career pathway is a group of careers based on similarities of duties, subjects, and skills.

5. What are the career pathways in AFNR? Name one occupation in each pathway.

The career pathways in AFNR are Animal Systems; Plant Systems; Power, Structural, and Technical Systems; Biotechnology Systems; Agribusiness Systems; Food Products and Processing Systems; Natural Resource Systems; and Environmental Service Systems. (The occupations named in each pathway may vary. Refer to Table 1–1 in the textbook, pages 8–9, for a greater listing of occupations.)

6. What is a human need? How do human needs relate to AFNR?

A human need is an essential element or component that supports human life. AFNR produces food, clothing, and wood materials that help satisfy human needs.

7. What are the three main kinds of human needs met through AFNR?

The needs of people are food, fiber, and wood products like shelter. These are important for nutrition and health and to protect the human body from dangers in the environment.

8. **What are the two major sources of food? Briefly explain each source.**

   The two main sources of food are plants and animals. Both plants and animals are living organisms that can be cultured for their products. Plant sources are the parts of plants, such as leaves, fruit, and roots. Animal sources are the animal products that are used to meet human needs.

9. **What is fiber? What are the sources of fiber?**

   Materials used to make clothing and fabric products for the home are called fiber. (In addition, some forestry products are known as fiber—for example, paper.) The major source of fiber is cotton, which is a plant; others are linen from flax and twine or rope from hemp. Three common animal fibers and examples of the animals that produce them are wool, sheep; fur, rabbit; and silk, silkworm.

10. **What is forestry? How does it relate to meeting human needs?**

    Forestry entails all of the processes in growing trees and manufacturing them into products. Five kinds of products are lumber, plywood, veneer, composition board, and paper. These help meet human needs for shelter and housing comforts.

11. **What is the distinction between feed grains and food grains?**

    A feed grain is a grain crop grown to provide feed for animals. A food grain is a grain crop grown to be used as a source of human food.

12. **What is the Census of Agriculture? How often is it done? How is the information collected?**

    The Census of Agriculture is an initiative of the Federal government to collect and report detailed agricultural information. It is done every five years (years ending with a 2 and a 7). Information is collected from farm and ranch producers by mailing a survey form to them.

EVALUATING

1=b, 2=g, 3=a, 4=i, 5=c, 6=h, 7=j, 8=d, 9=f, and 10=e

2

THE AGRICULTURAL INDUSTRY

CHAPTER SUMMARY

The agricultural industry is a complex system that provides for basic human needs with food, clothing, and wood products (shelter). The industry is large and diverse. Agriculture is the science of growing crops and raising livestock and other animals used for food, fiber, and other purposes. The agricultural industry is all of the processes involved in getting the products of agriculture produced and made available to the consumer. It includes three major areas: supplies and services, production, and marketing and processing.

Today, plant and animal production requires many things from off the farm. These inputs are known as supplies and services. Agricultural supplies are the inputs (materials, equipment, etc.) used to grow crops and to raise livestock. Agricultural services are the skills and knowledge of people who are highly trained to help with production.

Production agriculture is the farming part of the agricultural industry. It involves crops, livestock, and livestock products. The people who do the work are known as farmers or agricultural producers. Today's farms are specialized. Most farms produce only one or two crops or products. For example, a dairy farm will likely produce only milk to sell. A corn farm may grow corn and nothing else. The corn is sold to a mill or to a farmer who has livestock to feed. These are commercial farms because they are producing for a specific market.

Marketing and processing are important in providing the kinds of products people want. People who buy and use products are known as consumers. Not many people buy directly from producers. Consumers

often buy specially prepared products, such as for ease of cooking.

A major event in the history of agriculture was the domestication of some plants and animals. This was a long, gradual process. The emergence of commercial agriculture and the use of scientific means were big steps forward. Today, the agricultural industry is a highly technical and highly sophisticated endeavor.

Biosecurity is the use of approaches to manage risk and to assure the production of disease-free animals and other products. The goal is to prevent the intentional damage of a product or damage caused by biological agents and pathogens, which could result in the products being unsafe for consumption.

Agricultural practices vary in areas around Earth. Some nations have agricultural systems that are technologically very advanced; others continue to be primitive.

A number of organizations are important in the agricultural industry. These organizations serve useful roles for their members. Collectively, the members of these organizations have more power than individual members would have alone. Some organizations are for individual members; others are for businesses or companies. Most have some sort of dues structure to finance their operation. Organizations may focus on membership development, improvement of a commodity, political action to gain favorable laws, and promotion of a commodity. In agriscience, all organizations are grouped into one of two categories: professional or commodity.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the broad nature of science and technology in agriculture. Areas of science are reviewed as related to agriscience.

Upon completion of Chapter 2, the student will be able to:

1. List and describe three major areas of the agricultural industry.
2. Discuss major events in the history of agriculture.
3. Compare international agricultural practices.
4. Explain the meaning and importance of biosecurity.
5. Explain the role of professional and commodity organizations.

INTEREST APPROACH

Use an approach to gain the interest of students and to motivate them to achieve the objectives that are relevant to the local situation and student needs. One approach is suggested here. Various modifications can be made to suit student needs and interests.

Have students read the introductory part of the chapter. Using the questioning process, ask about superstitions. Determine if the students know of local superstitions related to agriculture, such as planting crops by the signs of the moon and treating cattle for hollow-tail disease. In addition, give other examples of superstitions, such as bad luck caused by breaking a mirror or allowing a black cat to cross in front of a person. Ask students to explain how science helps overcome superstitions. Science is used to find answers to questions. (Teachers may wish to review the objectives at this time.)

Another strategy is to have a member of a local commodity group serve as a resource person and discuss the mission and goals of the organization. In some cases, students' families may be members.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Following the interest approach, the teacher can use several strategies to cover the content of the chapter. The Activity Manual has useful activities to reinforce terms and concepts, to help students develop thinking skills, and to provide hands-on experiences.

The teaching strategy and plan could consist of having the students read the chapter or sections of it prior to class or in supervised study. The chapter content should be presented and discussed. Major concepts should be listed on a writing surface or shown with electronic presentation software. Students should record the information in their agriscience notebooks. (Remember, RLRWP-E is a strategy of repetition involving different student senses in the learning process.)

The terms "agriculture" and "agricultural industry" should be carefully defined. Students should be called on to provide feedback orally on the concepts involved.

The three major areas of the agricultural industry should be carefully covered: supplies and services, production, and marketing and processing. Examples of farms and businesses involved in these areas in the local community can be identified and discussed. Refer students to Tables 2–1 and 2–2. Ask them to relate the tables to agriculture in the local community. Also, cover terms such as agronomy, horticulture (including

landscaping, olericulture, floriculture, and pomology), forestry, animal science, poultry science, and aquaculture.

Go over the highlights of agricultural history. Students may take a field trip to a local agricultural history museum. In some cases, a knowledgeable resource on local agricultural history may be used.

Biosecurity has emerged in recent years as a concern. Have students list examples of local practices in agriculture related to biosecurity.

Go over the roles of professional and commodity organizations in agriculture. Distinguish between the two kinds of organizations. Students can also discuss the goals of organizations with members of local organizations or commodity groups.

REVIEW AND EVALUATION

After the chapter has been taught, review the content and evaluate student achievement. Re-teaching in some areas may be needed. Involve students in reviewing by having them answer the questions at the end of the chapter. This will be helpful in reviewing and evaluating.

Students should complete the items in the "Evaluating" section for positive reinforcement and for assessment. A written test can be used after the chapter has been covered. Activities in the Activity Manual may also help in review and evaluation. These same activities are beneficial in re-teaching and reinforcing important concepts.

How students perform in their supervised practice, as related to chapter objectives, is an excellent way to evaluate their learning.

SAFETY

The activities involved in achieving the objectives of this chapter do not present safety concerns.

One topic in the chapter particularly lends itself to a discussion of safety issues: food safety. Students may be asked to give examples of food that was unsafe or of people who got sick from eating bad food.

ADDITIONAL RESOURCES

Additional resources for the chapter include examples of the following: reports of research from agricultural experiment stations, agricultural magazines, and reference materials on various areas of science. Some teachers may also wish to include reference materials on international trade and biosecurity.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more detailed information, the use of complete sentences, or other details in the answers.

1. **What is the meaning of agricultural industry?**

   The agricultural industry is all of the processes involved in getting the products of agriculture produced and made available to the consumer in the desired forms.

2. **What are agricultural supplies and services? Why are they important?**

   Agricultural supplies are the inputs used to grow crops and to raise livestock. Agricultural services are the skills and knowledge of people who are highly trained to help with production. These are important because they allow the modern agricultural industry to be productive. Producers do not have to be self-sufficient with the inputs used.

3. **What is production agriculture?**

   Production agriculture is the farming part of the agricultural industry. It is growing crops and raising animals and their products.

4. **What are the major crops and animal species produced in the United States?**

   Major crops include rice, cotton, wheat, corn, and others as listed in Table 2–1. Major animals and animal products are hogs, sheep, goats, cattle (beef and dairy), and horses. Others listed in Table 2–2 also would be good answers for this question.

5. **What is horticulture? What are four areas of horticulture?**

   Horticulture is the science of growing vegetable, ornamental, fruit, and similar plants to meet human needs and to create a more pleasing environment. Four areas of horticulture are: ornamental horticulture, floriculture, landscaping, and olericulture. A fifth area is pomology. Any

four of the five areas would be appropriate for the answer.

6. What is forestry? What are three products from forestry?

Forestry is the science of growing and using trees. The trees are used for lumber, paper, furniture, and other materials. Student answers can reflect any of the products listed on page 16 in the textbook.

7. What is the importance of marketing and processing?

Marketing and processing serve useful connections between the producer and the consumer. Marketing moves products from farms to processing facilities, distribution centers, and retail stores. Processing is the act of changing the forms of products to better meet consumer demand and to protect the products from spoilage.

8. What is food safety?

Food safety is taking steps to ensure that food is wholesome and safe to eat. It is protected from contamination. The food may be canned, frozen, pasteurized, or otherwise treated to prevent or slow spoilage.

9. What is domestication? Why was it important in agriculture?

Domestication is taming or controlling wild plant and animal species and producing them for specific purposes. Domestication made it easier to have a dependable food supply.

10. What is one example of an agricultural invention? Who made the invention, and why was it important?

One example of an agricultural invention is the cotton gin made by Eli Whitney, which resulted in huge labor savings in separating seed and lint. Other examples are in Table 2–3 of the textbook. Students may choose to name any of them and provide who made the invention and why it was important.

11. How do agricultural practices vary among nations?

Agricultural practices vary among nations based on mechanization, improved crops, commerce, education of people, and soil and climate. Some variation may be based on the social customs and preferences.

12. What is biosecurity? How is food security a part of biosecurity?

Biosecurity is the use of approaches to manage risk and to ensure the production of good products. With biosecurity, the focus is on keeping consumable products safe and preventing contamination with diseases or other hazards.

13. What are two categories of organizations in the agricultural industry? Distinguish between the two.

The two categories of organizations in the agricultural industry are professional and commodity. A professional organization is developed around the career pursuits of its members. A commodity organization is developed around the production, marketing, or processing of a commodity or product.

EVALUATING

1=d, 2=f, 3=h, 4=a, 5=e, 6=b, 7=g, 8=c, 9=j, and 10=i

3

SUCCESS AND SAFETY IN CAREERS

CHAPTER SUMMARY

People want to be successful with their work. No one wants to fail. Employers have expectations of the people they hire. Employer expectations are focused on those behaviors employers seek and reward in their employees. Some expectations require considerable skill. Others relate to being at work on time and focusing on the work to be done.

A few examples of personal traits are:

- **Wholesome life style—**People need to have an approach to life that makes them good workers. What a person does after work can affect his or her ability at work.
- **Willingness to learn new things—**Work demands change. People must learn new job skills. Always be willing to learn. Be anxious to do a better job for your employer.
- **Loyalty—**Employers like employees who are loyal. They want employees to say good things about work and the employers.
- **Acceptance of others—**All people can make contributions. A person should never be biased toward others. Skin color, gender, language, and other differences should never be the basis for judgment.
- **Respect for others—**All people deserve respect. Differences of opinion must be settled in constructive ways. Violence is never acceptable at home or away from home. Physically abusing anyone—friend, coworker, spouse, child, parent, or sibling—is unacceptable.
- **Sense of humor—**A sense of humor is the ability of a person to see the amusing side of situations. Often it helps to be able to laugh at mistakes and then take actions to correct them.

Personal appearance is also important. Several guidelines for personal appearance are:

- **Clothing—**Select appropriate clothing; do not overdress or underdress. Clothing should be conservative and stylish and should fit properly. Keep clothing clean, in good repair, and properly pressed. Shoes should be clean, and dress shoes should be polished.
- **Personal hygiene—**Keep clean and free of odor. Daily baths and use of deodorant are important. Oral hygiene (brushing your teeth) helps in appearance, reduces bad breath, and prevents tooth decay.
- **Grooming—**Keep hair an appropriate length. Avoid extreme colors and styles. Fads are not popular with employers or customers!
- **Jewelry—**Keep jewelry simple and suitable. Body piercings and tattoos are quite distracting and are inappropriate in most job settings. Tattoos are difficult and costly to remove and may be on your skin for the rest of your life.
- **Fitness—**Get regular exercise and eat properly. Avoid substances that damage the body. Get plenty of sleep and rest. Regular medical and dental checkups are important to assure fitness and good health.
- **Demeanor—**Be happy, and let it show. Be friendly. Avoid holding grudges and talking negatively about someone.

Being safe at work is important to the worker, the employer, and other workers. Safety is the condition of being free of harm and danger. Always follow appropriate safety rules. Never take unnecessary risks.

Areas in labs and shops are often color coded for safety reasons. Yellow designates caution. Danger areas and stop buttons are designated with red.

A fire extinguisher is a device used to control fires. Some are pressure tank-type devices while others are class grenades that can be thrown. Other means of fire prevention and control may be used. Extinguishers are often classified by the classes of fire that they extinguish. Class A extinguishers (designated with a green triangle) are for ordinary fires such as paper, wood, and plastics. Class B extinguishers are used with flammable or combustible liquids such as gasoline, oil, and grease. A red square is used on such extinguishers. Class C extinguishers are used on fires involving electrical equipment, circuit breakers, outlets, and the like.

The material is such extinguishers does not conduct electrical current. A blue circle is the symbol used on Class C extinguishers. Class D extinguishers are used in chemical laboratories and similar places where chemical are kept. The symbol is a yellow decagon. Class K extinguishers are for fires involving cooking oils, fats, and transfats found in kitchens. The symbol is a black hexagon. Extinguishers should be obtained based on the kinds of materials in the area where the extinguisher may be used. Fire extinguishers with ABC classification are often recommended for home use.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand some life basics. The focus is on fundamental processes and methods for personal development. Learners are shown steps to take toward a successful future.

Upon completion of Chapter 3, the student will be able to:

1. Identify needed job skills for your success.
2. Explain and develop appropriate interpersonal skills.
3. Demonstrate appropriate citizenship skills.
4. Describe and follow appropriate safety practices.
5. Name fire extinguisher classes and describe the use of each.

INTEREST APPROACH

Students are often concerned about their futures. Education, jobs, and other life events create stress. This chapter can help students better manage stress as related to job success and improving relationships.

Have students read the introductory paragraphs of the chapter. Follow this by calling on one or more class members to explain what the paragraphs meant. Use this time for discussion of success and failure. What do the terms mean? (Success is achieving worthy goals.) After discussion, go over objectives for the chapter. Then move into the first section of the chapter.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

A variety of strategies can help students achieve the chapter objectives. Begin by having students study the fundamentals of career success. Use student input to develop a list of employer expectations on the writing surface. Carefully go over the list. Have students name examples of each and keep notes on the content. Next, go over the personal traits.

After students have read “Interpersonal Skills,” use the writing surface to develop key terms, using student input. Relate the importance of personal appearance. Some role playing might be used regarding clothing, grooming, jewelry, and demeanor. Of course, no one should be embarrassed or feel overly self-conscious during these activities. Also, cover the meaning of citizenship.

Move into the section “Safety.” Define the term, and go over safety in the lab, at work, and in daily living. Cover the use of PPE, and allow students to try various kinds of PPE so they know how to use it. Cover the meaning of first aid. Have students observe and inventory a first-aid kit. Review school policies in case of an accident.

Following the safety section, go into safety color codes, fires, and fire extinguishers. Bring examples of extinguishers into class and show the color of decal that is present. If practical, demonstrate how to use an extinguisher. It may be more appropriate to show a video on fire extinguisher use. An online example is: www.youtube.com/watch?v=IUoj)1HvC8c.

REVIEW AND EVALUATION

After the objectives of the chapter have been covered, the content should be reviewed, and student achievement should be assessed. The approaches should be student-centered. For example, have students demonstrate their accomplishment of the objectives. This could be done by asking class members to orally explain each objective in class. Students could also define the terms at the beginning of the chapter or answer the end-of-chapter review questions.

Activities in the Activity Manual can be especially helpful in reviewing, reinforcing, and re-teaching the chapter concepts. Students should demonstrate their understanding of the concepts in how they go about their supervised experience programs. In some cases, these programs may be laboratory-based and involve preparing entries for a science fair or demonstrations for parents and students.

Written or oral tests can be used to assess student achievement. This can be a teacher-made test or a prepared test from the Instructor’s Resource Guide or from an online testing system.

SAFETY

The major safety areas here may involve the use of the laboratory in the examination of cells and plant and

animal processes. The Activity Manual presents a summary of the safety procedures for these activities. Teachers must instruct students in laboratory safety practices applicable to the laboratory situation. Safety instruction and discussion can extend beyond the content of the chapter as related to organisms in our lives. Some pose safety hazards; others need human intervention to provide for their well-being. Keeping PPE clean and in good condition is a safety-related matter.

ADDITIONAL RESOURCES

Additional resources for this chapter include those in the school as well as those in the community. At school, the agriscience teacher may wish to use the laboratory facilities and safety equipment of the science or biology area. In addition, the teacher(s) in this area may be asked to assist with these activities. In some cases, safety reference materials may be helpful.

Beyond the school facilities, teachers may find valuable community resources. Locations of placement supervised experience may present opportunities for assessment, discussion, and action.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, or other details in the answers.

1. **What important personal skills are needed for career success? List any four.**

   The answer may include any four personal traits for career success: loyalty, wholesome lifestyle, willingness to learn new things, acceptance of others, respect for others, and sense of humor.

2. **What principles guide our social behavior? (List any four.)**

   Several principles guide our social behavior. The textbook lists eight. Any four will satisfactorily answer the question. Examples are be courteous, respect property, respect rights of other people, properly greet people, use appropriate grammar, be caring, and have empathy.

3. **Why is personal appearance important?**

   Personal appearance is important because it is what other people see when they look at you. We have little control over some of our personal features, but we can be neatly groomed, clean, keep fit, avoid excess jewelry and tattoos, and have a pleasant facial expression.

4. **What are the major expectations of employers?**

   Major expectations of employers are the willingness to accept responsibility, the ability to communicate, the ability to do the job, the willingness to be a team player, the practice of professionalism, the consistent use of honesty, and the use of customer service skills.

5. **What are the important citizenship traits?**

   Important citizenship traits include the following: abide by the law, vote, support the well-being of others, be patriotic, support charity, take pride in your community, and be a productive person at school, home, and work.

6. **What areas are included in personal appearance?**

   Areas included in personal appearance are clothing, personal hygiene, grooming, jewelry, fitness, and demeanor.

7. **Why is practicing safety important?**

   Practicing safety helps us be free of harm and danger. It protects us as well as those around us.

8. **What safety hazards might be present in a school lab?**

   Safety hazards that might be present in a school lab are chemicals, organisms, fire and heat, equipment, and sharp instruments.

9. **What safety hazards may be found at work?**

   Safety hazards that might be found at work are dangers posed by hand and power tools and equipment, engines and motors, electricity, and water.

10. **What safety suggestions should be followed in operating motor vehicles?**

    There are many safety features to consider with motor vehicles. The kind of vehicle and where it is operated are important, including homes, highways and driving, and recreation. Keep the vehicle in good condition. Always know and follow safety rules. Obey signs and decals on the equipment. Avoid fast starts and stops. Note: Others are listed in the textbook that could be included in the answer. Three good suggestions will be sufficient.

11. What three conditions are necessary for combustion to occur?

Combustion is a chemical reaction that requires three conditions: a flammable material, temperature to ignite the material, and oxygen to support combustion.

12. What are the five classes of fires? Identify an example of a combustible material in each class.

The five classes of fires are: Class A—ordinary materials such as paper or wood; Class B—flammable liquid such as gasoline; Class C—electrical equipment such as switch boxes and applicances; Class D—combustible chemicals such as magnesium and sodium; and Class K—kitchen fires typically involving grease or cooking oil.

EVALUATING

a=d, 2=a, 3=g, 4=f, 5=e, 6=b, 7=h, 8=c, 9=j, and 10=i

PART TWO: SCIENCE IN AGRICULTURE

4

SCIENCE RELATIONSHIPS

CHAPTER SUMMARY

Agriscience and technology are often used together. Agriscience is the use of science in producing food, fiber, and shelter. Technology is the use of science in practical ways to produce these commodities. Both involve considerable science applications.

Four major areas of science are presented:

- **Life science—**This is the science of living things, often referred to as biology. (Note: Additional chapters will cover the life science area in greater detail as related to living organisms, particularly plants and animals.)
- **Mathematics—**This is the science of numbers, including statistics.
- **Physical science—**This is the science of the nonliving world around us, which includes chemistry and physics. (Note: Later chapters in the student edition will offer more detail and practical applications on the physical sciences, particularly Chapters 23 and 24.)
- **Social science—**This is the science of human society and the behavior of people.

Each of these is related to the agricultural industry. Agriscientists use skills in these areas on almost a daily basis. New areas of scientific application and investigation are rapidly emerging. These include biotechnology, genetic engineering, animal identity and traceability, precision farming, remote sensing, laser technology, computational science, and radiation.

Agriscientists use the scientific method to solve problems and to make decisions. The steps in the scientific method are:

- Identify the problem.
- Get information.
- Suggest an answer.
- Experiment.
- Form conclusions.

In addition, the results of research should be reported. This shares what has been learned with others and helps them make better choices about experiments.

Computer technology has wide use in agriculture. Uses range from keeping records to preparing reports, exchanging information, marketing, preparing plans and designs, and complying with regulations. In all uses, digital safety is very important. This is sometimes known as online or Internet safety.

Information is knowledge or news about something or an event. The process of using information involves several tasks: locating information, assessing quality of the information, and using information. Increasingly, online sources are being used to access research bulletins, market reports, and other needed information.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand major relationships that exist between agriculture and science.

Upon completion of Chapter 4, the student will be able to:

1. Identify and describe areas of science in agriscience.
2. Use the scientific method in problem solving.

3. Describe the meaning and importance of research and development.
4. Identify new and emerging areas of technology.
5. Discuss the use of computer technology in agriculture.
6. Locate, assess, and use agriscience information.

INTEREST APPROACH

Trying to interest and motivate students may require more creativity for this chapter. Students often do not know and appreciate science relationships in agriscience. They may not understand or appreciate use of the scientific method. Begin by having students read the introductory paragraphs to the chapter. Call on one or more individuals to summarize the meaning of these paragraphs. Inquire about science classes students are taking. Determine if these classes help students understand that we use science to learn about the world in which we live. Move from the interest approach into the chapter objectives. Prepare to use the RLRWP-E instructional procedure.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

The teaching strategies for the chapter may be shaped by the interest approach that is used. Begin by having students read the first major section "Relationships with Science." Afterward, outline major concepts on the writing surface, using student input. Refer students to the normal distribution curve in Figure 4–8. Have them explain the curve and how it applies to the characteristics of populations. Students should take notes on the summary of the information.

Next, have students read the section "New Technology." Afterward, use the writing surface to list emerging technologies and key statements about each. Students should record information in their notes. Relate the content to examples that may be found locally.

Move into the next section "The Scientific Method." Have students read this section. Indicate that this is the general approach used by scientists in conducting experiments and carrying out research efforts. Relate information about the agriscience project that could be carried out under auspices of FFA. Have students name examples of problems and state the steps they would follow with the problems. Students may work individually or in pairs or small groups on problems to investigate with the scientific method.

Cover the section "Computer Technology in Agriculture" by having students read it in supervised study or as homework. Call on individual students to explain the meaning of computer technology. Next, call on another student and have the student describe applications of computer technology. Have another discuss the meaning of digital safety. Be sure to summarize content and clarify concepts, as needed.

Next, go over the section "Agriscience Information." Call on students to explain the meaning of information, describe how to locate information, information format, providers (sources) of information, assessing information, and using information. Have students experience various formats such as published bulletins, brochures, and online materials available from the local land-grant university.

REVIEW AND EVALUATION

The objectives should be reviewed after the chapter has been covered. Ask individual students to explain the content related to the objectives. Re-teach areas where students appear to have not mastered the objectives. The chapter summary, as well as the terms at the beginning of the chapter, may be used in the review process. Many teachers also use the Activity Manual for review and evaluation.

Evaluation will involve observation of student performance in the class and in the Activity Manual. Teachers may give written and/or oral tests on the objectives.

Practical evaluation will occur when teachers observe how students use the information in their supervised experience programs and science fair projects.

SAFETY

The objectives of this chapter present few learning activities that have safety hazards. However, teachers should always be on the alert for safety problems and should stress safety in their instruction. The Activity Manual presents safety illustrations throughout all of the activities.

ADDITIONAL RESOURCES

Teachers may need additional materials on the classification and naming of organisms in the local area. Science teachers and university specialists may be able to provide the needed information to classify the species. Publications specific to geographic regions that describe how to classify common plants and animals found locally are usually available.

Students would likely benefit from observing science fair projects or investigating literature about science fairs.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more detailed information, the use of complete sentences, or other details in the answers.

1. **What is science? Why is it important?**

   Science is knowledge of the world around us. It is important in helping us understand the environment and how organisms interact with the environment.

2. **What are the four major areas of science? Define each.**

   The four major areas of science are life science—the study of living things; physical science—the study of nonliving things; mathematics—the science of numbers; and social science—the study of human society.

3. **What are the two major areas of life science? Why are these areas important in agriscience?**

   The two major areas of life science are botany (the study of plants, which helps us understand the needs of plants and how to more effectively produce them) and zoology (the study of animals, which helps us understand the needs of animals and how to care for their well-being).

4. **What are the areas of physical science? How does each relate to agriscience?**

   The major areas of physical science are earth science, chemistry, and physics. Earth science helps us understand the structure of the surface of Earth, with some relationship to soil and its formation. Chemistry is the science concerned with the makeup of matter, and many things in agriscience need to be understood so better practices can be found. Physics is the study of the physical nature of objectives, such as light, forces, and mechanical advantage. Understanding physics often results in improved production practices.

5. **What is mathematics?**

   Mathematics is the science of numbers.

6. **What two systems of measurement are used?**

   The two systems of measurement are the customary or English system and the metric or International System (IS).

7. **What is statistics?**

   Statistics is a branch of mathematics that deals with the collection, analysis, interpretation, and presentation of data.

8. **What is the scientific method? What steps are used? Briefly explain each step.**

   The scientific method is an organized way of asking questions and seeking answers. It is the problem-solving approach used by scientists with experiments. Step 1: Identify the problem. For example, a pig is not eating. Step 2: Get information. For instance, were the food ingredients changed recently? Is the temperature different? Step 3: Suggest an answer. The pig may not be eating because a change in ingredients is resulting in indigestion. Step 4: Experiment. Return to the previous feed ingredients. Step 5: Form a conclusion. The pig still did not eat, so something else must be wrong. Step 6: (Optional) Some scientists report the results of their findings.

9. **What is a normal distribution?**

   The normal distribution is a bell-shaped curve that attributes the characteristics of a population to a normal distribution.

10. **What are the new areas of technology? Briefly explain each. Give examples of how each can be used in agriscience.**

    New areas of technology are biotechnology—the application of science and life processes to gain products; genetic engineering—artificially altering the genetic makeup of an organism; animal identification and traceability—the ability to follow the identity of an animal through the marketing process; precision farming—using cropping practices to improve yields based on land needs and yield history data; remote sensing—gathering and recording information from a distance; laser technology—the use of devices that use lasers for guidance and other purposes; computation science—the use of computers to solve problems; and radiation—the use of energy that travels in waves.

11. What are some ways computers are used in agriculture? Briefly explain each.

In agriculture, computers are used keep records, prepare reports, exchange information, marketing, and other uses would be acceptable in the answer. Answer should include some explanation of each.

12. What is information? What should be considered in assessing information?

Information is knowledge or news. In assessing information, consider: source (is it reputable), date (is the date current), illustrations (is the information clarified through illustrations), safety (are safe practices and precautions covered), and availability (is the information readily available).

EVALUATING

1=d, 2=a, 3=b, 4=h, 5=j, 6=c, 7=i, 8=g, 9=f, and 10=e

5

LIVING THINGS

CHAPTER SUMMARY

Organisms are living things that carry out life processes. All living things have similarities. This means that all living things carry on certain processes. When these processes stop, life ends and death has occurred. Decomposition of the organism will return its nutrients to the soil for use by another organism in its life processes.

Organisms are unique. These unique traits relate to species as well as individuals within a species. No two are identical in all regards. All are made of carefully organized substances. These substances provide chemical processes as well as structure for an organism.

Organisms carry out certain life processes that are essential for the living condition. Eight processes are presented. The processes are getting and using food, movement (locomotion), circulation, respiration, growth and repair, secretion, sensation, and reproduction. The processes are carried out by plants and animals.

Organisms are made of tiny building blocks known as cells that are much alike in plants and animals. A membrane surrounds the cell and is enclosed within a cell wall in plants. A nucleus is located near the center of the cell and is surrounded by cytoplasm.

Many organisms are made of more than one cell; they are known as multicellular organisms. Cells specialize into tissues, organs, and organ systems. Most all plants and animals produced for food, fiber, and shelter are multicellular.

Organisms pass traits from parents to offspring. The study of how the traits are transmitted is known as genetics. Various factors in heredity are involved. With sexual reproduction, a union of male and female sex cells occurs. The offspring have traits of both parents but are different from the parents. With asexual reproduction, no such union occurs, and the offspring are identical to the one parent. This is especially useful when the parent has a very desirable trait.

Cell division is an important part of growing and reproducing. One type of cell division is mitosis. Organisms become larger and replace damaged cells by dividing. Cell division to produce sex cells is known as meiosis. Various approaches, such as controlled breeding and genetic manipulation, are used to try to improve organisms.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the structural bases of life. The focus is on fundamental processes as well as structures of organisms. Learners are shown that plants and animals are different and alike.

Upon completion of Chapter 5, the student will be able to:

1. Explain important characteristics of living organisms.
2. Explain the meaning and stages of life span.

3. Name and discuss the life processes of living organisms.
4. Describe the structural bases of living organisms.
5. Identify cell growth processes.

INTEREST APPROACH

Students are often inquisitive about the nature and structure of plants and animals. The teacher can use this inquisitiveness as a basis for developing an interest approach. Several features in the chapter can be used to promote interest, such as the Technology Connection and AgriScience Connection. Local situations and interests can also be used.

One approach is to have the students read the introductory section to the chapter. Then, ask students to explain how they think animals are alike. Next, ask them to explain how animals and plants are not alike. This can be followed with plant similarities and differences. The scene shown in Figure 5–1 can also be used by asking students to look at the picture and to explain the biological processes of plants in growth. Summarize by explaining how understanding life processes is important in producing plants and animals that are used for food, fiber, and shelter. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

A variety of strategies can help students achieve the objectives of this chapter. Hands-on activities in the laboratory and activities in the Activity Manual will be most appropriate. Some of these may include the use of microscopes for viewing cells and other building blocks and processes of living things. Throughout the chapter, refer students to the figures and have them discuss what they see.

A general approach is to have students read various sections or all of the chapter. This material can be reviewed in class discussions and presentations. The important concepts to cover early in the chapter are organisms are unique; organisms have life spans and go through life stages; and organisms grow, reproduce, and respond to their environment.

The middle part of the chapter provides important information on the life processes of organisms, including plants and animals. These processes need to be presented in a general way that is applicable to plants and animals. The major processes are receiving and using food, movement, circulation, respiration, growth and repair, secretion, sensation, and reproduction.

Once the life processes have been taught, the objectives on the structural bases of life should be covered. Students should be given instruction on cells and cell structure (use the microscope here) and multicellular organisms with the specialization of cells into tissue, organs, and organ systems. These should be covered in a general or in a basic way. The specifics of each are dealt with in other chapters of the book.

Introduce students to the cell growth processes. Mitosis is cell division for growth and repair. Meiosis is cell division in sexual reproduction. (See figures 5-26 and 5-27.)

REVIEW AND EVALUATION

After the objectives of the chapter have been covered, the content should be reviewed, and student achievement should be assessed. The approaches should be student-centered. For example, have students demonstrate their accomplishment of the objectives. This could be done by asking class members to orally explain each objective in class. Students could also define the terms at the beginning of the chapter or answer the end-of-chapter review questions.

Activities in the Activity Manual can be especially helpful in reviewing, reinforcing, and re-teaching the chapter concepts. Students should demonstrate their understanding of the concepts in how they go about their supervised experience programs. In some cases, these programs may be laboratory-based and involve preparing entries for a science fair or demonstrations for parents and students.

Written or oral tests can be used to assess student achievement. This can be a teacher-made test or a prepared test from the Instructor's Resource Guide or from an online testing system.

SAFETY

The major safety areas here may involve the use of the laboratory in the examination of cells and plant and animal processes. The Activity Manual presents a summary of the safety procedures for these activities. Teachers must instruct students in laboratory safety practices applicable to their laboratory situation. Safety instruction and discussion can extend beyond the content of the chapter as related to organisms in our lives. Some pose safety hazards such as the allergic reaction to poison ivy or the puncture wound that may be created by the bite of a dog.

ADDITIONAL RESOURCES

Additional resources for this chapter include those in the school as well as those in the community. At school, the agriscience teacher may wish to use the laboratory facilities and equipment of the science or biology area. In addition, the teacher(s) in this area may be asked to assist with these activities. In some cases, biology reference materials may be helpful.

Beyond the school facilities, teachers may find valuable community resources. These range from specimens that students bring from their homes to the laboratories and the personnel of agribusinesses.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, or other details in the answers.

1. **What is an organism?**

   An organism is a living thing.

2. **Name and describe five important characteristics of organisms.**

   Organisms are chemically and structurally unique (includes chemical processes in protoplasm and structural characteristics in cells); need energy (energy comes from food and is needed for activity); have a life span (the period of life); are capable of growth and reproduction (growth is increasing in size and replacing body structures as they wear out); can reproduce (giving rise to new organisms of the same kind); and respond to their environment (organisms must often make adjustments to their surroundings).

3. **Name the three parts of the cell theory.**

   The three parts of cell theory are all living things are made of cells; cells are the basic units of structure and function in living things; and new cells are produced from existing cells.

4. **What is the difference between living and nonliving things?**

   When protoplasm activity stops in living things, they become nonliving. Life processes no longer occur.

5. **Describe the difference between autotrophs and heterotrophs.**

   An autotroph is an organism that captures energy from sunlight or chemicals and uses the energy to produce food. Examples are plants, some algae, and certain bacteria. A heterotroph relies on other organisms for its energy and food supply. Examples are cats, cows, and canaries.

6. **Name the five types of heterotrophs, and give examples of each.**

   Five types of heterotrophs and examples are herbivores (e.g., sheep) that eat plant materials; carnivores (e.g., dog) that eat the flesh of animals; omnivores (raccoons) that feed on plants and animals; detrivores (e.g., earthworm) that feed on nonliving plant and animal remains; and decomposers (e.g., certain bacteria) that feed on dead organic matter.

7. **Name and define the five stages of life.**

   The five life stages are beginning—how a species reproduces; growth—a time of rapid advancement; maturity—organism is fully developed; decline—organism loses its ability to maintain itself; and death—when the organism can no longer replenish itself.

8. **How do organisms respond to their environment? List examples of plants and animals and their preferred environment.**

   Organisms grow best in environments in which they are adapted. For example, rice grows best in a warm, moist environment. Winter wheat can survive and grow in a cold climate.

9. **What are the life processes of living organisms? List and explain each.**

   The life processes of organisms are obtaining and using food—food is needed for growth and repair; movement—within an organism to carry out life processes (e.g., movement of lungs) and as locomotion to obtain food; circulation—movement of food nutrients and other materials within an organism; respiration—how an organism provides its cells with oxygen; growth and repair—how an organism increases in size and replenishes its cells when they wear away; secretion—the production and availability of certain chemical substances; sensation—how an organism responds to its environment and certain sensations; and reproduction—how an organism produces new individuals of its species.

10. What is a cell? What are the major parts of a cell, and what are their functions?

A cell is the structural basis of life-building blocks of organisms. Major parts of a cell are the cell membrane, which surrounds the cell and controls movement of materials into and out of it; the nucleus, which stores genetic material near the middle of a cell; and the cytoplasm, which has a thick, semi-fluid material inside the cell but outside the nucleus that contains organelles.

11. What is cell specialization?

Cell specialization consists of the differences that occur in cells so they can perform unique activities for an organism.

12. How are tissues, organs, and organ systems related?

Tissues are structures of specialized cells and do specialized jobs in an organism. Organs are collections of tissues that perform certain functions. Organ systems are composed of several organs that work together to perform an activity.

13. Name and explain the two kinds of cell division.

Mitosis is cell division for growth and repair. Meiosis is the sexual reproduction of organisms.

EVALUATING

1=j, 2=a, 3=i, 4=b, 5=g, 6=e, 7=c, 8=n, 9=h, 10=d, 11=m, 12=l, 13=f, and 14=k

6

CLASSIFYING AND NAMING LIVING THINGS

CHAPTER SUMMARY

All known living things have been classified and named. Modern classification involves a system that shows relationships among and differences between organisms. No two have the same name. New organisms that have not been named are discovered each year. Many of these are in aquatic environments, particularly in deep parts of oceans.

The modern classification system is composed of seven divisions or stages that show relationships and differences: domain, kingdom, phylum or division, class, order, family, genus and species. In addition, agriscientists often use varieties, plant lines, cultivars, and breeds. A variety is a group of related organisms in a species. A plant line generally refers to a genetically-altered species such as corn that has been engineered to resist insects and/or allow the use of herbicide. A cultivar is a crop variety that retains its features when reproduced. A breed is composed of animals of the same species that have definite identifying characteristics and a common origin.

All living organisms are classified into one of three domains except for pre-cellular viruses. The domains are Bacteria, Archaea, and Eukarya. Eukarya is the most important in agriculture as it consists of organisms that have nuclei in cells. Within Eukarya, four kingdoms are used: Kingdom Protista, one-celled organisms that are more advanced than the Bacteria and Archaea; Kingdom Fungi, consists of yeasts, molds, and mushrooms; Kingdom Plantae, consists of species known as plants (many phyla; important agriculture and horticulture crops); and Kingdom Animalia, important in agriculture and as companions (14 phyla). Note that the kingdoms are often written with Latin spellings, such as animals being the Kingdom Animalia.

Cladograms are often used to show how characteristics separate species. Diagrams can also be used to depict evolutionary development from a root ancestor.

Scientific names contain two-word names, known as binomial nomenclature. These names are written in italics.

Tables giving the scientific names of many common agricultural species are listed in Chapter 6 of *Agri-Science*.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the classification and naming of living organisms. Emphasis is on the important horticulture and agriculture species, though relationships to other organisms are important.

Upon completion of Chapter 6, the student will be able to:

1. Describe the classification of living things.
2. Explain scientific names and identify species by scientific and common names.
3. Discuss three classification domains.
4. Describe the Protista, Fungi, Plantae, and Animalia Kingdoms and list examples of each.

INTEREST APPROACH

Trying to interest and motivate students may require more creativity for this chapter. Many students may not find classification and naming as exciting as other areas of study. Teachers should use approaches that are appropriate for their students. One example is presented here.

Have students read the introduction to the chapter in the text. Use this as a basis for discussing how people get their names. Call on students to give names in their families and to tell how their family members got the names they have. Ask students to tell how people of different cultures name their children. For example, names reflect cultural background. Relate all of the discussion to the classification and naming of organisms. (Teachers may wish to review the objectives at this time.) Prepare to use the RLRWP-E instructional procedure.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

The teaching strategies for the chapter may be shaped by the interest approach that is used. Emphasis should be on helping students achieve the objectives by using local examples in classifying and naming. Having students read the chapter and refer to the tables in the chapter will be most beneficial. A highlight of this chapter is that organisms are now classified into domains, which is new in the study of agriscience.

Use the writing surface (chalkboard or other) to present the modern classification system. List the divisions in the system (in order) on the writing surface. Include variety, cultivar, and breed as further divisions in the system that are important in agriculture. Discuss how scientific names allow people in all parts of the world to communicate clearly about plants and animals.

Present the three domains and four kingdoms in the Eukarya domain and examples of the phyla in each. List common examples in the local community for each phyla. (This part of the instruction must be kept relevant and in areas with which the students can identify.) Use taxonomy keys for the local area, and have students identify common plants and animals. In some cases, students could bring specimens of leaves or insects to school for identification.

Present the objectives on scientific names by using the system known as binomial nomenclature. (Refer students to Table 6-2 in the text that contains the scientific names of common agricultural and horticulture species.)

Conclude the instruction by emphasizing the role of scientific names in culturing plants and animals and in laboratory work.

REVIEW AND EVALUATION

The objectives should be reviewed after the chapter has been covered. Ask individual students to explain the content related to the objectives. Re-teach areas where students appear to have not mastered the objectives. The chapter summary, as well as the terms at the beginning of the chapter, may be used in the review process. Many teachers also use the Activity Manual for review and evaluation.

Evaluation will involve observation of student performance in the class and in the Activity Manual. Teachers may give written and/or oral tests on the objectives.

Practical evaluation will occur when teachers observe how students use the information in their supervised experience programs. For example, the ability of students to use the scientific names of plants in selecting pesticides and other products in their work is important in evaluation.

SAFETY

The objectives of this chapter present few learning activities that have safety hazards. However, teachers

should always be on the alert for safety problems and should stress safety in their instruction. The Activity Manual presents safety illustrations throughout all of the activities.

ADDITIONAL RESOURCES

Teachers may need additional materials on the classification and naming of organisms in the local area. Science teachers and university specialists may be able to provide the needed information to classify the species. Publications specific to geographic regions describe how to classify local common plants and animals and are usually available.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more detailed information, the use of complete sentences, or other details in the answers.

1. **What is taxonomy?**

   Taxonomy is the classification of living things. Taxonomy is also known as systematics.

2. **What are the eight divisions in the modern classification system? What is the sequence of the divisions from the broadest group to the most specific group?**

   The eight divisions (in sequence) are domain, kingdom, phylum or division, class, order, family, genus, and species.

3. **What three domains are used to classify organisms? Briefly describe each domain.**

   The three domains are bacteria, which are one-celled organisms with cell membranes, cell walls, and cytoplasm, but not nuclei; Archaea, which are one-celled organisms with cells that lack nuclei but have cell walls; and Eukarya, which are a large domain of important species, though some have one cell and others have many cells. Eukarya are the most important in agriculture because plants and animals are in this domain.

4. **How do members of the four kingdoms of the domain Eukarya provide for the needs of people? Give two examples for each kingdom.**

   Kingdoms in Eukarya and examples of what they provide are protista—provide some foods, (e.g., seaweed) and provide oxygen for the environment; fungi—provide better food products, (e.g., yeast in bread making) and medicine (e.g., penicillin); plants—provide many forms of food, fiber, and shelter; and animals—provide many forms of food, fiber, and shelter.

5. **What are the scientific names for the following animals: horse, sheep, goat, hog, chicken, humped cattle, and turkey?**

   *The scientific names are horse, **Equus caballus**; sheep, **Ovis aries**; goat, **Capra hircus**; hog, **Sus scrufa**; chicken, **Gallus domesticus**; humped cattle, **Bos primigenius indicus**; and turkey, **Meleagris gallopavo**.*

6. **What are the scientific names for the following crop plants: wheat, corn, cotton, and soybeans?**

   *The scientific names are wheat, **Triticum aestivum**; corn, **Zea mays**; cotton, **Gossypium hirsutum**; and soybeans, **Glycine max**.*

7. **What are the scientific names for the following trees: live oak, sweetgum and shortleaf pine?**

   *The scientific names are live oak, **Quercus virginiana**; sweetgum, **Liquidambar styraciflua**; and shortleaf pine, **Pinus echinata**. (Note: Sweetgum and shortleaf pine will require additional resources to answer.)*

8. **Why is the use of scientific names important?**

   Scientific names are important because they allow people to accurately communicate information. Scientific names are used all over the world. They help communicate cultural practices as well as the results of research.

EVALUATING

1=g, 2=e, 3=a, 4=b, 5=i, 6=d, 7=c, 8=h, 9=f, and 10=j

7

GENETICS APPLICATIONS IN AGRICULTURE

CHAPTER SUMMARY

Genetics is increasingly important in the study of agriscience. Scientists have used modern approaches in genetics (specifically molecular approaches) to develop new understanding and methods of improving organisms. Genetics is the science of heredity—the transmission of parental traits to offspring. All of the genetic makeup of an organism is its genome. Chromosomes and genes are increasingly important in understanding genetics. A chromosome is a threadlike structure inside a cell nucleus that contains genetic material and protein. Chromosomes are found in pairs, with, for example, a hog having 20 pairs. A gene is a segment on a chromosome that contains heredity traits. Different forms of genes are known as alleles. Genotype is the genetic combination for a trait. Phenotype is the appearance of an organism as related to genotype. Trait expression is often in two major groups: dominant and recessive. Knowledge of genetics can be used to improve organisms, including genetic modification.

Genetics is applied in two major ways to improve organisms: organismic and molecular. Organismic genetics deals with helping intact or complete organisms live and grow better. Molecular genetics (particularly as applied in biotechnology) involves changing the structure and parts of cells. It changes the genetic material of an organism.

Selection (the choosing of parents with desired traits) is genetics-based. Marker-assisted selection is now used on a limited basis. Cloning, increased fertility, greater production, culturing aquaculture products, ultrasonics, animal nutrition and feeds, and predicting the future involve genetics.

The set pattern of the heredity material in a cell is a genome. Chromosomes are the threadlike parts in a cell nucleus that contain genetic material, made of DNA, and protein. Genes are the segments of chromosomes that contain the heredity traits of organisms. The genetic makeup of an organism is known as its genotype. Some genetic factors are dominant, and others are recessive.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are designed to help students understand the meaning and importance of genetics and the areas that are being used and developed. Many of the practices followed in growing crops and raising livestock involve genetics applications. Future developments may change many of the current production practices.

Upon completion of Chapter 7, the student will be able to:

1. Discuss the meaning and use of heredity in agriculture.
2. Define and explain important genetics concepts.
3. Explain the use of genetics in trait expression and prediction.
4. Describe the use of genetics to improve organisms.

INTEREST APPROACH

Genetics is an important area in agriscience. Students may already have some background information. By questioning, explore their level of knowledge, and use the examples they list in class as the basis for the interest approach.

Another interest approach is to have the students read the introductory part of the chapter. Ask students to explain the following statement: “Agriscience is reaching the point that being able to dream it means being able to do it!” Have them relate their discussion to the production of plants and animals. Also, to the fullest extent possible, use local agriculture examples to explain new plant and animal forms and ways in which they are produced. (Teachers may wish to review the objectives at this time.)

Have students read the introductory paragraphs of the chapter. Afterward, call on one or more students to discuss what was read. Refer students to Figure 7–1. Ask students to explain how genetics is important in planting and producing cotton, including the variety or plant line to plant.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Begin by defining genetics and heredity. Students can read these sections and help provide the content as you summarize it on the writing surface. Define terms. Use a deliberate approach to ensure student comprehension. Use Punnett square activities to aid in developing understanding.

Move into the section "Controlled Breeding." Have students read the section and provide information as the content is summarized. In discussion, be sure to cover concepts associated with selection, inbreeding, crossbreeding, and hybridization.

Begin the content on asepsis. Relate the role of asepsis in genetics work. Demonstrate how it is achieved in the school lab. Demonstrate cloning, and have students perform cloning and tissue culture activities. Be sure to list key terms and their definitions on the writing surface. Ask students to explain the definitions. Give examples of each, as presented in the textbook. Use field trips or laboratory activities for students to see firsthand examples of aquaculture, ultrasonics, and other areas of organismic biotechnology. Also, have students go to a grocery store where they will make a list of the different products that involve new applications of genetics such as baby carrots and long shelf-life tomatoes. If time permits, students can construct a small growth chamber in the laboratory by using a plastic bottle or a bucket.

REVIEW AND EVALUATION

The textbook and the Activity Manual can be used for review and evaluation.

For review, have students define the terms at the beginning of the chapter and answer the end-of-chapter review questions. This may be done orally as a group activity or as supervised study with the students writing out the answers. Activities in the Activity Manual will also be useful.

Evaluation can involve some of the same activities as the review. The "Evaluating" section is one useful assessment tool. Oral and/or written tests can also be given. All of the activities can be implemented in reteaching, as appropriate.

SAFETY

Achieving the objectives of the chapter should involve few safety hazards. However, activities beyond the classroom could present safety problems. The teacher should always review the appropriate safety practices. The Activity Manual presents safety precautions with each activity.

Lab activities require considerable emphasis on safety. Learning is enhanced with meaningful activities, such as tissue culture and other approaches in cloning. Stress safety in all regards. Be sure students us appropriate PPE. Properly dispose of laboratory wastes.

ADDITIONAL RESOURCES

The textbook and the Activity Manual can be used to achieve the objectives of the chapter. In some cases, teachers may wish to use specific materials on genetics. An introductory book on genetics will be useful. Some materials can be obtained from a college or a university with an agriculture program.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is heredity? Genetics?**

   Heredity is the transmission of parental traits to offspring. Genetics is the science of heredity and variations in organisms.

2. **What is a genome?**

   A genome is the total genetic makeup of an organism.

3. **Distinguish between dominant and recessive genetic traits.**

   A dominant trait covers or masks the alleles for recessive traits. A recessive trait is masked by a dominant trait.

4. **What is controlled breeding?**

   Controlled breeding is the selective act of mating plants and animals to achieve desired traits in the offspring.

5. **Distinguish between selection, inbreeding, crossbreeding, and hybridization.**

   Selection is the act of choosing parents with desired traits for breeding with hope of graining these traits in offspring. Inbreeding is the mating

of offspring of the same parents to each other in an attempt to gain desired traits of parents. Crossbreeding is the mating animals of the same species but of a different breed, such as an Angus to a Hereford. Hybridization is the breeding of two different but closely related plants or animals resulting in the combined traits of both parent strains with common heredity.

6. **What are the contents of a genome?**

   A genome is the set pattern of heredity material in a cell. It contains the chromosomes.

7. **Distinguish between genotype and phenotype.**

   Genotype is the genetic composition of an organism. Phenotype is the appearance of an organism. If parents of offspring are not purebred, the offspring may have different genotypes and phenotypes. The more genetically similar the parents are, the more the offspring will be alike in genotype and phenotype.

8. **What is the Punnett square?**

   The Punnett square is a diagram used to predict the outcome of breeding.

9. **Distinguish between homozygosity and heterozygosity.**

   Homozygosity means the offspring tend to be like their parents because there is less variation in the parents. Heterozygosity occurs when the parents provide the offspring with different genes for traits.

10. **What is asepsis?**

    Asepsis is the condition of being free of disease-causing germs.

11. **What is recombinant DNA? Relate the process of gene splicing to vectors and breaking and joining.**

    Recombinant DNA is DNA that is taken from one chromosome and moved to another (same as gene splicing) in the laboratory. Only a tiny piece is involved. Vectors are small organisms that are used to carry DNA into a cell. Breaking and joining DNA involves ligation—the attaching of two DNA fragments of different organisms. Scientists use this process to change the genetic material in an organism. Note: Students may need to refer to Chapter 8 for this answer.

12. **What areas of agriscience have developments underway using genetic engineering?**

    Genetic engineering is being used for developments in the following areas: herbicide-resistant plants, insect-resistant plants, disease-resistant plants, transgenic animals, frost protection, longer storage life, and new animal products. Note: Students may need to refer to chapter 8 for assistance with this answer.

EVALUATING

1=g, 2=h, 3=i, 4=a, 5=d, 6=e, 7=f, 8=b, 9=c, and 10=j

8

BIOTECHNOLOGY IN AGRICULTURE

CHAPTER SUMMARY

The mention of biotechnology immediately gets the attention of most people. Some of them think about the positive uses of biotechnology; others think about potential hazards. The media have helped inform many people that stem cells can be used in biotechnology processes. Deciding what is proper and ethical is a problem for some people. Students have much the same impressions. Of course, we know that the benefits far outweigh the hazards. And, with good research and testing, hazards are minimized.

Biotechnology involves using biological processes to get new or better plants and animals. Organisms can be

made better and then used to produce new products. Because our society in general is uninformed about the benefits of biotechnology, many issues are associated with using biotechnological processes.

In agriscience, biotechnology is the applied science-based operations in producing, food, fiber, shelter, and many related products. This includes horticulture, forestry, agricultural supplies, and agricultural processing and marketing. It also applies to wildlife, aquaculture, natural resources, and the environment. Biotechnology is often referred to as multidisciplinary—a long word that means "many branches of learning and work."

Biotechnology can be broken down into two levels: organismic and molecular. Organismic biotechnology deals with helping intact or complete organisms live and grow better. Cloning is an example. Molecular biotechnology involves changing the structure and parts of cells. It changes the genetic material of an organism. Science methods are used to artificially alter the genetic makeup of organisms. Complex science processes are involved. Individuals with in-depth education in science do the work. Genetic engineering is a major part of molecular biotechnology. Genetic engineering is changing the genetic makeup in a cell to achieve a desired goal. In simple words, a trait in a cell of one organism may be isolated, cut, and moved to a cell in another organism. The other organism is changed as a result of moving the trait, such as the ability of a dairy animal to resist mastitis.

Issues sometimes associated with biotechnology are:

- Genetically altered organisms may be patented resulting in restrictions on the use of the organism and provide profits to the holder of the patent. Agribusinesses need the assurance of profit from a research investment. If not, the agribusiness would not invest in the research.
- Genetically altered organisms produce inferior food. Some uniformed people might say that the food is harmful. Substances or genetic alterations in a plant or animal should not appear in food products. For example, if a grain plant is modified to resist disease, the grain should not contain the protective agent. Some foods from genetically altered organisms may be safer, such as milk from a cow genetically modified to resist disease.
- Genetically altering an organism will create a monster. Such is always a possibility but never very likely because of the careful controls of scientists.
- Genetically altering an organism will result in the loss of members of the same species that have not been genetically altered. The gene pool for the species will be tainted or permanently changed. Fortunately, scientists carefully study genetically-altered organisms before release or use. Those released must be safe; those not safe should never be released.
- Genetically altered organisms may mate with unmodified organisms of the same species. This might result in organisms that are neither the desired altered form nor the "natural" unaltered form. This might have occurred but no serious signs of damage are present.
- Genetically altering an organism is against moral or religious beliefs. Good education is needed. People need good information about genetic engineering to adjust their beliefs.

A good knowledge of nucleic acid science is needed in biotechnology, including the pattern and structure of heredity material in a genome. Chromosomes are the thread-like parts in a cell nucleus that contain genetic material, made of DNA, and protein. Genes are the segments of chromosomes that contain the heredity traits of organisms. The genetic make-up of an organism is known as genotype. Some genetic factors are dominant, and others are recessive. DNA forms a structure known as a double helix. Segments of DNA can be cut out and new ones inserted, which is known as recombinant DNA. Work in this area is often known as genetic engineering. In 2013, 93 percent of soybeans, 85 percent of cotton, and 76 percent of corn in the United States was planted to GMO plant lines.

Gene stacking is the process of combining two or more genes of interest into a single plant line. The goal is to have a single plant line that is, for example, resistant to an insect and a herbicide or more. Stacked genes in a plant line are achieved by crossbreeding a transgenic line for one trait with a transgenic line for another trait. Plants with stacked genes are becoming the dominant forms of genetically-modified (GM) crops. It has been primarily used with corn and cotton to achieve combinations of insect protection and herbicide tolerance. Corn, for example, is sometimes triple stacked or quad stacked. A triple stacked plant line would have three goals such as resistance to two different insect pests as well as herbicide resistance. A quad stacked would be created for four goals of either insect or disease resistance or herbicide resistance.

Gene stacked lines are widely planted in the United States. Corn is a good example. Stacked varieties of corn accounted for 71 percent of the genetically-modified corn that was planted in 2013. Insect only was 5 percent and herbicide tolerance only was 14 percent.

Much work is underway exploring the potential of molecular biotechnology. Molecular biotechnology has been used to develop herbicide-resistant plants, as well

as plants that are insect- and disease-resistant. Other traits are being developed through genetic engineering are: transgenic animals, frost tolerance and protection, longer storage life and new animal products. Scientists feel that genetic engineering holds tremendous potential.

Biotechnology is far more than for agricultural uses. "Biofactories" are producing genetically modified yeasts and other organisms using computer programs that direct robotic equipment in producing the new forms. Some authorities are signaling that the spiraling new developments are creating a third industrial revolution, according to Ariana Eunjung Cha in an article entitled "Companies rush to build biofactories for medicines, flavorings, and fuels "in *The Washington Post* (October 24, 2013). These biotechnology developments are sustainable and immune to weather and disease issues that plague "natural" methods. Our future may well be tied to biotechnology.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are designed to help students understand the meaning and importance of biotechnology and the areas that are being used and developed. Many of the practices followed in growing crops and raising livestock involve forms of biotechnology. Future developments may change many of the current production practices.

Upon completion of Chapter 8, the student will be able to:

1. Discuss the meaning of biotechnology
2. Describe the use of nucleic acid science
3. Describe methods used in nucleic acid science
4. Explain the meaning and importance of genetic engineering

INTEREST APPROACH

A possible interest approach is to refer students to Figure 8-2. After a short time for them to study the illustration, ask what meaning can be drawn from the graph. Call on individual students to explain the meaning in terms to crop growers adopting and using genetically engineered crops.

Another interest approach is to have the students read the introductory part of the chapter. Ask students to explain the statement "Agriscience is reaching the point that being able to dream it means being able to do it!" Have them relate their discussion to the production of plants and animals. Also, to the extent possible, use local agriculture examples to explain new plant and animal forms and ways they are produced. (Teachers may wish to review the objectives at this time.)

Have students read the introductory paragraphs of the chapter. Afterward, call on one or more to discuss what was read. Refer students to Figure 8-1. Ask why precision and care in laboratory work is essential in doing research related to biotechnology. Allow students to offer a few suggestions such as "the work needs to be done correctly or the results will be unreliable." Next, move into the content of the chapter.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Begin with the first section in the textbook, "Biotechnology: Meaning and Issues." Have students read the section as homework or during supervised study. First, define biotechnology. Ask students to offer definitions. Indicate that the text book uses the Office of Technology Assessment of the U.S. Congress, which defines biotechnology as "any technique that uses living organisms or substances from those organisms to make or modify a product, to improve plants or animals, or to develop microorganism for specific uses." That definition includes so many areas, particularly of science.

Explain that in agriscience biotechnology is the applied science-based operations in producing, food, fiber, shelter, and many related products. This includes horticulture, forestry, agricultural supplies, and agricultural processing and marketing. It also applies to wildlife, aquaculture, natural resources, and the environment. Biotechnology is often referred to as multidisciplinary—a long word that means "many branches of learning and work."

Biotechnology is at two major levels: organismic and molecular. Ask students to name and explain them. First, organismic biotechnology is working with intact organisms or their cells. The organisms are not artificially genetically altered. Natural heredity and genetic variations are studied and used to gain desired results. Traditional breeding programs in agriculture are used, such as selection and hybridization. Also used are cloning, including tissue culture, grafting, layering, and budding. These do not involve intrusion into the natural genetics of an organism.

Next, cover molecular biotechnology. Call on students to explain molecular biotechnology. Indicate that it is using science methods to artificially alter the genetic makeup of organisms. Complex science processes are involved. Individuals with in-depth education in science do the work. Genetic engineering is a major part of molecular biotechnology. Genetic engineering is changing the genetic makeup in a cell to

achieve a desired goal. In simple words, a trait in a cell of one organism may be isolated, cut, and moved to a cell in another organism. The other organism is changed as a result of moving the trait, such as the ability of a dairy animal to resist mastitis.

After students have read the section of the chapter in the text called "Nucleic Acid Science" ask them to provide input as you summarize terms and processes on the writing surface. If time permits, use the Activity Manual or other materials to extract DNA from strawberries, onions, or other materials. Discuss the meaning and role of DNA profiling in the identification or organisms such as those that cause food poisoning. Relate how it can be used to trace food materials to their sources.

After students have read the part of the chapter on molecular biotechnology and genetic engineering, ask a member of the class to review the definition of molecular biotechnology. Use presentation and discussion methods to review genetics and cell structure. List key terms along with their definitions on the writing surface.

Have students read the section of the chapter in the text called "Molecular Biotechnology." Use presentation and discussion methods to cover recombinant DNA, including vectors and ligation. Direct students in doing the activities in the Activity Manual, with emphasis on the construction of the double helix. Have students name and discuss examples of genetic engineering in agriscience.

REVIEW AND EVALUATION

The textbook and the Activity Manual can be used for both review and evaluation.

For review, have students define the terms at the beginning of the chapter and answer the end-of-chapter review questions. This may be done orally as a group activity or as supervised study with the students writing out the answers. Activities in the Activity Manual will also be very useful.

Evaluation can involve some of the same activities as review. The "Evaluating" section is one useful assessment tool. Oral and/or written tests can also be given. All of the activities can be implemented in re-teaching, as appropriate.

Refer to the list of objectives in the textbook. Call on students to demonstrate that they know the content associated with each objective. Reteach areas where students appear deficient.

SAFETY

Achieving the objectives of the chapter should involve few safety hazards. However, activities beyond the classroom could present safety problems. The teacher should always review the appropriate safety practices. The Activity Manual presents safety precautions with each activity.

Lab activities require considerable emphasis on safety. Learning is enhanced with meaningful activities, such as DNA extraction. Stress safety in all regards. Be sure students us appropriate PPE. Properly dispose of laboratory wastes.

ADDITIONAL RESOURCES

The textbook and the Activity Manual can be used to achieve the objectives of the chapter. In some cases, teachers may wish to use specific materials on biotechnology. An introductory book on biotechnology will be useful. Some materials can be obtained from a college or university with an agriculture program.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences and other details in their answers.

1. **What is biotechnology?**

   Biotechnology is using biological processes to get new or better plants and animals.

2. **What is nucleic acid?**

   Nucleic acid is the substance in cells that directs all cellular structures and activities. Two types have been identified: DNA and RNA.

3. **What are the two natural types of nucleic acid? Briefly describe each.**

   The two types of nucleic acid are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). DNA is the molecule that codes the genetic information of living things. It is said to form a two-stranded double helix. RNA is a single strand of nucleotide units. RNA is comprised of short segments rather than long segments of DNA.

4. **What is a double helix?**

   A double helix is the two-stranded structure formed by DNA. It has alternating units of sugar and phosphorus that are held together by hydrogen bonds. The structure has a ladder-like

appearance because of the arrangement of the bases in DNA.

5. What is DNA profiling?

DNA profiling is the process of identifying individuals of a species based on DNA profiles. A DNA profile an encrypted or coded set of numbers that reflect an individual's DNA makeup. A DNA profile can be used to identify an individual organism, such as a human. (Note: A DNA profile is not the same as a genome sequence.)

6. What is DNA isolation? Describe a common process for DNA isolation.

DNA isolation is the process of extracting and separating DNA from other materials in a cell. The procedures vary with the cells or tissues being used. Overall, the process involves: breaking down the cell wall or membrane; digesting cellular components with a detergent substance; separating the polar compounds, and extracting and precipitating the DNA. The cells of strawberries, onions, and bovine thymus glands are used in school situations.

7. What is transgenesis?

Transgenesis is the process of moving a gene from one unrelated organism into another living organism so that the organism exhibits new traits that can be transmitted to offspring. Genetically engineered corn is an example.

8. What plant lines have been developed through genetic engineering?

The most widely cultured plant lines developed through genetic engineering include those of corn, cotton, and soybeans. Some are to resist pests; others are to create tolerance to the use of herbicide to manage weeds.

9. What is a vector?

A vector is a carrier of new DNA into a cell. Yeast and bacteria cells are often used as vectors.

10. What is genetic engineering?

Genetic engineering is a molecular form of biotechnology.The genetic information in a cell is changed or used to make a product.

11. What is recombinant DNA? Relate the process of gene splicing to vectors and breaking and joining.

Recombinant DNA is DNA that is taken from one chromosome and moved to another (same as gene splicing) in the laboratory. Only a tiny piece is involved. Vectors are small organisms that are used to carry DNA into a cell. Breaking and joining DNA involves ligation, or the attaching of two DNA fragments of different organisms. Scientists use this process to change the genetic material in an organism.

12. What areas of agriscience have developments under way using genetic engineering?

Genetic engineering is being used for developments in the following areas: herbicide-resistant plants, insect-resistant plants, disease-resistant plants, transgenic animals, frost protection, longer storage life, and new animal products.

EVALUATING

1=g, 2=h, 3=i, 4=a, 5=d, 6=e, 7=f, 8=b, 9=c, and 10=j

PART THREE: PLANT AND SOIL SCIENCE

9

PLANT STRUCTURE AND GROWTH

CHAPTER SUMMARY

Plants are important to human life. Many human foods and other products are of plant origin. The culture of plants to meet human demand is a major force in the agricultural industry. Understanding the basic principles of plant science can help us grow plants. Plant species are adapted to specific climates. However, plant species are found in nearly all climates. Important climate features are temperature, precipitation, light, and plant adaptations.

Plants are classified on the basis of their life cycles, as follows: annuals, plants that have a complete life cycle in one year; biennials, plants that have a complete life cycle in two seasons; and perennials, plants that live for more than two growing seasons. Some plants are cultured so their growth is different from what it appears to be (carrots are a biennial that is planted and harvested in one growing season).

As multicellular organisms, plants have several important parts. Plant parts are of two major types: vegetative and reproductive. Important vegetative parts are leaves, stems, and roots. Reproductive parts include flowers, fruit, and seeds.

Leaves are of two major types: monocots and dicots. Monocot leaves have parallel veins. Dicot leaves have branching veins. Many kinds of leaves are found on agricultural plants. Leaves make food for the plant by photosynthesis.

Stems vary on the basis of their location and structure. Stems are typically thought of as being above the ground; however, some are subterranean. Potatoes are tubers, which are stems below the ground. Onions are bulbs, which have layers resembling leaves below the ground level. Corms are similar to bulbs but have thinner leaves. Rhizomes are long underground stems. The stem structure is based on the amount of wood in the stem. Woody stems, such as those on trees, have many cells with strong walls. Herbaceous stems are soft and often green and contain woody cells. Stems contain tissue that transports materials known as xylem and phloem in plants.

Root systems are of two types: fibrous and taproot. Fibrous root systems have many small roots that branch out through the soil. Taproot systems have one main root that grows downward. Roots anchor a plant and absorb nutrients from the soil.

Tropism is the movement of plants. Most plants are anchored in one place but are able to move during growth and in response to their environment.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners develop an understanding of the fundamentals of plant life. Emphasis is on the structure and functions of plant parts.

Upon completion of Chapter 9, the student will be able to:

1. Describe how plants are adapted to climate.
2. Explain plant life cycles.
3. Identify the major vegetative parts of plants, and discuss their functions.
4. Explain the meaning and kinds of tropisms.
5. Identify useful plants.

INTEREST APPROACH

The interest approach can be localized to the plants that grow in the community. Emphasis can be on agricultural crops, horticulture, or forestry. Students should

be aware of many of the plants that grow locally. The Career Profile, Technology Connection, and Agri-Science Connection can be used as part of the interest approach or as the chapter is taught.

One approach is to have students read the introduction to Chapter 9. This could be followed with a discussion of the role of plants in the lives of all living things. Animals depend on plants for their food. Humans use plants for food, fiber, and shelter. On the writing surface, list plants that are grown in the local area for food, fiber, and shelter. Remind students that only about 1,000 of the 350,000 known species of plants are used for food, fiber, and shelter. Develop a list of plants found in the local area that are not used for food, fiber, and shelter. Conclude the interest approach by having each student select the most important plant that is listed. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Many strategies can be used in helping students achieve the objectives of this chapter. The terms, concepts, and applications in the Activity Manual will be most beneficial.

Better learning will result when the students are more involved in the learning processes. This includes reading the book, answering questions at the end of the chapter, defining the terms at the beginning of the chapter, and engaging in the "Exploring" activities at the end of the chapter.

One strategy could involve having the students contrast plant and animal life. The differences and similarities could be listed on the writing surface. In addition, use the writing surface to list the ways in which plants are adapted to climate. List each of the ways and the main points of the content for each.

Present the types of plants based on life cycle. List the life cycles. Then give a brief definition of each. For each of the types, have students name plants grown locally. Relate how plants that fit these cycles can be changed, such as growing tomatoes in a greenhouse in the winter.

Use the writing surface and text to list key points that describe plant parts. Sketch a plant on the writing surface, and label the parts as they are discussed. Summarize the functions of each part in a list on the writing surface. Name and describe the kinds of leaves, stems, and roots. Have students complete the appropriate sections in the Activity Manual on the parts and functions of plants. (Refer to Figure 9–17 in the text.)

Tropism is a concept that may need additional emphasis for student comprehension. Present the kinds of tropism, and explain each. If time permits, demonstrate phototropism with a plant near the window in the classroom or laboratory, or use the Activity Manual.

Conclude the instruction in this chapter with a review of the chapter summary.

REVIEW AND EVALUATION

Review the objectives of the chapter by having students orally explain each. Questions at the end of the chapter and the terms at the beginning can also be used in review. Activities in the Activity Manual are also excellent for review of the chapter objectives.

The Internet Topics can be used as part of review and to allow students to investigate content beyond the scope of the chapter.

Evaluation can involve the preceding review activities as well as oral and written testing. Performance on Activity Manual activities is another source of evaluation. Supervised experience activities can also be used, particularly if the students' experiences involve plants.

SAFETY

The objectives of this chapter do not involve learning outcomes and activities that are hazardous. However, laboratory activities that necessitate cutting plant materials and otherwise using equipment could pose a danger. Teachers should always make students aware of possible hazards. Further, some students have allergies to specific plant species, such as poison ivy. Students should be taught to identify such species, if appropriate.

ADDITIONAL RESOURCES

Additional resources may include reference materials on plant biology, such as the biology texts used in the school. Other reference materials on plant science, horticulture, and agronomy may also be used for enrichment. Another resource that may be particularly useful is the National Plant Database at the following Web address: **http://plants.usda.gov/**. Other useful Web sites include: Cradle of Forestry—**www.cradleofforestry.com**; The United States National Arboretum—**www.usna.usda.gov/**; and The National Arbor Day Foundation—**www.arborday.org**.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, or other details in the answers.

1. **What are the factors in the adaptation of plants to climate?**

   The major factors in the adaptations of plants to climate are temperature, precipitation, and light.

2. **What are the three ways of classifying plants based on life cycle? Distinguish between the life cycles.**

   Plants are classified as follows on the basis of life cycle: annuals (complete their life cycle in one year), biennials (complete their life cycle in two growing seasons), and perennials (live for more than two growing seasons or years).

3. **How can the life cycles of plants be altered?**

   Plant life cycles can be altered by changing the environment in which the plants grow. Plants damaged by cold weather can be grown in structures that protect them from the weather, such as in greenhouses. Light can also be used to alter the processes associated with the photoperiod.

4. **What is the major role of leaves?**

   Leaves make food for the plant.

5. **What are the major parts of a leaf? (Sketch a leaf and label its parts.)**

   The major parts of a leaf are the blade, veins, epidermis, stomata, internal cells, waxy coating, petiole, and stipule. (Refer to Figure 9–19 in the text for a sketch.)

6. **What are the types of leaves? Give an example of each.**

   The two major types of leaves and examples are simple (corn and magnolia) and compound (locust and clover).

7. **How are leaves attached to plants? What patterns are found?**

   Leaves are attached to plants in specific patterns. The three patterns are alternate, opposite, and whorled.

8. **What is the role of the stem?**

   The stem has five functions: support the leaves; support flowers and fruit; transport water and other materials between roots and leaves; grow; and store food.

9. **What are the two major kinds of stems? Distinguish between them.**

   The two major kinds of stems are woody and nonwoody (herbaceous). Woody stems have cells with strong cell walls. Herbaceous stems are soft and green. Most herbaceous stems contain only a small amount of xylem.

10. **What are the parts of a stem? (Sketch a cross section of a woody stem, and label the parts.)**

    From the outside to the center, the parts of a woody stem are bark (outer covering that protects the stem); cortex (located between the bark and phloem; the primary tissue in a stem); phloem (transports sugar in the plant); cambium (located between phloem and xylem, the cambium is the layer of cells where growth occurs); xylem (conducts water and nutrients from the roots to the leaves); and pith (center of stem where moisture and food are stored). Refer to Figure 9–29 in the text for a sketch.

11. **What does the root system do for a plant?**

    The root system anchors the plant, takes up water and nutrients from the soil, and stores food.

12. **What are the two major kinds of root systems? Distinguish between them.**

    The two major kinds of root systems are fibrous and tap. The fibrous system has many roots that branch out in the soil. The taproot system has one large root with smaller roots attached to it.

13. **What are the parts of a root system? What are the functions of these parts?**

    Root systems have primary roots, secondary roots, and root hairs. The primary root grows from the seed and has secondary roots attached to it. The secondary roots branch from the primary root and have root hairs attached to them. In addition to the kinds of roots, root systems also have root caps on the ends of the roots to protect them as they grow through the soil. The root hairs absorb water and pass it to the secondary roots, which pass it to the primary roots.

14. What is tropism? Name three kinds, and explain how they affect plants.

Tropism is the movement of plants. The three kinds are thigmotropism (how plants respond to solid objects), phototropism (how plants respond to light), and geotropism (how plants respond to gravity).

EVALUATING

1=j, 2=e, 3=i, 4=g, 5=h, 6=f, 7=a, 8=d, 9=b, and 10=c

10

REPRODUCING PLANTS

CHAPTER SUMMARY

Horticultural and agricultural plant producers know the importance of plant reproduction. Without it, no new plants would exist. New plants are regularly started and grown. Success in growing plants depends on understanding the fundamental processes of plant reproduction, which is often called propagation.

Plants propagate by sexual and asexual means. Sexual propagation means seed are used. Asexual propagation is using the vegetative parts of the plant to reproduce it. Some plants asexually propagate on their own, such as strawberry plants. Others are asexually propagated by artificial means, such as with a graft.

Sexual propagation involves two kinds of seed: monocot and dicot. Monocot seed have one seed leaf inside a seed that is structured different from the dicot. Dicots have two seed leaves. The structure and parts of monocot and dicot seed vary.

Seed are borne by flowers. Flowers vary greatly in structure and appearance. Flowers may be complete or incomplete, or they may be perfect or imperfect. Complete flowers have four principal parts: sepals, petals, stamens (male part of the flower), and pistils (female part of the flower). Incomplete flowers do not have one or more of these parts.

Perfect flowers have the stamen and pistil in the same flower. Flowers that lack a stamen or a pistil are imperfect. Plants with both male and female imperfect flowers on them are known as monoecious plants, such as corn. Dioecious species have plants that bear male or female flowers, such as strawberries.

Pollination is the transfer of pollen from the anther on the stamen to the stigma of the pistil. Fertilization occurs when the pollen cell unites with the ovule (egg). This involves a complex process in which two sperm are formed by a pollen grain.

Seed form after fertilization. Many seed form in ovaries that develop as fruit. The forms of fruit vary considerably.

Seed must be viable. They must come up and grow. Germination is the sprouting of seed to grow a new plant. In addition to seed viability, certain things must be present in the environment of the seed for it to grow.

Asexual propagation involves using vegetative parts of the plant (e.g., stems, leaves, and roots) to reproduce it. Asexual propagation has the advantage of producing offspring that are exactly like the parent. Methods of asexual propagation include layering, cuttings, budding, grafting, and tissue culture.

Quality seed from improved varieties should be used. Only varieties that are suited to a climate and produce a quality product should be planted.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners develop skills in propagating plants. Basic principles are presented along with practical information.

Upon completion of Chapter 10, the student will be able to:

1. Explain how plants reproduce.
2. Identify the kinds and parts of seeds and explain their functions.
3. Explain the types and functions of flowers.
4. Describe germination and the conditions needed for it to occur.
5. Explain the use of vegetative propagation.
6. Explain the importance of seed variety and quality.

INTEREST APPROACH

Have students read the introductory part of Chapter 10. Ask members of the class to explain the importance of new crops and animals being grown every year. Ask, "How would farmers produce wheat or other crops if they did not reproduce plants?" Involve students in a discussion of the importance of having a good "stand" of crop plants in a field. Help them in understanding that reproducing plants is essential for successful crop production.

Other strategies may be used, depending on the needs of the students. In some cases, the examples will be easy to localize to the community, the school greenhouse, the horticulture laboratory, or the school farm. Special features in the chapter can be used initially or throughout the chapter to promote interest and motivation. These features include the Career Profile, AgriScience Connection, Technology Connection, Internet Topics, and Academic Connection.

Teachers may wish to review the objectives for the chapter upon completion of the initial interest approach.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

After the initial interest approach, direct the students in a discussion of why plant reproduction is important. Use presentation and discussion methods to develop a list of reasons explaining why plants reproduce.

Use the writing surface or electronic means to present the ways in which plants reproduce. Give a brief explanation of each way and examples of crops that are included with each. Ask students to name examples of crops that reproduce sexually and asexually. They should record the information in their notebooks.

Using the writing surface and discussion techniques, present the material on the sexual propagation of plants. Distinguish between the kinds of seed and between differences in the structure of dicots and monocots. (Refer students to Figure 10–8 in the text for details on the structure and parts of monocot and dicot seed.)

After students have read the section of the chapter on how seed are formed, use presentation and discussion procedures to point out the kinds and parts of flowers. (Refer students to Figure 10–13 in the student textbook for an illustration of the parts of a flower.) Explain pollination and fertilization processes. Explain how seed are formed and explain the role of fruit.

Use presentation and discussion to cover the meaning and process of germination. Define the term "viability." Have each student use the Activity Manual to conduct a rag doll seed germination test. On the writing surface, write a list of the items needed for seed germination. Provide these as best as possible for the rag doll tests. (Several days will be required for the rag doll tests; therefore, other content of the chapter will be covered while the tests are underway.)

Present asexual reproduction of plants. List and explain the benefits and methods of vegetative reproduction. Have students propagate plants by using layering, cuttings, budding, grafting, and tissue culture. The Activity Manual will be most helpful for these activities.

Discuss the meaning and importance of improved seed. Relate seed quality to the results of the rag doll tests. Have students review labels on seed packages for percent of germination information.

REVIEW AND EVALUATION

The summary at the end of the chapter can be used in the review process. The terms at the beginning of the chapter and the end-of-chapter questions can also be used as a part of the review.

Evaluation can involve a number of procedures, including those in the review process. Use the items in the "Evaluating" section. Materials in the Activity Manual can be helpful in evaluation. Written and/or oral tests can be used to assess student achievement.

SAFETY

The objectives of this chapter include few learning outcomes that pose any safety hazards. Having students propagate plants asexually by using sharp knives and other instruments could result in possible dangers. Instruct students in the proper use of all instruments.

Appropriate safety precautions are listed in the Activity Manual.

ADDITIONAL RESOURCES

The objectives of this chapter can be achieved with few additional resources. The Activity Manual will be most helpful. References on plant propagation, especially tissue culture, may be useful. Bulletins containing materials on layering, cutting, and grafting may be available at no charge from the Cooperative Extension Service in your state. Web sites that address plant production may be useful.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in the answers.

1. **What is the purpose of plant propagation?**

   The purpose of plant propagation is to create more plants.

2. **Distinguish between the two major ways in which plants are propagated. Give advantages and disadvantages of each.**

   The two major ways in which plants are propagated are sexually and asexually. Sexual propagation involves using seed to produce more plants. Asexual propagation entails using the vegetative parts of plants to make more plants.

3. **What is a seed? Sketch a seed, and label its parts.**

   A seed is a container of new plant life. Refer to Figure 10–8 in the text.

4. **What is the purpose of flowers?**

   Flowers are the reproductive parts of flowering plants. They are specially made to achieve the development of seed.

5. **What are the parts of a complete flower? Sketch a flower, and label its parts.**

   A complete flower has sepals, petals, stamens, and a pistil. (Refer to Figure 10–13 in the text for the location of the parts of a perfect flower.)

6. **What is pollination? How does it occur?**

   Pollination is the transfer of pollen from an anther to a stigma of a flower of the same species. Wind, insects, and other means move the pollen.

7. **What is fertilization?**

   Fertilization is the union of the pollen cell and the ovule (egg). The pollen grain grows a long tube through the style toward the ovule. Two sperm are formed. One of the sperm unites with the ovule in the ovary. The other sperm forms tissue known as endosperm.

8. **How is seed formed?**

   Seeds are formed in the ovary of a flower after fertilization of the ovule. The ovary may form fruit in which the seed develop. Once fertilization has occurred, the flower is no longer needed.

9. **What kinds of fruit are produced by plants?**

   Two types of fruit are produced: fleshy and dry. Fleshy refers to large fibrous fruit, such as apples. Dry fruit refers to fruit that develops as pods (beans) or hulls (wheat).

10. **What is germination? Why is it important?**

    Germination is the sprouting of seed to grow a new plant. Seed must germinate for new plants to be produced.

11. **What does a seed need to germinate?**

    Seed need the following to germinate: proper moisture, temperature, and oxygen.

12. **Why is vegetative propagation used?**

    Vegetative propagation is used because it results in the offspring having true traits of the parents.

13. **What parts of plants can be vegetatively propagated?**

    The parts of plants that can be vegetatively propagated are below-ground parts (tubers, bulbs, corms, and rhizomes) and above-ground parts (leaves, buds, and stems).

14. **What methods of vegetative propagation are used?**

    The methods of vegetative propagation are layering, cuttings, grafting, budding, and tissue culture.

15. **Why should quality seed be used? What determines seed quality?**

    Good-quality seed come up, grow, and make the intended plant. Seed quality is determined by having purity of variety; being free of contamination; having good percent germination; being uniform in size; being free of damage or breakage; being free of disease; having been treated to prevent disease; and being from a grower or a dealer who has a good reputation.

EVALUATING

1=i, 2=a, 3=j, 4=b, 5=c, 6=e, 7=d, 8=f, 9=h, and 10=g

11

PLANT GROWTH

CHAPTER SUMMARY

Producing plants when, how, and where we want them is more involved than some people think. People must know the requirements for plant growth and how to provide what plants need.

Growth is by mitosis—a type of cell division. Plants have two kinds of growth: primary and secondary. Primary growth occurs when plants get larger; stems and roots grow longer and leaves and flowers grow. Secondary growth takes place when the stems and roots increase in diameter. Encouraging primary and secondary growth involves understanding growth processes.

Plants grow because of phytohormones. These substances naturally occur in plants and regulate the growth and development of plants. Several kinds of hormones are found, and growth can be encouraged by providing additional hormones. A common hormone used in horticulture is gibberellic acid.

Photosynthesis is the important process whereby plants produce sugar. Plants use carbon dioxide and water in the presence of light and chlorophyll to produce simple sugar and oxygen.

Plant growth processes must consider respiration and transpiration. With respiration, the sugar produced by photosynthesis is used by the plant for energy. Transpiration is the loss of water from the plant through the stomata. The stomata on the leaves open and close in an attempt to provide a good environment for the plant. If too much water is lost, the plant will suffer. Several cultural practices can be used to help plants avoid water loss.

Plants require several nutrients for growth. These are known as essential elements. Twenty elements have been found to be essential for plant growth. Of these, 17 elements have been carefully documented through research. Nitrogen, phosphorus, and potassium are the three elements that are needed in the largest amounts.

Fertilizers are chemical substances used to provide plant nutrients. Crops have varying needs, just as soil varies in available nutrients. Soil testing and plant tissue analysis are used to determine the nutrients that need to be added to the soil for a particular crop.

INSTRUCTIONAL OBJECTIVES

The objectives of the chapter are intended to help students develop an understanding of several important practices that help plants grow. These practices are based on the growth processes and needs of plants.

Upon completion of Chapter 11, the student will be able to:

1. Describe how and why plants grow.
2. List and explain factors in plant growth.
3. Explain photosynthesis and why it is important.
4. Explain transpiration and why it is important.
5. Name the nutrients plants need, and describe how plants get them.
6. Discuss nitrogen fixation in legumes.
7. Explain the use of fertilizer.

INTEREST APPROACH

Various strategies can be used in the interest approach to motivate students. Relating the needs of plants found in the local climate and agriculture is one effective strategy. Give examples of local crop needs, such as fertilizer and irrigation. Then have students discuss what would result if these practices were not used.

Another interest approach is to have the students read the introductory part of the chapter in the text. Ask them to explain what is meant by “producing plants when, how, and where they are wanted.” They might suggest that growing tomatoes in a greenhouse in the winter requires knowing the requirements of tomatoes. The same is true with other crops. Conclude the interest approach by reminding students of the importance of knowing the principles of plant science. If we know how plants grow, we can do things to help them grow better. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Use teaching strategies for the objectives of this chapter that focus on effective methods of teaching the principles of plant growth. Using the writing surface for presentation and discussion will be helpful with much of the content. Have the students read the chapter and participate in the class discussion to improve their learning. As information is presented on the writing surface or discussed in class, students should take notes. Remember that RLRWP-E will result in the greatest mastery of the content.

Various techniques can be used in the teaching plan to enrich instruction. Examples of plants can be brought to class for students to use in studying primary and secondary growth. Have students distinguish between secondary and primary growth. Plants can be treated with phytohormones, such as gibberellic acid, so the growth of those that are treated can be compared with the growth of those in a control group that receive no treatment. Activities in the Activity Manual will also be helpful. Refer students to Figure 11–9, parts of a tree. Move outside to a lab environment where trees are present. Ask students to point out the crown, trunk, and roots. Present a cross section of a tree or a piece of wood that shows plant growth rings. Have students count the rings as a means of estimating the years required for the wood to grow. Another observation is to locate mistletoe in a tree and to discuss relationships between the mistletoe and the tree.

Collecting soil samples and conducting analyses to determine the nutrients present in the soil will help provide hands-on learning. The information gathered should be compared to the needs of crops, as presented in Table 11–2 in the text.

Various types of fertilizer should be brought to the classroom, as appropriate. Students may tour a farm supplies business to observe the labeling and product formulation of different fertilizers. Tags from fertilizer containers should be used to help students learn about fertilizer analysis. Students can obtain experience in the different methods of fertilizer placement and handling in the school laboratory or in their supervised experience programs.

This chapter presents much practical information that can be used in growing plants. Application of the information in the school laboratory will be most beneficial.

REVIEW AND EVALUATION

The summary at the end of the chapter can be used to help review the content of the chapter. The activities in the Activity Manual are also useful. Some teachers may wish to incorporate the end-of-chapter review questions and the terms at the beginning of the chapter in the review.

Evaluation can involve implementing some of the review activities as well as using written and oral tests. Teachers can observe the performance of students in the school laboratory and in their supervised experienced programs. The same techniques can be used for re-teaching, as needed and as appropriate.

SAFETY

The objectives of the chapter involve few learning activities that pose safety hazards. However, some activities carried out in the teaching strategies (e.g., using chemicals to test soil and using fertilizers) could pose safety problems. The teacher should carefully review these safety problems with the students prior to the learning activities. Safety practices are presented in the Activity Manual.

ADDITIONAL RESOURCES

The objectives of the chapter can be achieved with few additional resources. A good book that carries beyond the content of *AgriScience* is *Introduction to Plant & Soil Science and Technology* (available from Pearson Education). The content will have additional meaning if it is related to situations in the local area. Bulletins and materials about crop fertilization and other cultural practices can be obtained from the division of agriculture at a college or a university. Here are a few university Web sites with information: University of Illinois (hydroponics): www.aces.uiuc.edu/vista/html_pubs/hydro/require.html; West Virginia Univesity (forage plants): www.caf.wvu.edu/~forage/growth.htm; Colorado State University (plant growth): www.ext.colostate.edu/mg/gardennotes/ 141.html; and Texas A&M University (Master Gardener): http://aggie-horticulture.tamu.edu/.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in the answers.

1. **How do plants grow?**

   Plants grow by cell division (mitosis).

2. **What kinds of growth occur in plants? Distinguish between the two.**

   The two kinds of growth in a plant are primary and secondary growth. Primary growth is linear growth; the stems and roots grow longer, and the leaves and flowers grow. In secondary growth, the stems and roots increase in diameter (become thicker).

3. **What kinds of hormones are found in plants? What does each do for the plant?**

   The hormones found in plants are auxin (regulates stem growth and fruit production); gibberellins (regulate stem and leaf growth, fruit development, flowering, and cell division); cytokins (promote cell division); ethylene (regulates growth and reproductive processes); and abscisic acid (promotes dropping of leaves and fruit from plants).

4. **What is photosynthesis? What are the major phases of the process?**

   Photosynthesis is the process by which plants make sugar. The two major phases are energy gathering and sugar making. Energy is gathered from the sunlight.

5. **How is photosynthesis carried out? Write the equation.**

   Photosynthesis is carried out by plants in the presence of sunlight and chlorophyll. Energy from the sun produces chemical energy, which rearranges the elements of carbon dioxide and water. Sugar and oxygen are produced. (Refer to Chapter 11, page 277 in the text for the equation.)

6. **What is respiration?**

   Respiration uses sugar and oxygen to produce energy to help plants grow and reproduce. (Note: Respiration is the reverse of photosynthesis.)

7. **What is transpiration?**

   Transpiration is the loss of water from a plant. Most of the loss is through the stomata of the leaves.

8. **Why do plants wilt? What can be done to prevent wilting?**

   Plants wilt because they do not have enough water. Wilting could be due to excessive transpiration or other causes. Wilting can be prevented by avoiding damaging plants during cultivation, planting drought-tolerant species, fallowing, using no-till culture, mulching, terracing, and irrigating.

9. **What are the essential nutrients for plants? List their names and chemical symbols.**

   The essential nutrients are carbon (C), hydrogen (H), oxygen (O), nitrogen (N), potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg), sulfur (S), sodium (Na), iron (Fe), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), manganese (Mn), chlorine (Cl), cobalt (Co), vanadium (V), and silicon (Si).

10. **What is the importance of nitrogen? What are the sources of nitrogen?**

    Nitrogen makes leaves healthy and green and helps plants grow fast. It is essential in protoplasm. The sources of nitrogen are nitrate (NO_3^-) and ammonium (NH_4^+) forms in fertilizer. Some nitrogen is naturally in the soil. Legume plants have the ability to "fix" nitrogen.

11. **What is a legume?**

    A legume is a plant that has the ability to take nitrogen from the air and put it into nodules that grow on their roots.

12. **What is the importance of phosphorus and potassium?**

    Phosphorus is needed for plants to store and transfer energy and to grow. It is also needed for seed germination. Potassium is needed for plants to carry out photosynthesis, move sugar,

and perform other functions. Both phosphorus and potassium are needed for plants to be healthy and to grow.

13. How is the appropriate fertilizer determined?

The fertilizer to use depends on the needs of the plants, the nutrients in the soil, and the pH of the soil. Soil samples are taken and tested for nutrients. The tissues of plants may be analyzed to determine nutrient deficiencies. Different crops use varying nutrients.

14. What types of fertilizer are used?

The types of fertilizer are dry, liquid, and other forms (e.g., gases).

15. What does "fertilizer analysis" mean? Explain the following label on a fertilizer bag: 5-10-5.

Fertilizer analysis tells what the nutrients are in the fertilizer. The first number is the percent of nitrogen in the fertilizer; the second number is the percent of phosphoric acid in the fertilizer; and the third number is the percent of potash in the fertilizer.

16. How is fertilizer placed?

Fertilizer is placed so it will be available to the plants without damaging them. The methods are pre-planting (before the crop is planted), planting (at the time of planting), and post-planting (after the crop is up and growing).

17. What are the important rules to follow in handling fertilizer?

The rules to follow in handling fertilizer are use only the recommended kind and amount; apply fertilizer only where it is needed; store fertilizer in dry places where nutrients will not be lost; clean equipment after it is used to apply fertilizer; wear protective clothing; and wash after using fertilizer.

EVALUATING

1=i, 2=d, 3=e, 4=a, 5=j, 6=g, 7=f, 8=b, 9=c, and 10=h

12

PLANT HEALTH

CHAPTER SUMMARY

Plants are subject to attack and damage by certain pests. Understanding pests, including their prevention and control, can help a producer to be more efficient in crop production.

Plants can be damaged by insects, nematodes, diseases, weeds, rodents, and other animals. Three conditions must be present for pest problems to develop: a pest, a susceptible plant, and an environment favorable for the pest to take advantage of the plant.

Entomology is the branch of zoology that deals with insects. Insects are small animals (Domain Eukarya) that damage plants by eating leaves, stems, fruit, or roots or by sucking the juices from them. Some insects raise their young on plants. Approximately 86,000 species of insects are found in North America. Insects are often classified by their mouthparts: chewing or sucking. They are also classified by their life cycles: complete metamorphosis or incomplete metamorphosis. Insects can cause damage at different times in their life cycles.

Although some insects are pests, other insects are beneficial. They may help crops grow by pollinating flowers, preying on other pests, and more.

Nematodes are tiny worm-like animals that live in the soil and attack the roots and stems of plants.

Diseases are abnormal conditions in living plants. Diseased plants may not grow or produce a crop. In some cases, they die. Diseases are of two types: environmental and parasitic. Environmental diseases are caused by conditions in the environment of plants. In

contrast, parasitic diseases are caused by tiny organisms (e.g., fungi and bacteria) and by viruses.

Weeds are plants that are growing where they are not wanted. Weeds are classified on the basis of their life cycles: annuals, biennials, and perennials. Weeds compete with plants, waste valuable nutrients, lower the quality of the crop, make harvesting more difficult, serve as hiding places for insects and disease, and look bad in a crop or a lawn.

Pests cause damage in many ways. The major loss is the reduction of the amount of crop that is produced. Some pests cause other kinds of damage, such as rodents that make holes in the ground.

Prevention is far better than trying to control a pest after it has gotten into a crop. Following good cultural practices can keep away many pests. Getting rid of pests may involve using mechanical methods, such as plowing to kill weeds; chemical methods, such as insecticides to kill insects; biological methods, such as using insects that eat other insects; and genetic methods, such as developing crops that are pest-resistant.

Integrated pest management (IPM) is an accepted approach to the overall welfare of society. It involves using a variety of prevention and control methods.

Safety is a major issue in using some of the methods of pest control. If these methods are used carelessly, the individuals using the materials and society as a whole can be harmed.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help students develop fundamental knowledge of practices in preventing and controlling plant pests. Emphasis is on prevention and on protecting the environment from hazards.

Upon completion of Chapter 12, the student will be able to:

1. Explain plant health and how pests cause damage.
2. Discuss the major kinds of pests.
3. Explain the role of entomology in plant health.
4. Identify conditions that may result in pest damage to plants.
5. Describe the meaning and use of integrated pest management.
6. List safety practices in using pesticides.

INTEREST APPROACH

Have students read the introductory part of the chapter. Ask them to explain how plants get sick. On the writing surface, list the examples of ways they have seen plants sick. Have them name the kinds of plants that have been sick. Next, ask students to describe how sick plants affect people (less food, fiber, and shelter; increased cost; etc.).

The interest approach could be localized. Examples of particular disease problems could be discussed. Perhaps the school laboratory has had insect or disease problems the students have observed. If so, these could be related in the interest approach. (Teachers may wish to review the objectives at this time.)

Another potential interest approach is to begin with a quadrat sampling activity. Students can fairly easily make population counts and use the data they collect as a part of an interest approach.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Many strategies can be a part of the teaching plans for achieving the objectives of this chapter. The general content of the chapter will need to be covered. Use student reading and involvement as well as presentations whereby key terms and information are summarized on the writing surface. The RLRWP-E process will pay big dividends in terms of student achievement of basic science and associated concepts.

Sequentially cover the chapter content. Remember that each objective has an “A” heading that begins a section at the top of the page. This organizes the content for ease of reading. After students have read a section, list key points on the writing surface. Then have students provide information that explains and gives the content associated with each key point.

As much as possible, “real things” should be used in the instructional process. Specimens of insects, diseased plants, and other items will be helpful. The Activity Manual will provide hands-on learning activities. Preparing and calibrating sprayers and measuring materials are also useful activities. (Note: For safety purposes, in measuring, teachers may wish to use water rather than dangerous chemicals.)

A few student-centered activities include making insect collections and classifying the insects by the type of mouthparts and metamorphosis; collecting specimens of diseased plants; collecting weed leaves and then classifying them by the type of life cycle; and collecting the labels of containers of pesticides. In some cases, students can be involved in preventing and controlling pests in the school laboratory or in their supervised experience programs.

REVIEW AND EVALUATION

Review can involve a number of approaches. The summary at the end of the chapter will bring closure to the chapter content. Students can be called on to explain the content of the various objectives. Other students can define the terms given at the beginning of the chapter. The end-of-chapter review questions are also helpful in reviewing and re-teaching, as needed. The Activity Manual will aid in reviewing the content as well as in evaluating the achievement of the chapter objectives.

Evaluation can involve any of these review approaches as well as the "Evaluating" section and oral or written testing. Observing the performance of students in their supervised experience programs will also provide useful evaluation information.

SAFETY

The objectives of this chapter can be achieved without students being exposed to safety hazards; however, safety is particularly important with the hands-on activities that could be a part of this chapter.

The handling and use of pesticides is always an area of considerable safety concern. Students should be taught how to read labels and how to respond to the safety precautions that are given. Students may have contact with hazardous pesticides in their supervised experience. They need to know how to properly use pesticides in approved and legal ways and how to respond in the event of an emergency.

The Activity Manual addresses safety practices with the activities contained therein. Be sure to cover this section with the students.

The last part of Chapter 12 in the text contains important safety practices. Carefully go over each item. Have students offer examples.

Teachers may wish to invite specialists on pesticide safety to serve as resource people in class. In some cases, pesticide applicator training may be provided.

ADDITIONAL RESOURCES

The objectives of this chapter can be achieved with few resources outside of the text and Activity Manual. However, local materials on keeping plants healthy can be obtained and used as resources in the class. These include information on pests in the crops, lawns, forests, and other areas in the local community. This information can be acquired from any agriculture college or university. Literature on pesticide safety and related issues may also be useful. The Academic Connection and Internet Topics sections may be beneficial in assessing and using additional resources. Resources of the Animal and Plant Health Inspection Service, USDA, may be helpful. Go online and chose from a range of options at www.aphis.usda.gov/.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is a plant pest?**

   A plant pest is anything that causes injury or loss to plants.

2. **What are insects? How are they identified?**

   Insects are small animals with three pairs of legs and bodies divided into three sections: head, thorax, and abdomen. The legs and wings, if any, are on the thorax. The head has antennae and mouth parts. The abdomen has no attachments but may be divided into segments.

3. **What are the life stages of insects? How do the stages relate to plant damage?**

   The life cycle of insects is known as metamorphosis. A complete metamorphosis has four stages: egg, larva, pupa, and adult. The incomplete metamorphosis has three stages: egg, nymph, and adult. Insects live on and/or attack plants in the different stages. The larva form is a damaging worm that often harms many plants. Some adult forms feed on plants.

4. **What is a beneficial insect? List three ways insects are beneficial.**

   Beneficial insects help crops grow. They make the environment better for plants. Insects are beneficial because they improve the soil, pollinate plants, and destroy other insects.

5. **What is a nematode? How do nematodes damage plants?**

   A nematode is a tiny worm-like organism that lives in the soil and attacks the roots and stems of plants. Nematodes damage the plants and keep them from growing as they should. They may also carry disease from one plant to another.

6. What is a plant disease? What are the signs of plant disease?

A plant disease is an abnormal condition in living plants. The signs of disease include rotting plant parts; leaves turning yellow; leaves and stems twisting; buds not developing into flowers and fruit; and dead plants.

7. What are the types of plant disease?

The types of plant disease are environmental and parasitic.

8. What is a weed? What are the kinds of weeds?

A weed is a plant that is growing where it is not wanted. The kinds of weeds are annuals, biennials, and perennials. They may further be classified as winter and summer weeds.

9. How do weeds cause problems for plants?

Weeds cause problems by keeping the desired plants from growing; wasting nutrients; lowering the quality of the crop; making harvest more difficult; serving as a hiding place for insects and diseases; and looking bad in a field.

10. What conditions must exist for pests to damage plants? Explain each.

Three conditions must be present: a pest (If a pest isn't where crops are grown, it can't cause a problem!); a susceptible plant (Some plants are more likely to be attacked by a pest than other plants.); and the right environment (Pests and crops can sometimes grow together without problems until a change makes the crop plants more susceptible.).

11. How do pests damage plants? How does the damage affect the producer?

Plants may be damaged when pests chew holes in plants, attack the vascular system, attack fruit, contaminate products, rob plants of food, and damage the land. Producers are affected by reduced yields, lowered quality, increased production costs, hiding places for other pests, and restricted marketing.

12. How are plant pest problems prevented?

Plant pest problems can be prevented by planting good seed, destroying diseased plants, applying the right fertilizer, disinfecting equipment, using good water, controlling animal movement, applying chemicals properly; and using tests to check for insects.

13. What methods are used to manage pests? Briefly describe each.

Methods used to manage pests are mechanical methods (plowing, mowing, and mulching); cultural practices (rotating crops, roguing, trap cropping, burning, using resistant varieties, and cleaning around fields); chemicals (sprayed or otherwise applied to crops and pests); biological methods (using living organisms to control pests); and genetic methods (developing crops that are resistant to pests).

14. What is the relationship between the way an insect gets its food and the kind of pesticide that may be used?

Insects get their food by chewing or sucking. Chewing insects eat leaves and any insecticide that may be on the leaf; therefore, they can be controlled with stomach poisons. Sucking insects do not eat the surfaces of leaves; therefore, the poison must be sprayed on the insects or in the juice of the plant. Insecticides sprayed on insects are known as contact poisons. Fumigants and systemic poisons will control chewing and sucking insects.

15. Distinguish between selective and nonselective herbicides.

Selective herbicides will kill only certain kinds of plants. Nonselective herbicides kill all plants upon contact. Selective herbicides may be known as translocated herbicides.

16. What is integrated pest management?

Integrated pest management (IPM) is a planned process of using methods that have the best outcomes for society. It is a blend of pest prevention techniques in a planned program. Some levels of pests are tolerated. Emphasis is on reducing pest numbers with a minimum amount of damage.

17. What are the important safety practices when using pesticides? Select three that you feel are most important.

Eleven safety practices are listed. Use only approved pesticides; know the pesticides; use a pesticide with low toxicity; use pesticides only when needed; do not contaminate resources; wear protective clothing; wash the skin after contact; properly dispose of empty containers; apply in good weather; use the right equipment; and know the emergency procedures. (Students should feel free to select any three of these safety procedures and to identify them with a check mark or in some other way. Teachers may want students to justify their choices.)

18. What is entomology? What does it include?

Entomology is the branch of zoology that deals with insects. It may include other noninsect species, such as spiders, mites, and centipedes. All are in the Domain Eukarya.

EVALUATING

1=i, 2=c, 3=a, 4=f, 5=g, 6=e, 7=b, 8=h, 9=d, and 10=j

13

SOIL AND LAND SCIENCE

CHAPTER SUMMARY

Soil is not dirt! In some situations, soil can become dirt. Using appropriate terminology is important when referring to soil. Many people refer to soil as dirt. Soil provides for human needs; dirt doesn't! Having plenty of food, fiber, and shelter requires productive soil. Soil is the top few inches of the earth's crust that support plant growth. It is made of four materials: minerals, organic matter, water, and air.

The mineral materials in soil are sand, silt, and clay. Sand has the largest particle size, and clay the smallest. Organic matter is made of the remains of plants and animals in various stages of decay.

Soil has two important physical qualities: texture and structure. Soil texture is the proportion of sand, silt, and clay in the soil. A soil triangle is often used to show the makeup of different soils. (Refer to Figure 13–11 in the text.) Structure is concerned with the arrangement of the particles into shapes or pieces.

Soil tilth is the physical condition of the soil when it is tilled. Good tilth means that the soil is loose and easily worked when seed are planted and other activities are performed.

The chemical nature of soil refers to the elements that are present as well as to the soil pH.

The biological nature of soil refers to the living organisms that are found in it. Earthworms, bacteria, nematodes and other organisms live in the soil. In addition, the roots of plants grow in the soil.

Soil is formed from parent material. The nature of the soil is a function of its parent material. Thousands of years of weathering may be required to change limestone and other parent materials into soil.

Soil profile is a vertical section of the soil at a particular place. Four horizons are found. Some of the horizons may be very thin or nonexistent.

Soil contains water in varying amounts. The water table is the depth of the natural level of free water below the surface of the earth. The forms of water in the soil include: capillary water (water that coats particles of soil and is free to move about); hydroscopic water (thin layers of water that adhere to soil particles and do not move about in the soil); and gravitational water (water that fills cracks and air spaces between soil particles). Water is lost from the soil by runoff, evaporation, transpiration, percolation and harvested crops. The degree of internal drainage is determined by how readily water moves through the soil. Some soils have poor internal drainage, especially those high in clay or with underlying rock.

Soil pH refers to the acidity or the alkalinity of the soil. The pH is determined by testing a sample of soil. The soil pH can be changed by adding materials, such as lime to acid soils to make them more alkaline and sulfur to alkaline soils to make them more acidic. Crops have varying pH preferences. Soils are modified to suit the crop that is to be grown.

Soil salinity refers to salt in the soil. Salinity may be a problem in some areas, especially in those where irrigation is widely used.

Several management practices are needed to prevent soil loss and to make the soil more productive. Erosion is the loss of soil (usually by water and wind) and should obviously be kept to a minimum. Some land may need drainage to help make it more productive. Land forming shapes the land so that it is better suited to farming.

Land is more than soil. Eight land capability classes are used to grade land on the basis of its highest use.

Some land is unsuited for cultivation. Land surveying is used to measure and mark real property–land. Various instruments are used to measure land such odometer wheels (distance or linear measurements), compass (direction), clinometer (elevation), and area in acres calculated from linear measurements. Land is described with two systems: metes and bounds and rectangular. The rectangular system is most widely used in the United States and is based on a system of base lines and meridians. Legal descriptions require accurate and precise information.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help students develop a fundamental knowledge of the soil. The emphasis is on soil materials, formation and productivity.

Upon completion of Chapter 13, the student will be able to:

1. Discuss the meaning and composition of soil.
2. Identify and describe the characteristics of soil.
3. Explain how soil is formed.
4. Explain the meaning and importance of soil profiles.
5. Identify and distinguish between the kinds of soil water.
6. Explain soil fertility, pH, and salinity.
7. Name and explain soil management practices.
8. Explain the meaning of land and how it is classified.
9. Discuss how land is measured and described.

INTEREST APPROACH

The interest approach used with this chapter should focus on local soils to the extent possible. The kinds of crops grown can be related to the nature of the soil.

Have students read the introductory part of Chapter 13 in the text. Ask them to explain how having plenty of food, fiber and shelter is related to the soil. Also, have them describe their observations of variations in soil from one place to another. (This may be in the local community or as they have traveled to other places.)

Another approach that may be taken is to clarify the terms “dirt” and “soil.” Encourage students to make it a habit to use the word, soil, when referring to soil. (Teachers may wish to review the objectives at this time.)

Begin covering the content of Chapter 13 with the first major heading and move sequentially through the chapter.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

The instructional strategies used with this chapter should focus on the achievement of the objectives. The teaching plans should provide for application of the information on soil in the local area.

Have students read the section of the chapter in the text called “Soil Composition.” List the key terms on the writing surface and then, with student input, develop a definition for each term. Bring samples of the soil materials to the classroom for students to observe and feel.

After students have read the section of the chapter on Soil Characteristics, use presentation and discussion methods to cover the content. List key terms and then their definitions on the writing surface. Refer students to the soil triangle in Figure 13–11. Give students samples of various soils to try to identify based on the soil triangle. Use the activities in the Activity Manual. Present the information on soil structure, tilth, and consistency in outline form on the writing surface.

Describe the chemical and the biological nature of soil. Have students collect soil samples and study the organisms in the soil. Use the activity in the Activity Manual to determine the microorganisms present in a soil sample.

After students have read the section of the chapter in the text called “Soil Formation,” use presentation and discussion to cover the content. Relate soil formation to the soils found in the local area.

After students have read the section of the chapter in the text called “Soil Profile,” write the key terms and their definitions on the writing surface. Take a field trip in the local area to study the profile of the soil. While there, have students identify the soil texture and parent material. (Refer students to Figure 13–18 for the horizons in a soil profile.)

After students have read the section of the chapter in the text called “Soil Water,” write the key terms and their definitions on the writing surface. Also, list the ways water is lost, and have students name ways the losses can be prevented.

Have students read the section of the chapter on soil pH. Using Figure 13–25, review the meaning of pH. List key terms on the writing surface, and then explain how pH can be determined and modified. Use the activities in the Activity Manual to collect soil samples and test the pH. Relate the sample results to the growth of crops in the local area (refer to Table 13–2).

Salinity can be covered, as appropriate in the local area.

After students have read the section of the chapter in the text called "Land," use presentation and discussion to cover the key terms and their definitions. Ask students to explain how land differs from soil. Describe the factors that determine the land capability classes. Review the classes that are best suited for cultivation and then relate them to the local area. Also, cover land classes that are unsuited for cultivation. Take a field trip so students will be able to observe different land capability classes. Have them assess whether the land is being used properly.

After students have read the section of the chapter in the text called "Soil Management Practices," use presentation and discussion to cover the main concepts. Place key terms and concepts on the writing surface. Erosion and the kinds of erosion should be defined. The ways erosion is controlled should be reviewed. The erosion situation in the local community should be discussed, with students assessing soil losses and potential practices for conserving the soil. Drainage and land forming may be included with the instruction on erosion.

REVIEW AND EVALUATION

Review and evaluation can involve similar strategies. Review by having the students describe the content of the objectives for the chapter. The students can also define the terms at the beginning of the chapter and answer the end-of-chapter review questions.

Evaluation can be based on the performance of students in the review as well as in the activities in the Activity Manual. A written test may be given on the content. The test may be developed by the teacher or drawn from the computer test bank.

SAFETY

Achieving the objectives of the chapter involves few safety hazards. However, activities that expand the content to the local community could present safety problems. Teachers should instruct students in the safety areas that are involved. Any activities in which chemicals are used to test soil should include safety instruction. The Activity Manual has appropriate safety precautions for conducting the activities.

ADDITIONAL RESOURCES

The text and the Activity Manual can be used to achieve the objectives of the chapter. Materials on local soils will be needed to give additional relevance to the instruction. These materials can be obtained from a college or university in the area that has an agriculture program. The soil scientists at an agricultural experiment station can be helpful. Technicians with the local office of the Natural Resources Conservation Service (NRCS) can provide accurate information on the soils and land in the area. The NRCS Web site may also have useful information: **www.nrcs.usda.gov**.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is soil? Where is it found?**

   Soil is the top few inches of the earth's crust, and it supports plant life. It is the medium in which many plants grow.

2. **What are the ingredients in soil? How do these ingredients determine the nature of the soil?**

   The four major ingredients in soil are minerals, organic matter, water, and air. The amounts of the ingredients vary. The proportion of each of these ingredients determines the nature of the soil.

3. **What is organic matter? How is it formed?**

   Organic matter is made of plant and animal remains in various stages of decay. Organic matter naturally develops, but cultural practices (e.g., plowing) encourage its formation.

4. **What is the soil triangle? Why is it useful?**

   The soil triangle illustrates how different soil textures are related to the different materials in the soil. The triangle is useful because it shows the relationships between the different soil textures.

5. **Why is biological activity important in the soil?**

   Biological activity is important because it helps break down organic matter, aerates the soil, and adds fertility.

6. **How is soil formed? What processes are involved?**

   Soil is formed over many years by erosion. The continual processes involved are weathering

of parent material, climate, plants, animals, slope, and drainage.

7. What is a soil profile? What horizons are found?

A soil profile is a vertical section of the soil at a particular place. The horizons are A (surface), B (subsoil), C (parent material), and R (bedrock).

8. Explain water table.

The water table is the depth of the natural level of free water below the surface of the earth. When a hole is dug in the soil, the water table is the level at which water will collect and stand.

9. What forms of water are found in soil? Distinguish between the forms.

Three forms of water are found in soil capillary, hydroscopic, and gravitational. Capillary water is a coating of water on soil particles that moves from one particle to another. Hydroscopic water is a thin layer of water on soil particles that sticks to the particles and does not move. Gravitational water is the water that fills the cracks and spaces between the soil particles.

10. How is water lost from the soil? What can be done to reduce the loss?

Water is lost from the soil by runoff, evaporation, transpiration through plants, percolation, and harvested crops. Various management practices can be used to conserve water. For example, building terraces will help to reduce runoff, and mulching will help to decrease evaporation.

11. What is internal drainage? Why is it important?

Internal drainage is determined by how readily water moves through the soil. It is important in how well crops grow on the land. Soil with poor internal drainage may be too wet for some crops.

12. What is pH? What pH ranges are found? Why is pH important?

The chemical way of expressing the acidity or alkalinity of soil is called pH. It refers to the hydrogen ion concentration in the soil. The range of pH is from 0 to 14, with 7.0 being neutral. It is important because different crops have varying pH preferences. The crops grow better in soil that has the appropriate pH.

13. How is pH changed?

The pH is changed by the addition of materials to the soil. Sulfur may be added to lower the pH (make soil less alkaline). Limestone may be added to raise the pH (make soil less acidic).

14. What is land classification? What factors are used in determining the class of land?

Land classification is the grading of land on the basis of certain factors that determine its capability. The factors are surface texture, internal drainage, depth of topsoil and subsoil, erosion, slope, and surface runoff.

15. Distinguish between the two major classes of land.

The eight major classes of land are listed here. ***Land suited for cultivation:*** *Class I—very good land with no or few limitations; Class II—good land with slope not exceeding 8%; Class III—moderately good land with slope not exceeding 10%; and Class IV—fairly good land with slope and internal drainage that may restrict its use.* ***Land not suited for cultivation:*** *Class V—unsuited for cultivation and best suited for pastures, hay crops, and forestry; Class VI—not suited for row crops because the slope is too great; Class VII—highly unsuited for cultivation because of erosion and other problems; and Class VIII—land unsuited for plant production because it is very steep or it is in marshes or bayous.*

16. What is erosion? How is it prevented?

Erosion is the loss of soil. The soil may be washed away by water or blown away by wind. Erosion is prevented or reduced by using minimum and no tillage cropping, mulching, terracing, strip cropping, contour plowing, crop rotation, diversion ditches, and levees.

17. What management practices may be used to make land more productive?

Management practices to make land more productive include drainage and land forming. Drainage removes excess water. Land forming changes the shape of the surface of the land so it is more productive.

18. What measurements are made of land, and how are these commonly made?

Measurements that may be made of land are linear (made with tapes, chains, by pacing, using odometer wheels), direction (made with a compass), elevation (made with differential leveling and clinometers), and area (made with linear measurements and calculations; remote methods may also be used).

19. What two systems of describing land are used? Distinguish between the two.

The two systems of describing land are metes and bounds (start at a known point to establish boundaries and run lines in directions for specified distances) and rectangular survey (use meridians and base lines to create a network of squares).

EVALUATING

1=i, 2=j, 3=a, 4=f, 5=g, 6=c, 7=b, 8=e, 9=d, and 10=h

14

PLANT PRODUCTION

CHAPTER SUMMARY

Plants provide many products that are essential in human life (and also in animal life). Cultural practices are used to ensure a safe, dependable supply of these products. Proper management of Earth's resources is needed to promote sustainability.

Areas of plant production include field, horticultural and forestry crops. The field crops area is concerned with producing plants in fields (a field is an open land area where crops are planted).

Major field crops are:

- Grain crops–Grain crops are species that are members of the grass family that are produced for seed or kernels known as grain. Major grain crops include corn, rice, and wheat. Others include oats, barley, rye, and grain sorghum. These serve as major food and feed crops in the United States and in other nations.
- Sugar crops–Sugar crops are produced for sugar or sweetener in human foods and beverages. Syrup (a sweat liquid) is obtained from the watery juices of some plants. This syrup is produced to produce sugar. The two major sugar crops are sugar cane and sugar beets.
- Oil crops–These crops are grown to produce vegetable oil. In most cases, oil is processed from the seeds. The most important in the United States are the soybean, canola, cotton, and peanuts. Safflower and sunflower seeds are also used for oil processing along with flax, sesame, olives, and tung.
- Fiber crops–A fiber crop is one that is grown for its fiber, with cotton being by far the most important. Cotton is graded by staple, color, and freedom from trash. Staple is the length of the fibers, with these designations used: upland cotton, which is 7/8 to 1 5/16 inches long; extra-long staple (ELS) cotton, which is 1¼ to 1 9/16 inch; and short staple cotton, which is ½ to 1 inch staple. Flax, hemp, jute, sisal, and kenaf are also grown for fiber. In addition to fiber, cotton seeds are used to manufacture oil.
- Turf crops–A turf crop is one that is grown for aesthetic, recreational, or functional purpose created by the surface of the plants. Most are grasses, such as a fescue lawn, but Bermudagrass, bent grass, and Kentucky blue grass are other examples. Turf is important on athletic fields, golf courses, lawns, and similar areas.
- Forage crops–A forage crop is one that is grown to provide vegetation for consumption by animals. Pastures, hay crops, silage crops, and others are examples. Pastures may be permanent or temporary; they may be comprised of native or improved.
- Horticultural crops–These crops may be of two broad types: ornamental and food crops. Ornamentals include cut flowers, potted plants, shrubs and trees and turf in landscapes. Food horticultural crops may be vegetables or fruits used for food purposes. Vegetables include tomatoes, potatoes, green peas, broccoli, and many others. Fruit includes oranges, apricots, peaches, apples, strawberries, pears, pineapples, and others. In addition, nut crops are often included as a horticultural crop with fruits, with examples being almonds and pecans.

- Forestry crops–Forestry is the production of trees for wood products and, sometimes, non-wood tree products such as maple syrup and rubber.

Successful plant production depends on a number of factors, including climate, soil, moisture, technology, market, labor, and skills. Additional considerations include traditional versus organic methods and sustainability.

Product practices include: selection of plant line or variety, seedbed preparation, planting and seeding, fertilization, pest management, irrigation, harvesting, post-harvest management of the product, and post-harvest field management. Specific practices vary with the crop that is raised. Corn, for example, is the most important crop in North America. Considerations include type, planting, growing degree day (GDD), and cultural practices. Rice is another important crop that is classed by grain length and cultural method. Wheat is a cereal grain crop grown primarily for its grain though other parts of the plant may have limited value. Wheat is classified by time of planting, color, and kernel hardness.

A greenhouse is a specialized structure for growing plants that would not grow efficiently or survive based on the outside weather. Bedding plants, flowering plants, food crops, and other plants may be grown in greenhouses. Bedding plants are later set outside.

Silviculture is the art and science of growing trees. Practices to improve productivity are known as timber stand improvement (TSI). Practices include planting, pest management, thinning, cleaning, liberation cuttings, and harvest cuttings. Forest fire protection is a major responsibility. Harvesting may be for poles, logs, and other products.

Home gardening is producing vegetables on a small plot or in containers for consumption by a family. Important duties include: planning, site selection, site protection, layout, soil preparation, seed and transplant selection, planting and transplanting, fertilizing, managing pests, irrigating, mulching, thinning and staking/training, harvesting, and end of season site cleaning.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are designed to help students understand the cultural practices in the successful production of plants. Several species of field crops are covered in more detail. Information is also presented on forestry, horticulture, and home gardening. The practices may be applied in supervised experience, school facilities, or elsewhere as students develop important plant production skills.

Upon completion of Chapter 14, the student will be able to:

1. Describe important areas of plant production.
2. List and explain general practices in plant production.
3. Describe practices in the production of selected field crops.
4. Identify general practices in ornamental plant production and management
5. Identify general practices in forestry production.
6. Identify general practices in home gardening.

INTEREST APPROACH

A possible interest approach is to make a tour of a crop farm, greenhouse facility, forest, or home garden. After a short time call on students to describe what they have seen. Ask how they would like to produce a particular crop. Call on individual students to list and discuss practices in plant production that they have observed (indicate that the practices will be covered in the chapter).

Another interest approach is to have the students read the introductory part of the chapter. Ask students to explain the statement, “The products of plants are important.” Have them tell what plant products are important and ask them to names examples of important plant products. Also, to the extent possible, use local agriculture examples to explain new plant products and ways they are produced. (Teachers may wish to review the objectives at this time.)

Have students read the introductory paragraphs of the chapter. Afterward, call on one or more to discuss what was read. Refer students to Figure 14-1. Have them to describe the contents of the picture with emphasis on the role of technology in plant production. Next, move into the content of the chapter.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Begin with the first section in the textbook, “Areas of Plant Production.” Have students read the section as homework or during supervised study. First, define field crop and ask students to name examples in the local area followed by in the state, nation, and on Earth. Go over each field crop sequentially beginning with grain crops followed by sugar crops, oil crops, fiber crops, turf crops, forage crops, horticultural crops, and forestry crops. Identify examples of each crop and discuss the importance and cultural issues. Be sure to distinguish

bedding plants, flowering plants, and foliage plants in horticulture. Also, distinguish food crops from ornamental crops. Spend considerable time on each of these crop areas.

Next, have students read "Growing Plants." Afterward, call on individuals to summarize the information. List general considerations on the writing surface. Discuss each and ask students to elaborate on each. Be sure to cover the concept of "organic agriculture" as compared to traditional agriculture. Go over sustainable agriculture and have students discuss why sustainability is important. The general considerations have been covered, go over the section "Production Practices." List each practice on the writing surface and use student input to explain the appropriate content. Observe the practices on a farm, in the school greenhouse, or elsewhere in plant production.

Have students read the section "Field Crop Production." You may wish to have them read a subsection of this at a time, such as "Maize" may be sufficient for one reading assignment and discussion. Cover maize in detail, including measurement, corn type, and as a crop. Summarize major points on the writing surface; have students keep notes on this information. Next, cover "Rice." Have student read the section and provide information for outlining the topic on the writing surface. Students should take notes on the information. Next, cover wheat much as was done with maize and rice. Remember, your local community may have other crops that may need to be covered here or the community may not have one of these and, therefore, it can be omitted.

Students should read the section "Plant Production in Greenhouses." Use student input to define the term, greenhouse, and describe a typical greenhouse structure as a frame covered with a plastic or glass covering. Ask students to tell why a greenhouse would be used–control environment, temperature, light, moisture, and air quality.

Next, have students read the section "Forest Production." Cover the content using student input to outline the major points on the writing surface. Define the term silviculture. Have students discuss the meaning of TSI and list and explain the practices that are included. Go over the equipment used in forestry work as presented in Table 14-7 in the textbook. Indicate that forests often require protection. Use student input to name and discuss the major causes of damage to forests and how the damage possibilities are minimized. Cover the meaning of forest harvesting, including the use of cruising.

Have students read the section "Home Gardening." Use student input to name and discuss the general practices in being successful with a home garden. The practices can be discussed in terms of the school garden, family gardens of students, or other garden situations in the local community. In some cases, students may be involved with production of vegetables for local sales or on a larger scale in commercial vegetable production. Refer students to Figure 14-27 and to Table 14-9. Have each student prepare a sketch of a garden layout and choose the vegetable crops to be grown. Note that seed catalogs, garden brochures, and online gardening information may be useful. Some students may wish to include species of vegetables that are not included in the Table 14-9. Note that organic gardening can be introduced in this section of the chapter.

REVIEW AND EVALUATION

The textbook and the Activity Manual can be used for both review and evaluation.

For review, have students define the terms at the beginning of the chapter and answer the end-of-chapter review questions. This may be done orally as a group activity or as supervised study with the students writing out the answers. Activities in the Activity Manual will also be very useful.

Evaluation can involve some of the same activities as review. The "Evaluating" section is one useful assessment tool. Oral and/or written tests can also be given. All of the activities can be implemented in reteaching, as appropriate.

Refer to the list of objectives in the textbook. Call on students to demonstrate that they know the content associated with each objective. Reteach areas where students appear deficient.

A practical approach to review and evaluation is to grow a school crop or garden. Students can be involved in all of the practices. Some students may use these activities as directed laboratory supervised experience.

SAFETY

Achieving the objectives of the chapter should involve few safety hazards. However, activities beyond the classroom could present safety problems. The teacher should always review the appropriate safety practices. The Activity Manual presents safety precautions with each activity.

Activities involving tools, equipment, pesticides, fertilizers, treated seeds, and similar plant production inputs may pose safety hazards. These should be identified, discussed, and appropriate steps taken to minimize risk. In some cases, such as gases in

greenhouses, students may need to take major steps using personal protective equipment.

ADDITIONAL RESOURCES

The textbook and the Activity Manual can be used to achieve the objectives of the chapter. In some cases, teachers may wish to use specific materials on plant production. An introductory book on plant science will be useful. Some materials can be obtained from a college or university with an agriculture program, such as recommendations in plant production including varieties or plant lines, fertilization, pest management, and cultural practices. Online resources may also be useful. Most every land grant university has online materials related to vegetables adapted in the state. Here are a couple of Web sites for beginning study: National Gardening Association - www.garden.org/foodguide/ browse/ veggie and Smart Gardener - www. smartgardener.com/

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences and other details in their answers.

1. **What is a field crop? Name one important example.**

   A field crop is one that produced in a field or large area of land. Examples are corn, cotton, wheat, and soybeans.

2. **What is the source of grain?**

   Grain is the seed or kernel of a cereal grain plant.

3. **What are the two main sources of sugar? Compare and contrast the two in a couple of sentences.**

   The two main sources of sugar are sugar cane and sugar beets. Cane is a grass plant; the beet is a root crop. Juice (and sugar) is processed from the stalk of cane and extracted from the engorged beet root.

4. **What is vegetable oil? Name three plant species that are sources of vegetable oil.**

   Vegetable oil is a type of fat obtained from seed or fruits of certain plants. Three major sources of vegetable oil are soybeans, cotton seed, and sunflower seed (students could name other examples).

5. **What are three plant sources of fiber?**

   Three plant sources of fiber are cotton, flax, and kenaf. (Students could name other examples as per content of the textbook.)

6. **What is turf? Name an example of a turf species.**

   Turf is short-growing, matted grass. Examples include fescue, Bermudagrass, rye grass, and Kentucky blue grass.

7. **What is forage? Distinguish between pasture, hay, and silage.**

   Forage is vegetation that is used as livestock feed. Pasture is land on which annual or perennial grasses and legumes are grown for grazing by livestock. Hay is green plant material that has been cut, dried, and stored for later use as animal feed. Silage is chopped green plant material that has fermented.

8. **What are bedding plants? Name two examples of ornamental species and two vegetable plant species.**

   Bedding plants are typically annual species that are set in masses in flower beds for color or other appeal. These plants are often started in greenhouses or other structures before the danger of frost has passed. Examples include the petunia and the zinnia. (Some vegetable plants are managed similarly, such as tomatoes started in a greenhouse and later set in a garden or field.)

9. **What is forestry?**

   Forestry is the production of trees for wood and other products. (Forestry is not to be confused with fruit trees grown in orchards and the like.)

10. **What is a cultural practice? Name four general cultural practices with plants.**

    An activity or treatment needed for a plant to survive, grow, and be productive. Examples of practices are variety or plant line selection, seedbed preparation, planting and seeding, fertilizer application, and pest management. (Five practices were named; others from the textbook would be acceptable.)

11. What types of corn are produced? Which is the most important for grain?

The types of corn are dent, flint, floury, and sweet (as well as few others of little importance). The most important for grain is dent corn.

12. What is a growing degree day?

A growing degree day (GDD) is a measure of the temperature requirements for best corn growth. It is determined with a mathematical formula.

13. What are the two ways rice is classified? Distinguish between the two.

Two ways of classifying rice are: grain length and cultural method. Grain length may be short, medium, and long. Cultural method is of two major types: lowland and upland. Lowland rice is grown in large, flat fields. Upland rice is grown in small areas on hillsides.

14. What are the three general ways wheat is classified? Define each.

Wheat is classified by time of planting, color, and kernel hardness. Time of planting is often in two groups: spring wheat and summer wheat. Spring wheat is planted in the spring and harvested in the summer. Winter wheat is planted in the fall and grows slowly through the winter with increasing growth rate in the spring when maturity is reached. Color is determined on the basis of the color of the seed coat: red or white. Kernel hardness is either soft or hard. Hardness is determined by the endosperm inside the seed coat.

15. What is a greenhouse? Why are greenhouses used?

A greenhouse is a framed structure covered with a transparent material that is designed to provide a good environment for the growth of plants. Greenhouses are used to protect tender plants from a harsh weather environment and to provide the environment needed to gain certain plant growth, such as flowering.

16. What is silviculture? What practices are included in silviculture?

Silviculture is the art and science of growing trees. The practices include planting, pest management, thinning, cleaning, liberation cuttings, and harvest cuttings.

17. What general practices are followed in home vegetable gardening?

General practices in home vegetable gardening are: planning, site selection, site protection, site layout, site preparation, seed and transplant selection, planting and transplanting, fertilizing, pest management, irrigation, mulching, training and staking, harvesting, and end of season site cleaning.

18. What is garden site protection? Why is it needed?

Garden site protection is preventing animals such as rabbits, deer, and livestock from damaging a growing vegetable plant population. It is needed because these animals can destroy a vegetable crop or greatly reduce yield.

EVALUATING

1=f, 2=b, 3=e, 4=c, 5=a, 6=i, 7=h, 8=j, 9=d, and 10=g.

PART FOUR: ANIMAL SCIENCE

15

ANIMAL BIOLOGY

CHAPTER SUMMARY

Scientists have identified over a million different kinds of animals on the earth. Of these, only a few are important in providing food, fiber, and shelter for humans. Knowing how to care for these animals properly helps people in producing them.

Animals are members of the kingdom Animalia. They are made up of many cells, can move about, and get their food from other sources. Animals can be grouped according to body structure, their habitation, and the products they produce.

The two main groups on the basis of body structure are vertebrates and invertebrates. Vertebrates are the most important animals in agriscience. Vertebrates have backbones. Fish, birds, and mammals are vertebrates. Mammals are animals that give birth to live young and produce milk to feed them. Invertebrates have exoskeletons, or crusty coverings on the outside of their bodies. Examples are insects, crustaceans, and mollusks.

Animals are either terrestrial or aquatic. Most of those produced on farms and ranches are terrestrial, but the production of aquatic species is increasing.

Animals produce many kinds of products, including food and fiber. Other products are medicine, glue, soap, pet food, floor wax, and paintbrush bristles.

The anatomy and physiology of animals vary among the species, but there are many common features. Anatomy is the study of the form, shape, and appearance of animals. Physiology deals with the functions of the cells, tissues, organs, and systems of the body.

The major body systems of animals are (1) skeletal system, which is made of bones and cartilage and gives the body a framework; (2) muscular system, which is the largest system of the body and provides for the movement of animals; (3) nervous system, which is a highly developed system that conducts impulses from the brain to the muscles; (4) circulatory system, which moves digested food, oxygen, wastes, and other materials around the body; (5) respiratory system, which moves gases to and from the circulatory system; (6) excretory system, which rids the body of wastes from cell activity; (7) digestive system, which prepares food for use by the body; (8) reproductive system, which carries out reproduction and varies in parts and functions between female and male animals; and (9) mammary system, which develops only in females to provide milk for baby animals.

All the body systems are similar in the same species, except for variations in the reproductive systems of males and females and the mammary system of the females. Of course, most fish and poultry do not give birth to live young or have mammary glands that produce milk for the young.

Each system performs vital functions for animals. The failure of a system will likely result in the death of the animal. Understanding the systems and how they function can help producers provide for the needs of animals.

INSTRUCTIONAL OBJECTIVES

The objectives of the chapter are intended to help students have a rudimentary understanding of the principles of animal science. Emphasis is on the anatomy and physiology of the common vertebrates produced on farms and ranches.

Upon completion of Chapter 15, the student will be able to:

1. Identify and describe animal species.
2. Explain principles of animal anatomy, morphology, and physiology.
3. Identify organ systems, and describe the structure and functions of each.
4. Identify reproductive system anatomy and processes.
5. Identify the mammary system anatomy and processes.
6. Explain reproductive processes with poultry.

INTEREST APPROACH

The interest approach can be localized, based on the needs and interests of students. Animals found in the local area, especially those found at the homes of the students, should be emphasized. In some cases, students may have supervised experience that involves animals. These students can be asked to tell about their animals and give some information about the care provided the animals.

One approach, after students have read the introduction to the chapter, is to have them name the animals found in the local area. The emphasis should be on those that provide food and fiber or are companion animals. In some cases, wildlife may also be appropriate. After a list has been developed on the writing surface, ask students to name some differences between and similarities of these animals. List these on the writing surface. Conclude by indicating that the focus of this chapter is on the differences between and the similarities of animals and how these differences and similarities influence the ways people raise them.

Another approach in gaining student interest is to refer students to the Technology Connection, “Wrinkled Hogs.” Have students read the material. Call on one or more students to talk about what the content means. Ask if any students have seen a hog that has the appearance of the one shown.

Teachers may wish to review the objectives at this time.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

In developing teaching plans for this chapter, teachers must decide the depth of knowledge students will need to demonstrate an understanding of animal anatomy and physiology and the species of animals to be highlighted. The species that predominate in the local area should be emphasized. Teachers who wish to stress fish or poultry will need to use additional resources. (The treatment in the chapter is from the perspective of mammals. All mammals tend to have many similarities in anatomy and physiology.)

Students should read the chapter in the book sections at a time or in its entirety, depending on the teaching strategy. In general, reading sections is appropriate. This chapter, as are all chapters, is laid out with the “A” heads corresponding to the objectives of the chapter. The figures (both line art and photographic) in the text will be important in helping students understand the location and structure of the anatomy of the animals. The activities in the Activity Manual will be very useful with this chapter.

Following the interest approach, the grouping of animals can be covered. Use the writing surface to contrast vertebrates and invertebrates. Bring specimens of crawfish, insects, or other animals to class to illustrate invertebrates. Use farm or companion animals, fish, or birds to illustrate vertebrates. The place where animals live involves habitat and climate. On the writing surface, develop lists of animals that are adapted to different habitats and climates.

Use the writing surface or presentation technology to develop lists of the products people get from animals. Have students bring examples of these products to class. Relate these to the species of animals that are produced in the local area.

The first section, “Animals and Their Body Features,” should be carefully covered to assure that students have mastery of the information. Use the writing surface to outline content using student input. Be thorough in distinguishing invertebrates and vertebrates. Give detail to the important species of vertebrates such as livestock, swine, and poultry. Also, go over companion animals and the most common species.

Begin the instruction on anatomy and physiology by having students read “Anatomy, Physiology, and Morphology” in the textbook and explain how animals are complex living organisms. Define the terms *anatomy, physiology,* and *organ systems,* and then write a short definition of each on the writing surface.

Instruction on the skeletal system should include careful study of Figures 15–18 and 15–19. Ask students to tell how chickens and hogs are alike and different. Also have them examine the bones of chickens and hogs. (These can be from food and brought to school by students.) Have students observe the structure of the different bones. (At this point, you may wish to call the attention of students to the Academic Connection.)

Instruction on the muscular system should focus on muscles as the major food parts of animals. Stress the

importance of good muscling in animals. From a physiology standpoint, distinguish between voluntary and involuntary muscles. Have students name activities associated with each of the kinds of muscles.

The major parts of the nervous system should be listed on the writing surface, and their purposes explained. Describe the receptors and their roles. Have students compare the nervous system of farm animals with that of humans. Emphasis can be on the receptors.

Instruction on the circulatory system should include an explanation of blood. On the writing surface, list and define the kinds of blood cells. Have students refer to Figure 15–22 for the parts of the circulatory system of a horse. List the parts and their functions on the writing surface.

Since students often incorrectly consider respiration to be the same thing as breathing, extra attention may need to be given to the meaning of *respiration.* Review the parts of the respiratory system, and then list the functions of each part. Describe the breathing processes and how the rate of breathing is related to the need of the animal for oxygen. Have students observe the breathing rate of an animal.

The function of the excretory system should be described. The major parts of the system, along with a brief statement of the functions of each part, should be listed on the writing surface.

Instruction on the digestive system should begin with a description of its function. The kinds of digestive systems should be listed and compared. Have students review Figure 15–26 to identify the parts of the digestive system of a cow. List the major advantages of the ruminant over the nonruminant. Have students review Figure 15–28 for the digestive system of a chicken. Next, refer students to Figure 15–29 for the digestive system of a dog. Ask students to describe the movement of food through different kinds of digestive systems. A fish or another animal could be dissected so that the students can observe the digestive system as well as other systems.

Instruction on the reproductive system will involve describing the purpose and structure of the male and female systems. The concepts of puberty and sexual maturity should be explained. Have students review Figures 15–31 and 15–32 for the reproductive parts of a cow and a bull. The process of reproduction should be described, with key terms and definitions written on the writing surface. Instruction may include having students observe bovine sperm under a microscope; the parts of reproductive systems in dissected animals, such as fish; and the incubation of chicken eggs.

The function and major parts of the mammary system should be listed on the writing surface and then described. Students can be referred to Figure 15–36, structure of the udder. Afterward, differences as related to poultry can be covered.

REVIEW AND EVALUATION

Review and evaluation are important in assessing student achievement of the objectives. The suggestions presented here are also useful in re-teaching, as appropriate. Review can involve several approaches, including having individuals in the class explain the content related to each objective. The summary at the end of the chapter as well as the end-of-chapter questions and terms at the beginning of the chapter can be used in review. The Activity Manual has excellent activities that can be used for reviewing and for reinforcing learning. Participation by students in science fairs and the agriscience program of the National FFA Organization is also beneficial.

Evaluation can involve observation of student performance throughout the instruction as well as performance on the end-of-chapter questions, the “Evaluating” section, and activities in the Activity Manual. Written and/or oral tests may be used.

SAFETY

Achieving the objectives of this chapter involves few safety hazards. However, some of the activities could pose possible dangers to students. The Activity Manual lists the major areas of safety that should be observed in the activities. Any activity that involves using animal specimens always poses potential safety hazards. If dissection is done, students should be properly instructed in how to dissect an animal safely.

ADDITIONAL RESOURCES

Additional resources can be used to enhance the instruction. Specimens of animals may be appropriate. Books with more detail on anatomy and physiology of animals will probably be helpful. *Introduction to Livestock & Companion Animals* (available from Pearson Education) is a popular textbook used in secondary schools. High school biology textbooks may also be useful references.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What are vertebrates and invertebrates? Distinguish between the two.**

   Vertebrates are animals with backbones. Invertebrates do not have backbones. Nearly all animals have skeletons that give structure to their bodies. Invertebrates have outer shells or coverings known as exoskeletons.

2. **What are the distinguishing characteristics of the phylum Arthropoda? List examples of species in this phylum.**

   Arthropods have hard outer shells or coverings that give their bodies protection and support. Shrimp, crawfish, lobster, and insects are examples.

3. **What important animals are in the phyla Annelida and Mollusca?**

   Earthworms and leeches are examples of Annelida animals. Snails, oysters, and clams are examples of Mollusca animals.

4. **What important animals are in the phylum Chordata?**

   Fish, birds, and mammals are Chordata animals.

5. **What important animals are in the following classes: Osteichthyes, Aves, and Mammalia?**

   Osteichthyes include the bony fish, such as trout and catfish. Aves includes birds, such as chickens, ducks, and turkeys. Mammalia includes all mammals, such as dogs, cattle, horses, goats, and hogs.

6. **Define anatomy, morphology, and physiology.**

   Anatomy is the study of the form, shape, and appearance of an animal. Morphology is the study of the form, structure, and configuration of an organism. Physiology is the study of the functions of cells, tissues, organs, and systems.

7. **List the major body systems of animals. Briefly describe two important functions of each.**

   The organ systems of animals and two functions are skeletal system—protects internal organs and keeps them properly arranged; muscular system—provides for locomotion and other kinds of movement; nervous system—conducts impulses from the brain to the muscles and collects information from the environment; circulatory system—moves digested food and oxygen around in the body; respiratory system—moves gases to and from the circulatory system; excretory system—rids the body of wastes and maintains balance in the animal's body; digestive system—prepares food for use by the body and breaks it into molecules for absorption; reproductive system—creates new animals, with males producing sperm and females producing eggs; and mammary system—produces milk for babies. (Note: In some cases, the systems may perform only one important function.)

8. **Distinguish between voluntary and involuntary muscles.**

   Voluntary muscles are controlled by the thinking part of the brain. A message must be sent for them to move. Involuntary muscles are automatically controlled by a lower part of the brain.

9. **What are the major parts of the nervous system?**

   The major parts of the nervous system are the central nervous system—composed of the brain and the spinal cord; autonomic nervous system—made up of nerves connected to the involuntary muscles; and peripheral nervous system—composed of all nerves outside the brain and the spinal cord connected with the voluntary muscles.

10. **What is blood? What liquids and solids does it contain?**

    Blood is the fluid in the circulatory system. It contains plasma (the liquid part) and solids in the plasma (glucose, vitamins, blood cells, minerals, and amino acids). Blood contains red and white cells and platelets.

11. **Distinguish between internal and external respiration.**

    Internal respiration is the exchange of gases between the cells and the blood within the body. External respiration is the exchange of gases in

the lungs between the blood and the atmosphere.

12. What is breathing? What determines the rate of breathing?

Breathing is the process whereby air enters and leaves the lungs. The rate is regulated by the amount of oxygen the animal needs.

13. What wastes are given off by the excretory system?

The wastes given off by the excretory system are wastes from cell activity, excess water, and blood substances.

14. Distinguish between ruminants and nonruminants. List a major advantage and disadvantage of each.

Ruminants chew cuds and have compound stomachs. Nonruminants have simple stomachs with one compartment and do not chew cuds. Ruminants eat large amounts of roughage and make poor use of grain, unless it is cracked. Nonruminants do not make good use of roughage but are able to eat grain.

15. What is puberty?

Puberty is the age at which an animal is capable of reproducing.

16. What is the major purpose of the female reproductive system and the male reproductive system?

The major purpose of the female reproductive system is to provide an egg and a good environment for fertilization and growth of the new animal. The major purpose of the male reproductive system is to produce sperm and to deposit them in the reproductive tract of the female.

17. What occurs after an egg is fertilized?

After fertilization, the egg travels down the oviduct and attaches itself to the wall of the uterus, where it gets nourishment and grows by cell division into another animal.

18. How does the frequency of breeding vary between males and females? Why is this important to producers of animals?

Males can breed a number of females because they have no role in carrying the developing embryo and fetus. Females can be bred only at the time of estrus. This is important because a producer can use one male to breed several females.

19. Why do females have mammary systems? What is lactation?

Mammary systems produce milk for feeding babies. Lactation is the production of milk.

20. Since chickens and turkeys do not have mammary systems, how do their babies receive needed nutrition?

Young chickens and turkeys start eating small particles of food shortly after hatching.

EVALUATING

1=i 2=a, 3=j, 4=b, 5=g, 6=d, 7=h., 8=c, 9=e, and 10=f

16

ANIMAL NUTRITION AND FEEDING

CHAPTER SUMMARY

Feed provides the nutrients that animals must have to live and grow. The feed animals receive should meet their needs. The feed needed depends on an animal's age, reproductive status, and other conditions. Animals utilize feed to maintain themselves, grow, reproduce, lactate, perform work, and produce other products.

Feeds are made of products that contain nutrients. Nutrients are the chemical substances in feed that support the life of the animal. A ration is the total amount of feed an animal gets in a 24-hour period. A balanced

ration is one that provides all the nutrients needed by the animal.

The major nutrient needs are energy, protein, minerals, vitamins, and water. Energy supports all life processes and is provided by carbohydrates and fats. Protein is needed for maintenance, growth, and reproduction. Protein is made of amino acids. Twenty-three amino acids have been identified, with 10 being essential. Minerals are needed for maintenance, growth, reproduction, and other uses. Eighteen minerals are needed by animals. Vitamins are important in many life processes.

Feedstuffs are the contents of a ration. Feedstuffs are classified on the basis of fiber content. Roughages are high in fiber and low in energy. Pasture, hay, silage, and similar feedstuffs are common roughages. Concentrates are low in fiber and high in energy. Examples are grain and protein supplements. Supplements also include minerals and vitamins.

Good feedstuffs provide the nutrients animals need. These nutrients vary according to the species of animal. Feedstuffs should supply nutrients, be palatable and free of hazardous materials, provide variety, be economical, and be easily stored. Feed may be manufactured on the farm or by commercial feed mills.

Animals are fed in different ways, depending on the species and the stage of development. Free-access feeding means that the animals have access to as much feed as they want at any time. Scheduled feeding means that animals are fed at certain times of the day.

INSTRUCTIONAL OBJECTIVES

The objectives of the chapter are intended to help students acquire a fundamental knowledge and understanding of animal nutrition. The emphasis is on the requirements of nutrients and the sources of the nutrients, including how animals are fed.

Upon completion of Chapter 16, the student will be able to:

1. Describe nutrition needs of animals.
2. List and explain the functions of nutrients.
3. Identify and select feedstuffs that provide nutrients.
4. Explain the characteristics of good feed.
5. Discuss the role of quality forages.
6. Describe how animals are fed.

INTEREST APPROACH

After students have read the introductory part of the chapter, have them describe the feed needs of animals. Ask them to indicate what the feed needs of their pets (dogs, cats, fish, and horses) are. Further, ask them about the food needs of humans, as presented in Chapter 1. Students who have animals as part of their supervised experience may be called on to explain the feed care that they provide their animals. What do the animals eat? How are they fed?

On the writing surface, make a list of the feed needs that the students indicate for each species. Students could bring to class labels from feed containers so that they can obtain more information about feed ingredients. Indicate that the primary purpose of the chapter is to help students learn about the feed needs of animals. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Students will more efficiently achieve the objectives if the instructional strategies are closely tied to both the text and the Activity Manual. Have students read the chapter or several sections at a time, as best fits the situation. Use class discussion and presentation to cover the content. List key points on the writing surface.

Go over the feed needs of animals. List the needs on the writing surface and have students explain each of the needs. Relate the needs to animals of different ages and stages in life.

Explain *nutrient, ration, balanced ration,* and *diet.* Write the terms and their definitions on the writing surface. On the writing surface, list the major nutrient needs of animals. Ask students to describe each and to give examples of sources of the nutrients. Summarize key points on the writing surface.

Define *feedstuff.* Explain how feedstuffs are classified by fiber content. List examples of feedstuffs, and then summarize the meaning and characteristics of each. Emphasize distinctions between roughages and concentrates. Also, describe the kinds and roles of supplements, additives, and implants.

On the writing surface list the requirements of good feedstuffs. Ask students to explain the meaning of each requirement and to give examples of feedstuffs that meet the requirements. Students may wish to indicate these in terms of the food they eat.

Explain how feed is manufactured and the forms that are used. List key terms on the writing surface.

Have students analyze the information on a feed label. (Have students refer to Figure 16–29 as an alternative to using an actual label.)

Cover the section "Pastures and Forage Crops" by first having students read the section. Follow this by outlining content on the writing surface using student input. Indicate that pastures provide productive use for land that otherwise would not be productive. Use of pastures allows animals to graze low-quality forages that are converted into protein by the animals. Go over the kinds of pastures and examples in the local community. Discuss carrying capacity, stocking rate, and animal unit. Review important practices in pasture management. Cover the qualities of hay, silage, and other roughages.

Have students describe how animals are fed. List the key terms on the writing surface. Have students give examples of each method of feeding animals in the local community. They can also give examples that relate to their pets. A field trip to a feed mill or a farm supplies store that has a wide range of feeds would be appropriate. Some farms have their own feed mills and store feedstuffs.

REVIEW AND EVALUATION

Use the summary at the end of the chapter to begin the review process. Call on students to explain the objectives for the chapter. Use the end-of-chapter review questions and the list of terms at the beginning of the chapter for review. The activities in the Activity Manual are good for reviewing and re-teaching, as appropriate.

Evaluation will involve observing student performance on each of the review activities as well as on a written or oral test. Supervised experience programs in which students feed animals provide for evaluation on a firsthand basis.

SAFETY

Achieving the objectives of this chapter involves few safety hazards. However, learning activities, such as field trips, can create opportunities for hazardous situations. Teachers should instruct students in all areas related to safety, as they arise. The Activity Manual lists safety considerations for all activities, as appropriate.

Safety of humans who handle animals as well as the safety of animals creates important instructional concepts. Animals can create human injuries. Always know and respect animals as a potential hazard.

ADDITIONAL RESOURCES

The objectives of the chapter can be easily achieved by using the text and the Activity Manual. Additional information that could enrich learning can be obtained from feed labels and from books that present information on feed, such as *Introduction to Livestock & Companion Animals* and *Aquaculture* (available from Pearson Education).

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences and other details in their answers.

1. **How do animals use feed? How do these uses vary with the age and size of the animal?**

   Animals use feed to maintain their bodies and for growth and other processes (e.g., reproduction, lactation, and producing other products as well as for work). Young animals need more feed for growth. Older animals need feed for maintenance and other processes, such as reproduction, lactation, and producing products.

2. **What are the nutrient needs of animals? Briefly describe each.**

   The nutrient needs of animals are energy—supports life processes; protein—needed for maintenance, growth, reproduction, and other functions; minerals—needed for maintenance, growth, reproduction, and other functions; vitamins—needed for regulating body functions and for keeping the body healthy; and water—needed for body processes.

3. **What feedstuffs provide the nutrients needed by animals? Distinguish between the feedstuffs and give examples.**

   Feed ingredients are feedstuffs. Feedstuffs include roughages (feedstuffs high in fiber, such as pasture and hay); concentrates (feedstuffs low in fiber, such as grain and protein supplements); supplements (mineral and vitamin sources); and feed additives (additives placed in

feed during manufacture to preserve the feed and to enhance animal growth).

4. What kinds of pasture may be used?

Pasture is land that has grass and other plants for animals to graze. Pastures may be permanent or temporary. Permanent pastures are have grasses, clovers, and other plants that live and grow for years. Temporary pastures may be planted for summer, winter, or semipermanent grazing.

5. What determines the quality of hay?

Hay quality is determined by the age and the species of the plants that are cut for hay. It should also be free of weeds and should be properly dried and stored.

6. What are feed additives and implants? Distinguish between how the two get into the bodies of animals.

Feed additives are placed in feed during manufacture to help preserve the feed and to provide for the additional needs of animals. Animals receive the additives in their bodies by eating the feed. Implants are solid materials that are placed under the skin to release substances over a period of time. Hormones are often given to animals with implants.

7. What are the basic requirements of feed?

Feed must contain balanced nutrient content, be palatable, be free of hazardous materials, have a variety of feedstuffs, have bulkiness, be economical, and be properly stored.

8. How is feed obtained? What is involved with the sources?

Feed may be produced on the farm or ranch, or it may be obtained from a commercial feed mill. Getting feed involves obtaining the feedstuffs; grinding or otherwise preparing the feedstuffs; mixing the ingredients in the proper amounts; and preparing the feed in the form that will be used.

9. What is a mixed feed?

A mixed feed is made from a variety of ingredients.

10. How are concentrates made into feed?

Concentrates are made into feed by one or more of the following processes: cracking and rolling, grinding, and extruding.

11. What is a feed label? What information does a label have on it?

A feed label is a written statement about the feed. The information includes the ingredients, nutritional content, and weight of the product in the container (bag, can, or other container).

12. How are animals fed? Distinguish between the methods.

Animals are fed using free access or scheduled feeding. With free access feeding, the animals have access to the feed all of the time and can eat when they so desire. Scheduled feeding means animals are fed only at certain times of the day.

EVALUATING

1=h, 2=c, 3=a, 4=j, 5=b, 6=f, 7=i, 8=g, 9=e, and 10=d

17

ANIMAL BREEDS AND BREEDING SYSTEMS

CHAPTER SUMMARY

Animal breeding is an important part of animal production. New animals must be produced every year to replace those that are used. Breeding animals involves supporting the creation of new life and in the forms that are desired. Different animals are produced for different purposes.

Most animals produced on farms and ranches are of definite breeds and bloodlines. A breed is a group of animals of the same species that share common traits. A bloodline is a group within a breed that has one common ancestor. Offspring inherit various traits from their parents. In some cases, mutations occur when the offspring have a genetic trait that is different from their parents. Animals belonging to a breed are known as purebreds. Various breeds of beef cattle, dairy cattle, hogs, sheep, goats, horses, and chickens are found in North America. In some cases, specific breeds are not important in producing these animals for different products.

Various breeding systems are used to produce the kinds of animals that people want. All breeding systems can be placed in two categories: straightbreeding and crossbreeding.

Animals are classified by their age and sexual condition. Males are often castrated to keep them from reproducing and to enhance their growth as meat animals. Castration involves removing the testicles. Females are sometimes neutered by spaying, which involves removing the ovaries. (Have students refer to Table 17–1 in the text for a summary of the sexual classifications of selected animals.)

Various production systems may be used. The kind used depends on the end product that is desired. Purebred production systems produce purebred animals. Meat-animal production systems include cow-and-calf production and feeder pig production. These provide new animals that are to be fed out for harvesting. Finishing systems feed out the animals for harvesting. Cattle are fed out in feedlots, while hogs are fed out in confinement systems that are sometimes known as pig parlors.

Two methods of inseminating livestock are natural and artificial. In natural insemination, a male is mated with a female of the same species. In artificial insemination, semen is collected from a male and placed in the reproductive tract of a female. The use of artificial insemination has greatly increased in recent years. Semen quality and estrus manipulation are important factors in the use of artificial insemination.

Animals must be managed properly to assure maximum breeding potential. Knowing when to breed, testing for pregnancy, and managing the breeding female are important in successfully breeding animals.

Poultry production requires a different approach to breeding because of the differences in the reproductive processes. Aquatic animals require an approach different from both poultry and mammals.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help students acquire basic knowledge of, and skill in, breeding systems with animals. The emphasis is on areas prerequisite to advanced study of animal breeding.

Upon completion of Chapter 17, the student will be able to:

1. Discuss trait inheritance in animals.
2. Explain breeding systems.
3. List examples and identify common breeds of animals.
4. Identify the sexual classification of animals.
5. Discuss production systems used with selected species.
6. Describe management in breeding animals.

INTEREST APPROACH

Several approaches can be used to get the interest of students and to motivate them to achieve the objectives. Teachers should select those approaches that are most responsive to the needs and interests of students.

One approach is to have students read the introductory section of Chapter 17. Have the students use the data on the per capita consumption of red meat to determine if the amount they eat is more or less. Ask each student to give the number of pounds of red meat he or she consumes in a year, and then add up the amounts from all the students in the class. Have students estimate the number of beef animals, hogs, and sheep that would be needed as meat for the class members. Emphasize that producing new animals is essential in order for people to have food. Without new animals, there would soon be no meat for food. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

The instructional strategies should focus on helping learners achieve the objectives in animal breeding. The learning activities should relate to the animals in the local area. Teaching plans may include a variety of activities, such as field trips to livestock shows, local farms, or colleges with agriculture programs to observe the different breeds. Resource persons in artificial breeding can be asked to demonstrate insemination procedures.

Student achievement will be higher if the students read the content and participate in lecture-presentations in the classroom. Most teachers will choose to cover several sections of the chapter at one time.

Following the interest approach, begin with an explanation of breeds and bloodlines. Write the two terms on the writing surface, and then ask students to define them. Use their definitions to develop an acceptable definition of each on the writing surface.

Cover the major breeds of livestock by listing the breeds on the writing surface and then asking students to identify the characteristics of a particular breed. Summarize the major factors under each breed.

On the writing surface, outline the breeding systems used. Define key words, and then have students give examples of the terms in breeding animals. Have students record the information in their agriscience notebooks.

Have students refer to Table 17–1 for the sexual classifications of common animals. Define the applicable terms, such as *heifer, ewe, castrate, spay, steer, barrow* and *stag.*

Use a combination of lecture and discussion to cover the production systems. Write key terms and definitions on the writing surface.

Present the methods of insemination and the processes involved. Explain the meaning of *semen quality.* If bull sperm is available, examine it with a microscope. Describe the female estrous cycle and its relationship to breeding.

Describe the procedures involved in managing breeding animals, and then have students relate how producers in the local area manage their herds.

Ask students to explain how breeding poultry and fish differs from breeding mammals. Incubate several chicken eggs in the laboratory so that students can observe the development during the 21-day incubation period. Fish eggs can also be artificially hatched in the school laboratory, which will require about a week for catfish and other common species.

The Activity Manual contains useful activities for helping students achieve the objectives of the chapter.

REVIEW AND EVALUATION

Review and evaluation can involve several approaches. In some cases, review can also serve as evaluation. Review can consist of asking students to explain the objectives for the chapter, having students define terms at the beginning of the chapter, and having students answer the questions at the end of the chapter. Activities in the Activity Manual will be useful for both review and evaluation.

The review activities and written or oral tests can serve as forms of evaluation. Use the findings for reteaching students, as appropriate.

The “Evaluating” section at the end of the chapter will also be useful as one tool in assessing student mastery of selected terms.

SAFETY

Achieving the objectives of the chapter will involve few safety hazards. However, activities that carry instruction beyond the classroom could involve situations where safety would be a consideration. An example would be a field trip to a place where students are around animals, which could result in the students being exposed to dangers from unruly animals. Laboratory activities that necessitate using animal fluids may pose hazards. Teachers should explain to students the proper safety precautions. The

Activity Manual includes appropriate safety warnings for the activities presented in it.

ADDITIONAL RESOURCES

Few additional resources are needed for this chapter. In some cases, teachers may wish to have additional information on various aspects of breeding. Materials can also be obtained from the various livestock breed associations and suppliers of semen. A Web site with extensive images of various livestock breeds is at Oklahoma State University: **www.ansi.okstate.edu/breeds/**.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is a breed? Distinguish between bloodline and breed.**

   A breed is made up of animals of the same species that share common traits. A bloodline is a group of animals within a breed that have one common ancestor.

2. **What are the common breeds of beef cattle? Name one major trait that would help you identify each breed.**

   The major breeds of beef cattle are Angus—black and polled; Brahman—loose skin and large hump; Brangus—black and polled; Charolais—light color with pink skin; Chianina—white with black tail switch; Hereford—red with white face; Polled Hereford—polled and red with white face; Limousin—red to yellow; Santa Gertrudis—red with loose hide similar to a Brahman; Shorthorn—red-white mixed color; and Simmental—white or light face with red body.

3. **What are the common breeds of dairy cattle? What are the advantages of each breed?**

   The common breeds of dairy cattle and production advantages are Ayrshire—medium milk and milk fat production; Brown Swiss—medium amount of milk production with 4.1 percent milk fat; Guernsey—medium milk production with 5 percent milk fat; Holstein—high milk production with low milk fat (3.5 percent); and Jersey—low milk production with highest milk fat (5.4 percent).

4. **What are the common breeds of hogs? What major traits help identify them?**

   The common breeds of hogs and major traits are American Landrace—white with occasional black spots, long sides and a level top, and ears drooping over the eyes; Berkshire—black with six white points (feet, face, and tail switch) and erect ears; Chester White—white with occasional bluish freckles on the skin; Duroc—shades of red with ears that droop over the eyes; Hampshire—black with a distinctive white band around its shoulders; Poland China—black with six white points (feet, tip of tail, and nose); and Yorkshire—white with erect ears.

5. **What are the classes of sheep on the basis of wool quality? Give an example of one breed in each class.**

   The classes of sheep on the basis of wool and one breed in each class are fine wool sheep—Rambouillet; medium wool sheep—Suffolk; long wool sheep—Cotswold; crossbred wool sheep—Columbia; carpet wool sheep—Black Faced Highland; and fur sheep—Karakul.

6. **What are the three classes of goats? How do the classes differ?**

   The classes of goats are mohair and cashmere—produced for their long hair; dairy goats—produced for their milk; and Spanish goats—produced for meat and to control vegetation. The Boer can be listed as a breed of meat goat.

7. **What are the three groups of horses? Briefly distinguish between the groups. Which is most widely found today?**

   The three groups of horses are light horses, ponies, and draft horses. Light horses are used for riding, driving, and racing. Ponies are ideal as pets and for children to ride. Draft horses are powerful; they pull heavy loads. Light horses are the most widely found group.

8. **What is a breeding system? Name and distinguish between the common breeding systems.**

   A breeding system is the way animals are selected for mating to get certain results. The kinds of breeding systems are straightbreeding—mating animals of the same breed (e.g., purebred

breeding, outcrossing and inbreeding) and crossbreeding—mating animals of different breeds but of the same species.

9. What is a production system? How do production systems differ from breeding systems?

A production system is an approach to obtaining certain kinds of animals or products from animals. The goal is to produce the best meat animals rather than purebred animals.

10. What production systems are used to produce beef? Briefly describe each.

The production systems used to produce beef are purebred systems—purebred animals are produced; cow and calf production—cows are kept to produce calves; and finishing—cattle are fattened on pasture or in feedlots for harvesting.

11. What production systems are used to produce pork? Briefly describe each.

The production systems used to produce pork are purebred systems—produce purebred hogs; feeder pig production—produce pigs for finishing; and finishing—raise hogs to market weight (220 pounds).

12. What two methods are used to inseminate animals? Distinguish between the methods.

The methods of inseminating animals are natural and artificial. With natural insemination, the male mates with the female. The male deposits semen in the female's vagina. Artificial insemination consists of collecting semen from a male and artificially placing it in the reproductive tract of a female.

13. What are the major management practices in breeding animals? Briefly describe each.

The major management practices are determining when to breed females—young females should be old enough to carry the offspring and to give birth; testing for pregnancy—some producers use pregnancy testing to determine if females are pregnant; feeding and observing the pregnant female—providing adequate nutrition is essential, and observations help determine when parturition will occur; helping females give birth—most females need no help but occasionally problems occur; caring for the females after parturition—watch for problems, such as a retained afterbirth; and caring for the breeding male—feeding and otherwise keeping the animal in good health.

14. What is the general production system for broilers?

Broilers are young chickens grown for meat. Fertile eggs hatch chicks 21 days after incubation was begun. The chicks are fed a carefully selected diet for five to six weeks and sometimes a little longer until they reach a weight of 3 to 5 pounds. Successful broiler production involves providing a good environment for the chicks. When the chicks reach broiler size, they are ready for processing.

EVALUATING

1=i, 2=b, 3=e, 4=c, 5=g, 6=a, 7=j, 8=f, 9=h, and 10=d

18

PROMOTING ANIMAL HEALTH

CHAPTER SUMMARY

The products of one animal can influence the quality of the food of many people. Meat scientists at Texas A&M University estimate that 542 consumers receive steaks and roasts from one beef animal. Each consumer expects to receive quality, tasty beef. If the animal isn't good, 542 consumers had a deficient dining experience.

Disease causes large losses to animal producers and animal product processors. Losses from animal disease in the United States amount to more than $10 billion

annually to producers. Processors and others involved in marketing often face losses due to disease or contamination of meats and products. Following a few simple procedures can help prevent many health problems.

Health is the condition of the body and is a measure of how the functions of life are performed. A disease is something that causes injury, pain, or death. Good health is the absence of disease.

In recent years, concern about biosecurity has come about. This has arisen out of fear that animals might be harmed in some way so that their well-being is threatened. Biosecurity is the use of approaches to manage risk and assure the production of disease-free animals and animal products.

Animals that are in good health eat well, are alert and content, have bright eyes and shiny coats, have normal feces and urine, and have normal vital signs. Vital signs include breathing, pulse rate, and body temperature. All animals have certain vital signs that vary according to the species. (Table 18–1 presents the vital signs of major agricultural species.)

The environment in which animals live affects their health. Most animals live best in environments of a certain temperature range. An endotherm is an animal that maintains a certain body temperature. An ectotherm is an animal whose body temperature adjusts to the environment. Light, moisture, moving (such as hauling), and pollution, in addition to temperature, are important factors in the health of animals.

Maintaining good health is an important key to successful animal production. Good sanitation, by keeping areas where animals are raised clean, helps prevent disease. Proper nutrition also keeps down disease. Isolating diseased animals from those that are healthy can help prevent the spread of disease. Trucks, equipment, and human traffic can transport disease from one place to another. Preconditioning helps prepare animals for shipment and other stressing activities. Immunization helps animals develop immunity to disease.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help students understand diseases in animals. Emphasis is on the principles of prevention from a management perspective.

Upon completion of Chapter 18 the student will be able to:

1. Explain health and identify health signs.
2. Describe environmental influences on animal health.
3. Discuss losses caused by poor animal health.
4. Explain how good health is promoted.

INTEREST APPROACH

The interest approach for this chapter can be localized, based on the kinds of animals and disease problems experienced in the community. In some cases, the approach may be based on human disease problems.

One suggested approach is to have students read the introductory part of the chapter. Ask them to explain why the producer is important in maintaining animal health. Have students give examples of practices animal producers or keepers of companion animals can follow in the local area to keep their animals healthy. Also, have students describe situations in which animals have experienced poor health. Have students explain the losses that occurred to the owners. (Teachers may wish to review the objectives for the chapter with students at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

The animals that are produced in the local area and the health problems that may arise should be considered in the instructional strategies for this chapter. Some students will have animals of their own and can offer firsthand input on animal health.

Students should be actively involved in achieving the chapter objectives. This includes reading the chapter content, completing the activities in the Activity Manual, carrying out related supervised experience activities, and performing other activities that are appropriate.

After the interest approach, begin the chapter by having the students read the sections that are to be taught. In some cases, students may read the entire chapter before the instruction is begun. As with all chapters, maximum student mastery will occur with the RLRWP-E procedure.

After students have read the section on animal health (including both good health and ill health), ask them to define *health.* Then, write the definition on the writing surface. Ask them to define *disease.* Then, write the definition on the writing surface. List the vital signs of good health on the writing surface. For each of the signs, ask students to name the characteristics of animals that have good health. (Have the students refer to Table 18–1 for the vital signs of common animals.) Have each student take the vital signs of an animal and then compare his or her observations with the normal vital signs.

Ask students to describe the general signs of ill health. List these on the writing surface. Explain that

each disease has signs of its own and may not have all the general signs.

After students have read the section on environmental influences on health, list the environmental factors affecting health on the writing surface. Ask students to describe each. Carefully define *endotherm* and *ectotherm,* and then have students give examples of each. (Ectotherms were previously known as cold-blooded animals. Scientists now refer to them as ectothermic animals because their body temperature is related to the temperature of their environment.)

On the writing surface, list the kinds of losses caused by diseases in animals. Have students give examples of each kind of loss.

Use the writing surface to outline the practices that should be followed to maintain good health. List and then discuss key procedures, such as sanitation, proper nutrition, isolation, restriction of truck and equipment traffic, restriction of human access, preconditioning, and immunization. Have students give examples of each.

REVIEW AND EVALUATION

Review and evaluation can be carried out simultaneously, except for the final mastery test that may be given. Observation of student participation throughout instruction in the chapter will provide useful information. Note how students participated in discussion and lab activities and how well they maintained their notebooks.

Review activities include using the summary at the end of the chapter, the terms at the beginning of the chapter, the end-of-chapter review questions, and the activities in the Activity Manual. The “Evaluating” section will also be helpful.

Evaluation can involve the review activities as well as written or oral tests. Re-teaching can include the review activities described above. A teacher-made test can also be used to help assess student mastery of the objectives. Assessment of practical application of chapter content may occur in the supervised experience of students.

SAFETY

The objectives of the chapter can be accomplished without safety hazards; however, developing the skills to actually perform some of the activities may pose safety hazards. If students are around animals, especially those that are sick, they should be cautioned about proper safety procedures. (Remind students of zoonosis and its meaning.) Careful and thorough safety instruction should be given to students before allowing them to administer animal medicines. Activities in the Activity Manual have appropriate safety precautions listed.

ADDITIONAL RESOURCES

The objectives of the chapter can be achieved by using the textbook and the Activity Manual. The instruction may result in students asking questions that require additional resources. Books on animal health and related areas may be needed. Pamphlets and bulletins from suppliers of animal medicines and agricultural experiment stations at colleges and universities may be useful.

Additional resources may include use of the Internet. Here are a few examples of Web sites to begin the investigation of animal disease: Centers for Disease Control (CDC)—**www.cdc.gov/**; Food and Agriculture Organization (FAO)—**www.fao.org/**; Animal and Plant Health Inspection Service—**www.aphis.usda.gov/**; and NetVet—**http://netvet.wustl.edu/**.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **Define animal health and disease.**

   Health is the condition of the body and is a measure of how the functions of life are being performed. Disease is something that causes pain, injury, or the inability to do normal things.

2. **What are the general signs of a healthy animal?**

   Good health in animals is indicated by good appetite, alertness and contentment, bright eyes and shiny coat, normal feces and urine, normal vital signs, and the ability to reproduce (adult animals).

3. **How does the environment influence animal health?**

   Animals prefer certain environments. When the environment changes and the animals are not in the one that they are suited to, the animals

are stressed. Stress results in the animals being susceptible to disease.

4. **What losses occur due to poor animal health?**

   The kinds of losses due to poor animal health are death, lower production, and human disease.

5. **What practices can be followed to help assure good animal health?**

   Maintaining good health involves following these practices: employing good sanitation; feeding animals a balanced diet for proper nutrition; isolating the sick animals; restricting truck and equipment traffic; restricting human access; preconditioning animals; and immunizing animals.

6. **Distinguish between animals that are endotherms and those that are ectotherms. How is this important in identifying an animal with an infection?**

   An endotherm is an animal species that maintains a certain body temperature such as a dog or hog. An ectotherm is an animal species whose body temperature adjusts to its environment, with the snake and lizard being examples. With enthotermic animals, an elevated body temperature is a sign of an infection.

7. **What is sanitation?**

   Sanitation is the practice of keeping areas where animals are kept clean. It reduces disease sources.

8. **What is isolation? Why is it useful?**

   Isolation is the separation of diseased and non-diseased animals. It protects healthy animals from exposure to those that are diseased.

9. **What is immunity?**

   Immunity is the condition of an animal being resistant to a disease. Some occurs naturally; other is artificially induced through immunization practices.

10. **What is preconditioning? Why is it used?**

    Preconditioning is the process of preparing animals for stressful situations. Transportation, in particular, is stressful to an animal. Preconditioning helps the animal resist stress-related problems (builds increased resistance to disease).

EVALUATING

1=g, 2=a, 3=j, 4=h, 5=i, 6=d, 7=c, 8=f, 9=e, and 10=b.

19

ANIMAL CARE AND WELL-BEING

CHAPTER SUMMARY

Animals are complex organisms. Knowing the needs of animals and how their bodies function helps us do a better job of caring for them. Some types of animals have been domesticated and raised for hundreds of years. Domesticated animals are removed from their native environments and raised in situations created by humans. Caring for animals is often known as husbandry. Animal husbandry is the scientific management and control of animals. The needs of the animals are met in an environment that provides for their well-being. It is essential to understand animal needs and to properly provide for them.

Animal well-being is the state of an animal's health and comfort. We provide for an animal's well-being in ways that best meet its needs. Differences are considered when providing care. Producers of animals, as well as those who have companion animals, must practice animal well-being. Terms such as "animal welfare" and "animal rights" are sometimes used when referring to animal well-being.

Quality assurance is an effort to promote quality products through good management practices. The goal is to provide consumers with high-quality products that are safe to eat or use. Quality assurance is sometimes abbreviated as QA. Students should practice quality assurance with animals in supervised experience programs. QA

may be set up as a program. A quality-assurance program is an organized effort with specific requirements promoted for compliance to occur. QA programs are offered through producer organizations with support from processors and government agencies. In the U.S. Department of Agriculture, the Animal and Plant Health and Inspection Service (APHIS) is involved.

Animal restraint is sometimes needed to manage an animal. It is needed for performing exams, administering medicines, loading and transporting, and checking identification. Only those practices that promote the well-being of animals should be used.

Animal safety is managing animals to prevent injury or death. Often, simple practices will suffice. A few examples are: understand animal behavior, understand animal biology, use safe facilities, use safe feed, avoid excessive force, keep facilities clean, operate equipment properly, avoid keeping poisons where animals are kept, and transport animals safely.

Just as animal safety is important, human safety around animals is also important. This involves carrying out management activities so that injury or death of humans is minimized. Regardless, all risk cannot be taken away but being prudent can certainly reduce risk to a minimum.

INSTRUCTIONAL OBJECTIVES

The objectives of the chapter are intended to help students have a rudimentary understanding of the principles of animal science. Emphasis is on the anatomy and physiology of the common vertebrates produced on farms and ranches.

Upon completion of Chapter 19, the student will be able to:

1. Discuss major factors in animal production.
2. Explain animal well-being.
3. Explain the meaning and importance of quality-assurance programs.
4. Identify and demonstrate animal restraint practices.
5. Describe and practice animal and personal safety.

INTEREST APPROACH

The interest approach can be localized, based on the needs and interests of students. Animals found in the local area, especially those that are found at the homes of the students, should be emphasized. In some cases, students may have supervised experience that involves animals. These students can be asked to tell about their animals and to give some information about the care that is provided to the animals.

One approach—after students have read the introduction to the chapter—is to have the students name the animals found in the local area. Have students view Figure 19–1. Ask if the well-being of the chick is being compromised. Discuss how to care for the chick to ensure that it is not injured or unduly stressed. (In some cases, students may weigh chicks in the school lab and make comparisons over time in terms of growth.)

Teachers may wish to review the objectives at this time and move into content of the lesson.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

In developing teaching plans for this chapter, teachers must decide the depth of knowledge students will need to demonstrate an understanding of animal anatomy and physiology and the species of animals to be emphasized. The species that predominate in the local area should be emphasized. Teachers who wish to stress fish or poultry will need to use additional resources. (The treatment in the chapter is from the perspective of mammals. All mammals tend to have similarities in anatomy and physiology.)

Students should read the chapter in its entirety or sections at a time, depending on the teaching strategy. In general, reading sections is appropriate. This chapter—and all chapters—is laid out with the “A” heads corresponding to the chapter objectives. The figures (both line art and photographic) in the text will be important in helping students understand the location and structure of the anatomy of the animals. The activities in the Activity Manual will be useful with this chapter.

Have students read the section “Animal Production Factors.” Use student input to summarize major concepts on the writing surface. List the needs of animals, and discuss how husbandry practices should consider the needs.

Move into the section “Animal Well-Being.” Have students read the section. The students should then provide information as the content is summarized on the writing surface. Ask students to identify examples of animals having been mistreated in the local community. Also, identify examples where animals have received good treatment.

The section on quality assurance has content that is becoming increasingly important to animal producers. Have students read the section. Use their input to summarize the content on the writing surface.

Have a local animal producer serve as a resource person to discuss quality assurance. Students may also conduct a Web search for information on quality-assurance programs. A search of the APHIS site at USDA will also be beneficial.

Content on animal restraint goes well with the veterinary medicine information. If animals are available, students may practice restraint procedures. Be safe! Be sure students understand and practice appropriate safety as related to animal species.

REVIEW AND EVALUATION

Review and evaluation are important in assessing student achievement of the objectives. The suggestions presented here are also useful in re-teaching, as appropriate. Review can involve several approaches, including having individuals in the class explain the content related to each objective. The summary at the end of the chapter as well as the end-of-chapter questions and terms at the beginning of the chapter can be used in review. The Activity Manual has excellent activities that can be used for reviewing and for reinforcing learning. Participation by students in science fairs and the agriscience program of the National FFA Organization is also beneficial.

Participation in the Veterinary Science event of HOSA (Health Occupations Student Association) will provide valuable hands-on activity, learning, and assessment opportunity.

Evaluation can involve observation of student performance throughout the instruction as well as performance on the end-of-chapter questions, “Evaluating” section, and activities in the Activity Manual. Written and/or oral tests may be used.

SAFETY

Achieving the objectives of this chapter involves few safety hazards. However, some of the activities could pose possible dangers to students. The Activity Manual lists the major areas of safety that should be observed in the activities. Any activity that involves using animals always poses potential safety hazards. Cover safety in detail before students have any contact with animals.

ADDITIONAL RESOURCES

Additional resources can be used to enhance the instruction. Specimens of animals may be appropriate. Books with more detail on anatomy and physiology of animals will probably be helpful. An example is *Introduction to Livestock & Companion Animals* (available from Pearson Education).

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is animal husbandry?**

   Animal husbandry is the scientific management and control of animals (to gain useful products).

2. **What are the two native needs of animals? Briefly explain each.**

   The two native needs of animals are habitat and climate. Habitat is the environment in which an animal lives, such as terrestrial or aquatic. Climate is the weather and includes temperature and precipitation, among other factors.

3. **What husbandry practices are followed with animal production? Name and briefly explain any three.**

   Husbandry practices typically followed with animal production are making good choices—what and how to raise; providing nutrition and feeding—being sure to meet the needs of animals; promoting good health—caring for animals to reduce stress and using practices that reduce likelihood of disease; managing reproduction—allowing or promoting reproduction to gain desired offspring; protecting from hazards—some animals need protection from weather, predators, and other hazards; dealing with wastes—disposing of wastes so minimal environmental impact occurs; and being an ethical producer—this involves meeting the needs of animals and never abusing them as well as relationships with other animal producers.

4. **What is animal well-being?**

   Animal well-being is caring for an animal so its health and comfort are promoted.

5. **What practices should be followed in promoting animal well-being? Name and briefly explain any three.**

Practices to follow in monitoring animal well-being are (others are included in the textbook) providing food, water, and other nutrients; providing housing or protection; and respecting animals as living organisms. Discussions could indicate that these help promote good health, growth, and productivity.

6. **What is euthanasia? Why would it be used?**

Euthanasia is the act of killing an animal to relieve it of suffering and pain. It is used when there is no hope for the animal to overcome its disability from disease and suffering.

7. **What is the name of the federal law that prohibits the interstate commerce with animals for fighting?**

The name of the federal law is The Animal Fighting Prohibition and Enforcement Act of 2005.

8. **What is quality assurance from the perspective of an animal producer?**

Quality assurance is an effort to promote quality products through good management practices. The production practices assure animal quality.

9. **What is the focus of food safety control points in quality assurance?**

Food safety control points focus on having a product that is safe to eat.

10. **What records are kept by animal producers in quality-assurance programs?**

The records are primarily of the animal husbandry practices that are followed. This includes medicines used, the amount given, the location of the injection site, and when the medicine was given.

11. **What is restraint? Why is it important?**

Restraint is the control of an animal so it can be transported, examined, treated, groomed, or otherwise managed. Proper restraint protects the animal, people who are assisting with the animal, and property from damage.

12. **What are five methods of restraining animals? Briefly explain one of them.**

Five methods that may be used in restraining animals are feline bags—for cats; head squeezes—for larger animals; chemical restraint—when other methods don't work, it is shot as a blow dart to tranquilize an animal; physical restraint—using a halter or head squeeze; and diversionary restraint—directing attention away momentarily for an activity, such as holding a fold of skin while giving a vaccination.

13. **What are five principles in animal safety?**

Any five from text (see page 559) such as these: understand animal behavior, understand animal biology, use safe facilities, use safe feed, and avoid excessive force.

14. **What are five principles in human safety when working with animals?**

Any five from text (see page 561) such as these: know animal behavior, understand behavioral change of sick animals, avoid startling animals, use proper restraint devices, and avoid exposure to animal secretions, dander, and the like.

EVALUATING:

1= f, 2=g, 3=b, 4=h, 5=a, 6=c, 7=d, and 8=e

20

VETERINARY SCIENCE

CHAPTER SUMMARY

Veterinary science is the study of the health and diseases of animals. This includes hands-on care of animals to promote productivity and well-being. A major part of veterinary science is veterinary medicine, which is the branch of medicine that deals with animals. The veterinarian is the lead individual in providing veterinary medical care. A doctor of veterinary medicine degree is required to be a veterinarian.

Veterinary medicine is carried out in veterinary hospitals or veterinary clinics. A veterinary hospital is a veterinary facility that can keep animals overnight for medical purposes. A veterinary clinic provides many of the same animal care practices but does not keep animals overnight for medical purposes. Kennels and other boarding facilities for animals may be operated in a separate facility. Most all veterinary practices follow science-based approaches in animal care though some may utilize alternative approaches such as acupuncture and herbal medicine.

A wide range of activities is carried out in a veterinary facility. Practices are often separated into small and large animal facilities. Small animals are typically companion animals but not necessarily so. Large animals, such as horses and cattle, may be carried for on a farm or ranch without transporting to a clinic or hospital. Veterinary services that are mobile are said to be ambulatory practices. Activities in a veterinary clinic or hospital range from greeting customers to diagnosing animal conditions, providing treatments, and setting fractured bones. (Table 20-1 in the textbook presents a rather lengthy list of activities in a veterinary facility.)

A number of animal care practices are used in veterinary medicine. Most all of these involve some interaction with animals. Here are a few examples: checking vital signs, listening to internal sounds, collecting and analyzing specimens, giving medications, and using diagnostic equipment such as ultrasound and radiography. Wound treatment and surgical practices are also included.

Diseases are classified in several ways, such as contagious or noncontagious and acute or chronic. A contagious disease is spread by direct or indirect contact of animals. Most are known as infectious diseases because they are caused by organisms that get into the body of the animal. Microorganisms that cause infectious diseases are known as pathogens. Examples of pathogens are bacteria, protozoa, viruses, fungi, prions, and parasites. A noncontagious disease is one that is caused by conditions or substances that are not transferred from one animal to another—no pathogen is involved. Wounds, bone fractures, and poisons are three examples. When classified by time of affliction, diseases are chronic or acute. A chronic disease is one that afflicts an animal for a long time. An acute disease is one that afflicts an animal severely for a short time. Some diseases are known as body system diseases. These cause body system problems or failures. There are many common diseases, as listed in the textbook.

Animals respond to disease in a range of ways that are to defend against infection. The primary defenders are the skin and mucous membranes of the body. The secondary defenders become active when an infectious agent gets past the primary defenders. The antibody is a form of secondary defender. Antibodies are produced by the body of an animal as its response to infection. These include leukocytes (white blood cells), phagocytes (cells that surround and destroy disease-causing microorganisms), and lymphocytes (in the vertebrae of vertebrate animals).

Immunity is the ability of an animal to resist disease. Immunity may be natural (animal develops without vaccination) or acquired. Acquired immunity may result from an animal having a disease and developing immunity without vaccination. Animal care often involves administering immunizing agents such as vaccines, serums, bacterins, and toxoids.

Diseased animals often need medications to enhance their ability to destroy pathogens in their bodies. Antibiotics are often used, with penicillin being most widely known. Pesticides may be used with parasites (always according to directions). Dietary supplements may be used to help animals overcome anemia and provide energy.

Medications may be administered as systemics (absorbed into blood stream), topical applications (onto skin or outer surface), and internal medicines (substances placed inside an animal's body). Injections are often used to administer medicine directly into the

blood stream with a hypodermic needle and syringe or other device. Injections may be intradermal (just below outer layer of skin), subcutaneous (just beneath the skin), intramuscular (into the muscle), intravenous (into blood vessel), intraperitoneal (inside belly wall of animals—mostly cattle), intranasal (administered into nostrils), and intrammary (administered into teat canal for mammary infections).

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are designed to help students understand the nature of veterinary science and its importance in promoting the health and well-being of animals and humans. Upon completion of Chapter 20, the student will be able to:

1. Discuss the meaning and importance of veterinary science.
2. List and describe common medical practices performed by veterinary staff.
3. Discuss the classes of animal diseases and list examples.
4. Describe how animals defend against disease.
5. Select methods of disease prevention.

INTEREST APPROACH

With most students, veterinary science/medicine is an area of high interest. The interest approach for this chapter may build upon that latent interest.

Several possible interest approaches may be used. One is to tour an animal health care facility such as a veterinary hospital or clinic. Students can observe the examination areas, devices used in veterinary medical care, and other aspects of the facility. Another is to tour an animal production facility to investigate the practices used in promoting animal health. Schools with animal laboratories may be able to provide similar observational experiences in the laboratory.

Another interest approach is to have the students read the introductory part of the chapter. Ask students to explain the statement, "getting the services of a team." Have them tell how veterinary care represents a team effort. Who all is involved? Why is veterinary science and medicine a prestigious career area? Allow students to tell about any experiences or observations they have made of veterinary work. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Begin with the first section in the textbook, "The Field of Veterinary Science." Have students read the section as homework or during supervised study. First, define "veterinary science" and ask students to discuss what is involved. Next, go over veterinary medicine. Relate that each veterinarian has a "practice," and explain that this is how they go about their work. Use student input to name and list examples of activities in a veterinary clinic or hospital (see Table 20-1). (This is an appropriate time to have a veterinarian speak to the class about the nature of veterinary medicine and the work of being a veterinarian, veterinary assist, or other individual in a clinic or hospital.)

Next, have students read "Common Practices." Afterward, call on individuals to summarize the information and name practices. List each practice on the writing surface and use student input to explain the appropriate content. The practices to include are: checking vital signs, listening to internal sounds, laboratory analysis (includes specimen collection), giving medications, and using diagnostic equipment such as radiology and ultrasonography. Wound treatment and surgical practices are also included.

Have students read the section "Classes and Examples of Diseases." You may wish to have them read a subsection of this at a time, such as "Contagious Disease" may be sufficient for one reading assignment and discussion. Indicate that diseases are often in two groups: contagious and noncontagious. Cover the section "Contagious Diseases" in detail, including concepts associated with infectious disease and pathogen. Use student input to name and explain the major pathogens: bacteria, protozoa, viruses, prion, fungi, and parasites. Distinguish internal and external parasites. Use student input to cover the section on "Noncontagious Diseases," including examples. Move into "Time of Affliction." Next, cover "Body System Diseases." Move into the section on "Common Diseases." Use student input to list these diseases, including descriptive information, and how the disease is prevented. Note: Diseases in the textbook that are not of local importance may be omitted or covered in less detail.

Next, have students read the section "How Animals Defend Against Disease." Use student input and the writing surface to present the concepts of primary defenders and secondary defenders.

Have students read the section "Disease Management." Use student input to outline concepts of immunity and pathogen destruction on the writing surface.

Next, go over major concepts associated with disease control. Have students discuss the meaning and importance of immunity and the destruction of pathogens. Use their input to outline the ways medications are administered. Demonstrate equipment used to administer medications. Have students practice loading syringes. Ask students to discuss situations with animals that they know about in terms of disease management.

REVIEW AND EVALUATION

The textbook and the Activity Manual can be used for both review and evaluation.

For review, have students define the terms at the beginning of the chapter and answer the end-of-chapter review questions. This may be done orally as a group activity or as supervised study with the students writing out the answers. Activities in the Activity Manual will also be very useful.

Evaluation can involve some of the same activities as review. The "Evaluating" section is one useful assessment tool. Oral and/or written tests can also be given. All of the activities can be implemented in reteaching, as appropriate.

Refer to the list of objectives in the textbook. Call on students to demonstrate that they know the content associated with each objective. Reteach areas where students appear deficient.

A practical approach to review and evaluation is to grow a school crop or garden. Students can be involved in all of the practices. Some students may use these activities as directed laboratory supervised experience.

SAFETY

Achieving the objectives of the chapter should involve few safety hazards. However, activities beyond the classroom could present safety problems. The teacher should always review the appropriate safety practices. The Activity Manual presents safety precautions with each activity.

Activities involving tours, observing animals, administering medications, and the like pose some risk. Appropriate safety practices should be followed. It is well to go over the hazards and relate how risks are reduced.

ADDITIONAL RESOURCES

The textbook and the Activity Manual can be used to achieve the objectives of the chapter. In some cases, teachers may wish to use specific materials on veterinary science/medicine. The Web site of the American Veterinary Medical Association (AVMA) is a good source of reliable information: www.avma.org/ The media library of the AVMA (available through its Web site) is an excellent source of detailed information about veterinary care.

Catalogs (paper and online) are good sources of information on animal care equipment and other needs. Animal supplies stores also have equipment and medicines that may be useful in instruction.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences and other details in their answers.

1. **What is veterinary science?**

   Veterinary science is the study of animal health and diseases. The overall goal is to promote well-being using a science-based approach.

2. **Distinguish between a veterinary hospital and a veterinary clinic.**

   A veterinary hospital is an animal health facility that can board animals overnight for health care reasons. A veterinary clinic is an animal health facility that does not board animals overnight for health care reasons.

3. **What activities are carried out in a veterinary clinic or hospital? List any five.**

   Note: Any five of the activities presented in Table 20-1 will suffice as an appropriate answer. Examples include: greeting and welcoming customers, vaccinating against disease, treating and dressing wounds, examining and diagnosing animal health problems, and setting fractured bones.

4. **What is a production animal veterinary practice? Why are they important?**

   A production animal veterinary practice is a practice that primarily deals with agricultural animals that are being produced for their products such as beef and dairy cattle and swine. They are important because of the role of products of these animals as human food.

5. What is a chronic disease? Acute disease?

A chronic disease is one that afflicts an animal over an extended time. An acute disease is one that severely afflicts an animal for a short time.

6. Distinguish between contagious and noncontagious disease.

A contagious disease is one that is spread by direct or indirect contact of animals—one animal can catch it from another. A noncontagious disease is one that is not spread by direct or indirect contact of animals but is caused by conditions or substances that are not transferred from one animal to another.

7. What is an infectious disease? Pathogen?

An infectious disease is a disease that is caused by organisms getting into the body of an animal. The organisms enter, grow, and are active in the animal's body. A pathogen is a microorganism that causes infectious diseases, such as bacteria, fungi, viruses, and others.

8. How are diseases related to body systems?

Some diseases only attack specific body systems. The disease may be confined to a particular organ or organ system.

9. What are some common diseases of animals? What animals can have each of these diseases? What are the symptoms? How are the diseases prevented and treated?

Note: The textbook lists quite a number of animal diseases. Listing and providing the needed information for any two should be a satisfactory answer though teachers may establish higher requirements. Example 1: anaplasmosis—parasitic disease primarily of cattle with symptoms of muscular tremors, rapid heartbeat, and loss of appetite; prevent with immunization; treatments are available if disease is caught early. Example 2: rabies—a highly infectious viral disease of the nervous system of several species including dogs, skunks, and raccoons; infected animals wonder about, attack without reason, fear water, paralysis, and death; prevent with vaccination.

10. How do animals defend themselves against disease?

Animals defend themselves against disease with primary and secondary defenders. The primary defenders are the skin and the mucous membranes of the body. The secondary defenders are antibodies and phagocytes.

11. What is immunity? What are the common kinds of immunizing agents?

Immunity is the ability of an animal to defend itself against disease. Natural immunity is present at the time an animal is born. Acquired immunity is developed by the animal, sometimes as a result of having a disease and recovering and other times artificially through medical means. Producers help animals develop acquired immunity by using immunizing agents known as biologicals. The common immunizing agents are vaccines, serums, bacterins, and toxoids.

12. What may be used to help an animal overcome disease?

Animals often need help in overcoming disease. This is provided with antibiotics, pesticides, and dietary supplements.

13. What kinds of medications may be used?

The kinds of medications that may be used include systemics, topicals, and internal medicines.

14. What are the kinds of injections? Describe how they are used.

The kinds of injections and their uses are: subcutaneous injection—made just beneath the skin; intramuscular injection—made through the skin into a muscle; intravenous injection—made into a vein; intrapeitoneal injection—made through the belly wall of cattle and a few other species; intranasal injection—made into the nostrils; and intramammary injection—made into a teat canal to treat diseases of the udder.

EVALUATING

1=g, 2=a, 3=j, 4=h, 5=i, 6=d, 7=c, 8=f, 9=e, and 10=b.

PART FIVE: NATURAL RESOURCES AND EARTH SCIENCE

21

NATURAL RESOURCES AND THE ENVIRONMENT

CHAPTER SUMMARY

Agriculture involves using the earth's resources to produce food, fiber, and shelter. Using the resources in a responsible manner is essential! Chapter 21 focuses on sustainable resource use as well as maintaining the environment and using technology properly.

The environment is composed of all of the factors that affect living things. Natural resources are all of the things that naturally occur in the environment. Sustainable agriculture is using practices to maintain our ability to produce food, fiber, and shelter indefinitely.

Ecosystems are made up of all of the parts of a particular environment. They include living and nonliving things. The living things are known as biotic factors (plants and animals). The nonliving things are abiotic factors (rocks, lay of the land, and climate). The biosphere is the area of Earth that supports life, which includes many ecosystems.

The area where a plant or an animal grows is its habitat. How a plant or an animal responds to its habitat is its niche. The food chain is the sequence in which living things obtain their food.

Renewable natural resources can be replaced. These include soil, water, wildlife, fish, forests, and air. Agriscience emphasizes employing special precautions to use and maintain these resources.

Nonrenewable natural resources cannot be replaced, such as fuel and minerals. Alternatives to some of these have been developed. Certainly, many of the nonrenewable resources can be recycled.

Environmental pollution is the damage done to the environment by people. Major resources that are polluted are air, water, soil, and aesthetics. Toxic substances may enter the environment. In addition, soil can be lost by erosion. Waste products and discharged water (known as effluent) are major sources of pollution. Also, discarded junk and litter make the environment less attractive.

The proper disposal of wastes is crucial. Landfills, incineration, and recycling are used with most wastes. Agriculture can cause pollution, and steps must be taken to keep the sources of pollution from damaging the environment. Using hazardous materials and releasing wastes necessitates strictly following rules and regulations. Safety is always important. Proper protection of the human body from some materials is a must.

Agricultural technology, used properly, is very beneficial. However, not using some of the materials properly can cause damage to the environment and can injure people. The use of technology is good; its misuse is bad!

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the role of natural resources and their responsibilities in properly using them.

Upon completion of Chapter 21, the student will be able to:

1. Define natural resources, environmental science, and sustainable agriculture.
2. Describe the role of ecosystems.

3. List and describe examples of natural resources.
4. Identify important wildlife species.
5. Describe responsible use of wildlife.
6. Discuss the meaning and sources of pollution.
7. Describe methods of agricultural waste disposal.

APPROACH

Since this chapter focuses on areas that are widely discussed in the media, student interest should already exist to some degree. The interest approach could be localized to particular natural resource problems in the community, or it could address a worldwide situation.

One approach is to use the introductory section of the chapter. After students have read it, have them offer suggestions on how the earth's resources could be used to meet the food, fiber, and shelter needs of the ever-growing human population. Ask students to explain how this relates to the goal in agriscience and technology to use and protect the earth's resources. Ask students to name places where famines and starvation have occurred. These places could be identified on a wall map. (Teachers may wish to review the objectives at this time.)

(Note: The Academic Connection, Internet Topics, Technology Connection, Career Profile, and Agri-Science Connection may be used in gaining interest or at any point during instruction on the chapter.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Follow the interest approach with a presentation and a discussion of the chapter content. Students could also read sections of the chapter and participate in the discussion. In addition, the Activity Manual has useful hands-on learning activities.

Begin by helping students learn and understand the concepts of environment, natural resources, and sustainable agriculture. List the definitions on the writing surface, and then ask students to explain them. The students can give examples, as found in their local communities. Also, present ecosystems and the factors involved: biotic and abiotic. Have students relate how an ecosystem works. Use a local area of forest or even a part of the school grounds as a place for students to visit and collect data.

Present the concept of sustainable agriculture. Have students explain what it means. Then offer local examples.

Use the writing surface to outline the kinds of natural resources. Begin by naming the two major kinds. Call on students to define and to give examples of each. Soils will be covered in more detail later in the text. Emphasis here should be on water, the cycle involved, and how it is renewed and conserved. As suggested in the Activity Manual, students can collect water samples and run different tests to assess the water quality and the extent of pollution. Many students will be very interested in the wildlife area, and this should be used to enhance their interest in the use of natural resources. Forests and air should be discussed. Remind students that forestry involves growing trees in a manner similar to how other crops are grown. Air tests could be made to determine the particulate and other materials present in the air.

Nonrenewable natural resources should be of interest to students from the standpoint of fuel for motor vehicles. Have students discuss what will happen when and if all fuel oil is used.

Students will likely enjoy studying about wildlife in the local area. Have students read the section "Wildlife Management and Species." Afterward, use student input to outline key concepts on the writing surface. Relate species to those found locally that are used as game and nongame animals and plants. Move into the section "Responsible Use of Wildlife." Have students read the section and provide input as you outline the major concepts on the writing surface.

Along with the chapter section "Pollution," present local pollution concerns. Students may want to solve a local pollution problem, such as picking up litter along a road or sponsoring a recycling project. Taking a field trip to a landfill or inviting a resource person to class will be helpful in giving relevance to waste disposal.

The sources of agriculture pollution and the steps for preventing it should be carefully presented. Have students discuss possible sources of agriculture pollution in the local community.

Conclude the instruction in this chapter by having students discuss how agricultural technology is good when it is not misused. They may wish to give examples of misuse and to discuss the benefits of technology.

REVIEW AND EVALUATION

The chapter summary and the end-of-chapter review questions can be used in reviewing and evaluating student learning. The end-of-chapter questions can also be used in re-teaching important concepts, as needed. Laboratory activities in the Activity Manual provide an excellent hands-on review of the chapter.

Achievement can be evaluated by using written or oral tests and supervised experience programs. Forming the students into action groups to help solve problems in the local community would help reinforce learning. Using the "Exploring" activities in the text would be very beneficial.

SAFETY

The objectives of the chapter do not include learning outcomes that pose specific safety problems. The conduct of some of the learning activities could present hazardous situations to students. Activities in the Activity Manual are coded to alert students to possible areas of danger. Students should be aware of the safety practices around water, in dealing with wastes, and on field trips to collect information. In terms of environmental safety, students can be referred to the Technology Connection that addresses the use of LiDAR. Relate that the work underway focuses on air quality and having safe air.

Students should be instructed in safety related to enjoying wildlife. The safety instruction may be through hunter safety education program or other approaches. Such may be beyond the scope of instruction in the class.

ADDITIONAL RESOURCES

Additional resources could be used to enrich the content from the perspective of the local community. Publications on natural resources, wildlife, and environmental science in the local area and approaches to waste disposal would be useful. These may be obtained from a college or a university, a state agency on environmental protection, or a local government agency, such as the agency that operates a landfill. Local businesses and industries as well as waste management companies also may have pertinent information on waste disposal.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, or other details in the answers.

1. **What is the environment? What are natural resources? How are they related?**

   The environment consists of all of the factors that affect the life of a living thing. Natural resources are the naturally occurring things that support life. They are related because the environment contains the natural resources.

2. **What is the biosphere?**

   The biosphere is the area of the earth that supports life.

3. **What is an ecosystem? Distinguish between factors in an ecosystem.**

   An ecosystem is made up of all of the parts of a particular environment. The two factors are biotic (living things) and abiotic (nonliving things).

4. **How does an ecosystem work? Describe habitat, niche, and food chain as parts of the ecosystem.**

   All of the biotic and abiotic factors interact in an ecosystem. Habitat is the area where a particular plant or animal lives. Niche is the special way of life that a plant or an animal has in its habitat. The food chain is the sequence in which living things obtain their food. All of these are a part of the ecosystem.

5. **What is sustaining natural resources?**

   Sustaining natural resources involves using natural resources in such a way that they can be replaced. Sustainable agriculture includes all of the things done by agriscientists to help people maintain the ability to produce food, fiber and shelter. This ensures future productivity.

6. **Distinguish between renewable and nonrenewable natural resources.**

   Renewable natural resources are those that can be replaced (e.g., soil, air, and water). Nonrenewable natural resources are those that can't be replaced (e.g., fuel and minerals).

7. **What are the most important renewable natural resources?**

   The most important renewable natural resources are soil, water, wildlife and fish, forests, and air.

8. What is the importance of the following renewable natural resources: soil, water, wildlife and fish, forests, and air?

Soil is the resource where seeds are planted and crops grow; nutrients for plant growth are from the soil. Water, often called the most important resource, is used by humans, other animals, and plants (crops) to sustain life. Wildlife and fish are parts of nature that provide recreation and food. Trees in forests provide valuable wood products and produce oxygen to protect the environment. Air contains oxygen, which is needed for life processes.

9. What are the major kinds of nonrenewable natural resources?

The major nonrenewable natural resources are fuel (solid, liquid, and gas) and minerals.

10. What is pollution?

Pollution is the contamination of the environment by people.

11. What are five important sources of pollution? Explain each.

The sources of pollution are toxic products (substances that contain poison or have the potential to poison plants and animals); soil loss (soil particles enter water and air); waste products (garbage, leftover materials at a factory, and animal manure and wastes); discharged water or effluent (water used and discarded by the processing plants, farms, and other places); and junk and litter (trash or old machinery that is no longer used).

12. Name three kinds of wastes.

Wastes may be gases, such as carbon monoxide and carbon dioxide; solids, such as paper and cans; or liquids, such as sewage and water runoff.

13. What methods of waste disposal are used? Briefly describe each.

Three methods are used to dispose of waste: landfills, incineration, and recycling. Landfills are large earthen pits that are carefully located and designed to hold wastes for decomposition. Incineration entails burning wastes in specially designed facilities. Recycling involves recovering and reusing materials rather than throwing them away.

14. What are possible sources of agricultural pollution?

Sources of agricultural pollution are introducing pests, such as those in products that are shipped; exotic plants or animals, such as ornamental plants or pets that get loose; chemicals; waste water; processing wastes, such as leftover pods from a vegetable processing plant; and new life forms, such as nonnatural plants that could get into the environment.

15. What can people do to reduce agricultural pollution?

People can reduce agricultural pollution by knowing regulations, following rules, storing materials properly, controlling wastes, using materials correctly, disposing of containers, and following safety practices.

16. Distinguish between consumptive and nonconsumptive uses of wildlife.

Consumptive wildlife use is harvesting or taking wildlife. Nonconsumptive wildlife use is enjoying wildlife without harvesting or taking it.

17. What are three uses of wildlife? How are these carried out responsibly?

Three uses of wildlife are fishing, hunting, and birding. Fishing and hunting are consumptive and should follow all laws and regulations associated with these activities. Birding is nonconsumptive but may have rules to follow.

EVALUATING

1=e, 2=d, 3=b, 4=j, 5=c, 6=i, 7=f, 8=g, 9=h, and 10=a

22

EARTH SCIENCE

CHAPTER SUMMARY

Space on Earth is limited. Similarly, resources are also limited. Ways must be found to use resources wisely to assure that human well-being is met for many generations into the future. Just as humans, plants, and animals depend on the earth for their life-supporting nutrients, they use the earth's resources in supporting their life processes.

The earth's structure is made up of a surface (crust), an interior, and an atmosphere. All these affect plant and animal life in one way or another. Certainly, the fertility of the soil and the contents of the atmosphere influence all life.

Changes occur on Earth because of movements of the planet in the solar system, movements in its interior, and weathering. Day length, seasons, changes in the earth's surface, and soil formation are caused by the earth's movements.

Weather is the general condition of the atmosphere. Weather includes temperature, air pressure, wind, humidity, and precipitation. Weather changes because one or more conditions in the atmosphere change.

Climate is the average weather conditions in an area. The earth is divided into three climate zones: the tropical climate zone, which is near the equator; the temperate climate zone, which is between the tropical and polar climate zones; and the polar climate zone, which includes the North and South Poles. Climate influences the kinds of plants and animals that can be produced. Some debate is occurring about global warming and the effect it will have on where crops are grown. Melting of the polar ice cap is a sure sign of such warming. The size of the ice cap is getting smaller each year.

Life succession is the pattern of growth of plants and animals in a particular place. It involves the continual replacement of the organisms that live there. Primary succession takes place when a biotic community develops where none has existed. Secondary succession occurs when an area is destroyed by natural disaster or by the actions of people and a new biotic community develops, much as with primary succession. Cut forests and abandoned fields are examples of secondary succession.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help students develop a fundamental knowledge of earth science as it relates to sustainable practices in producing plants and animals.

Upon completion of Chapter 22, the student will be able to:

1. Describe the major features of the earth.
2. Explain changes that occur in the earth.
3. Describe atmosphere and its importance in agriscience.
4. Identify and describe the major factors in weather.
5. Explain climate factors in agriscience.
6. Explain succession as related to agriscience.

INTEREST APPROACH

The introductory paragraphs and figure for Chapter 22 will be useful in an interest approach. Have students read the introductory part, and ask them to explain how living things must share the earth's space. Students may also describe their impressions of Figure 22–1. Ask them to tell why scientists need to know about the movement of bacteria in the soil. Also, have the students describe how plants provide food for animals that, in turn, die and return to the earth as nutrients.

Examples in the local community can also be used in the interest approach. These include unusual resources, such as minerals; natural features; and climate. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Instructional strategies should be based on the needs and interests of the students as well as on any unusual natural resources found in the area. Teaching plans can include presentation and discussion of the information related to the objectives.

As with all chapters, student mastery is increased by active involvement in reading, listening, discussing, writing, and doing hands-on activities associated with the objectives. Students should immerse themselves into the content and learning process.

After students have read the section on the earth's structure, outline the content of the chapter on the writing surface. Write key terms and their definitions on the writing surface. Have students offer examples of the different features. Focus on the earth's crust, interior, and atmosphere.

On the writing surface, list the ways the earth changes. These are movements in the solar system, movements in the earth's interior, and weathering. Use a globe or draw illustrations on the writing surface to explain how the earth rotates and revolves. Explain how seasons and day length relate to rotations and revolutions. Ask students to explain how seasons and day length pertain to plants and animals in the local area, such as the kinds of plants grown and the ways animals are raised.

Have students read the section of the chapter on the atmosphere. Emphasize key terms about the weather, including *temperature, air pressure, wind,* and *humidity.* Include discussion of clouds and precipitation in the instruction. Many activities can be used with this chapter, including those in the Activity Manual. Keeping records of temperature, precipitation, and other weather features helps students understand the content. Have the students explain how weather changes and what the effects of climate zones are on agricultural production.

After students have read the section on life succession, use presentation and discussion to explain the concepts involved. Distinguish between primary and secondary succession. Ask students to name places in the local area where succession is obviously underway.

REVIEW AND EVALUATION

The activities in the textbook as well as those in the Activity Manual can be used for review and evaluation.

Review should focus on the learning related to the achievement of the objectives for the chapter. Use the end-of-chapter questions and the terms at the beginning of the chapter in the review process.

Evaluation can consist of observation of performance on the review activities as well as written or oral tests. Tests may be teacher-made or from a test bank.

SAFETY

The achievement of the objectives of this chapter involves few safety hazards. However, activities that enrich the learning process often present possible safety hazards. The Activity Manual contains specific safety information related to the learning activities.

ADDITIONAL RESOURCES

The textbook and the Activity Manual can be used to achieve the objectives of the chapter. In some cases, teachers may wish to use newspapers with weather information or other reports of long-term weather data.

Numerous Internet resources are available to support this chapter. A good resource for information is the National Weather Service—**www.nws.noaa.gov**. Another source for weather information is weather.com—**www.weather.com**. (Local zip codes can be entered for current weather information. Students might be encouraged to keep a weather log for a week comparing their weather measurements using school instruments with those available over the Internet.)

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is the universe? How is the earth a part of the universe?**

   The universe is all that exists—both known and unknown—in the galaxies. The earth is in the Milky Way galaxy, which is a part of the universe.

2. **What are the parts of the earth's solar system?**

   The solar system that the earth is in has one sun, nine planets, more than 40 moons, and more than 100 billion stars.

3. **What are the three major parts of the earth? How do these parts relate to each other?**

   The three major parts of the earth are the crust, interior, and atmosphere. Resources from

all three are used to support life on the planet. Changes in one result in changes in the others.

4. Distinguish between continental and oceanic crust.

Continental crust is the crust that is known as land. Oceanic crust is the crust that is beneath the oceans and other bodies of water.

5. How does Earth move in the solar system? Name the kinds of movements, and explain each. Why are these movements important in producing plants and animals?

The earth moves in several ways in the solar system. Two important kinds of movements are rotations and revolutions. The earth rotates around the sun to create day and night, with 24 hours or one day required for a rotation. It revolves around the sun to create seasons, with 365.24 days or one year required for a revolution. These movements are important because they create seasons and day length that are important in regulating plant and animal growth.

6. What is weathering? What are the two major kinds of weathering? Why is weathering important?

Weathering is the process whereby the rocks and minerals on the crust of the earth are changed. Rocks break into smaller and smaller pieces. Chemical weathering takes place when new substances are formed by chemical reactions that occur. Mechanical weathering occurs when larger rocks break into smaller rocks. Weathering is important because it results in the formation of soil.

7. What are the major elements of the weather? Describe how each is measured.

The major elements of weather are temperature, air pressure, wind, moisture, and precipitation. Temperature is measured with a thermometer; air pressure is measured with a barometer; wind speed is measured with an anemometer; and direction is measured with a wind vane. Moisture is measured as relative humidity and involves a relationship between the air temperature and the humidity. Precipitation is measured with a rain gauge.

8. What is climate? List and briefly explain three climate zones.

Climate is the average of all the weather conditions for an area over a period of time. The three climate zones are tropical, which is a wide band around the earth that lies on both sides of the equator with warm climate; temperate, which is a band around the earth between the tropical and polar zone; and polar, which includes the North and South Poles with cold or cool climates.

9. What is succession?

Succession is the process of plants and animals growing and changing. It is the natural continual replacement of the organisms that live in an area.

10. What is primary succession? When does it happen?

Primary succession is the development of a biotic community where none existed. Long periods of time may be required for it to happen, such as in North America when the glaciers began to disappear and low forms of life began to grow. The low life forms were gradually replaced by higher forms as better soil developed.

11. What is secondary succession? When does it happen?

Secondary succession occurs when an area has been destroyed by a natural disaster or by people. It may happen when fields are abandoned, forests are cleared, or land is burned.

12. How can agriscientists get involved in succession?

Understanding succession helps agriscientists understand growth processes. They can get involved in re-seeding abandoned fields, planting forests, and controlling burning.

EVALUATING

1=i, 2=g, 3=h, 4=b, 5=a, 6=j, 7=e, 8=d, 9=f, and 10=c

PART SIX: PHYSICAL SCIENCE AND TECHNOLOGY

23

CHEMISTRY IN AGRISCIENCE

CHAPTER SUMMARY

Chemistry is the study of the substances that form the building blocks of living and nonliving things. These "blocks" are often referred to as matter, which is anything that has volume and mass. When something has volume, it takes up space. Mass is the amount of matter that an object contains.

Matter can be in three states: solid, liquid, and gas. Changes in the state of matter occur because of changes in either temperature or pressure or in both.

Matter has both physical and chemical properties. The physical properties include color, odor, melting and boiling points, solubility, hardness, density, and crystal formation. The chemical properties of matter explain how it is changed when it is combined with other matter.

Matter is classified into three general groups: elements, compounds, and mixtures. Elements are substances that can't be broken down further into simpler materials. Compounds are made of two or more elements that have been chemically combined. Mixtures are made of substances with parts that have different properties.

The Periodic Table of the Elements is used to group and organize the elements for study. It shows relationships between the elements. All elements can be placed into one of two categories: metals and nonmetals.

New chemical compounds are formed when elements bond. Valence electrons are shared.

Four kinds of chemical reactions used in agriscience are composition, decomposition, single replacement, and double replacement. Some chemical reactions are different from these if oxidation and reduction are involved.

Carbon is an important element in agriscience. Combinations of hydrogen and carbon are known as hydrocarbons. These are important in many agricultural chemicals and chemical processes.

Solutions and suspensions are often used in agriculture. A solution is a mixture of two or more substances. A suspension is a solute containing a solvent that may settle out unless kept agitated. In a suspension, often known as a colloidal suspension, materials are suspended in a liquid, such as a bacterin. An emulsion is made when two liquids are combined, such as oil and water for making salad dressing.

Surfactants are used to help water spread over waxy or oily surfaces, such as the leaves of plants. Nearly all pesticides have surfactants added to provide better coverage of plants.

Three substances with electrical charges are acids, bases, and salts. An acid has a pH below 7.0, whereas a base has a pH above 7.0. A salt has a pH close to neutral. Salts are formed when acids and bases are combined.

Chemical changes are important in agriculture. Photosynthesis, oxidation, and food preservation are three good examples.

All work in agriscience chemistry necessitates making accurate measurements. Special care must be taken; otherwise, dangerous and costly mistakes could result.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are designed to help students attain important knowledge of, and skill in, the application of the principles of chemistry in agriscience. Emphasis is on the fundamental processes.

Upon completion of Chapter 23, the student will be able to:

1. Explain the meaning and properties of matter.
2. Describe the major kinds of matter.
3. Explain the meaning of compounds and how they are formed.
4. Discuss the importance of carbon and organic substances.
5. Distinguish between solutions and suspensions.
6. Distinguish acids, bases, and salts.
7. Describe chemical reactions in agriscience.
8. Explain the use of measurements and conversions in chemistry and make calculations.

INTEREST APPROACH

Some students will approach agricultural chemistry positively; others, negatively. These feelings are based on previous experiences, such as in chemistry class. You can help dispel the fear of chemistry by indicating that this chapter is filled with practical approaches and will build upon previous study. Begin by having the students read the introductory part of Chapter 23. Ask them what is meant by "Everything is made out of something!" After discussion, explain that chemistry is concerned with the materials that "things" are made of.

The interest approach can be modified, based on the interests and needs of students. Some students may already have taken chemistry; others may have little familiarity with it. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Objectives of the chapter should guide instructional content. Achieving the objectives will involve careful use of the textbook and the Activity Manual. Presentation and discussion methods will also be helpful. Students should take notes on salient information.

Following the interest approach, have students read the section of the chapter in the text called "Matter." Then, write the key terms and their definitions on the writing surface. Call on students to explain the terms and to give examples of the three states of matter: solid, liquid, and gas. Illustrate the importance of temperature and pressure in determining the states, with water being a good example. List the kinds of matter on the writing surface, and then have students offer explanations of each. (Have students refer to Table 23–1 in the text or to a Periodic Table of the Elements in Figure 23–11 for a list of the common elements.) Ask students to distinguish between the metals and the nonmetals. Also, have students explain compounds and mixtures. Remind them that mixed fertilizer is a good example of a mixture, while sodium chloride is a good example of a compound. (Refer students to Table 23–2 in the text for a listing of the common compounds in agriscience.)

After students have read the section of the chapter in the text on chemical reactions, list the four kinds of reactions on the writing surface. Ask students to explain each kind and then to give an example. Students should record salient information in their notebooks.

After students have read the section of the chapter in the text called "Organic Chemistry," refer them to Figure 23–20 for an example of a hydrocarbon molecule.

After students have read about solutions and suspensions, list the key terms on the writing surface. Ask students to explain each of the terms and then to give examples. Emphasize the use of solutions and suspensions in agriscience.

After students have read the section of the chapter in the text called "Acids, Bases, and Salts," list the key terms on the writing surface, and then have students offer definitions for the terms. Discussion should include naming practical examples and describing how they are useful in agriscience work.

The important applications of chemistry in agriscience entail many of the common processes that occur on farms and ranches and in agribusinesses. After students have read the section of the chapter in the text called "Chemical Reactions," list important changes on the writing surface, and then have students explain what is happening with the changes.

Conclude the chapter with instruction on measurements in chemistry. Show students examples of beakers, test tubes, and other containers that are used. Explain how they are graduated to make measurements easier and more accurate. Have the students practice using the various measurements and containers. Materials in the Activity Manual will be useful with this area.

REVIEW AND EVALUATION

Some of the same approaches can be used for both review and evaluation. The observations of the teacher regarding student achievement can be the basis for reteaching, if appropriate.

For review, students can define the terms at the beginning of the chapter and answer the end-of-chapter

review questions. Activities in the Activity Manual will also be helpful.

Evaluation can also include oral or written tests, as well as observations of the students during supervised practice.

SAFETY

The objectives of the chapter can be achieved with few safety hazards. However, enriching the instruction with laboratory activities may bring a number of hazards into the instructional environment. The teacher should carefully explain all areas related to safety. The Activity Manual offers a number of activities in which safety is stressed. Students should be familiar with the safety procedures to follow in applying the principles of chemistry in agriscience.

ADDITIONAL RESOURCES

The objectives of the chapter can be achieved by using the text and the Activity Manual. In some cases, a reference on the fundamentals of chemistry, such as a high school chemistry book, may be helpful. Teachers who wish to provide more in-depth instruction may obtain a wall chart of the Periodic Table of the Elements (available from science supply houses or school supply firms).

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What two conditions are involved in changes in state?**

   The two conditions are temperature and pressure.

2. **Name and describe two properties of matter?**

   The two properties of matter are physical properties and chemical properties. Physical properties include color, odor, solubility, melting and boiling points, hardness, density, and crystal formation. Chemical properties are often more difficult to spot. For example, when the solid charcoal burns, it joins with oxygen in the air to form carbon dioxide.

3. **What is an element? How many elements are known to exist naturally? Artificially? Name five common elements, and give their symbols.**

   An element is a substance that cannot be broken down into simpler material by ordinary means. Scientists know of 118 elements, of which 98 are natural and 20 are artificial. Five common elements and their symbols are oxygen, O; hydrogen, H; calcium, Ca; carbon, C; and nitrogen, N. (Note: Students may name any of the elements from a Periodic Table of the Elements.)

4. **Describe the differences between the Fahrenheit and Celsius temperature scales.**

   The Fahrenheit scale is an English system of measurement. It has a freezing point of 32º and a boiling point of 212º at sea level. The Celsius scale is a metric system of temperature measurement, with a boiling point of 100º and a freezing point of 0º.

5. **What is the Periodic Table of the Elements? How is it used?**

   The Periodic Table of the Elements is a way of grouping the elements to show relationships and differences. It also contains information about the elements. It is used by scientists and students to obtain information about how elements will react.

6. **What is the Periodic Law?**

   The periodic law states that the properties of elements are dictated by their atomic numbers.

7. **Name and distinguish between two categories of elements. What is a metalloid?**

   The two categories of elements are metals and nonmetals. Metals are easily identified by their brilliant appearance or metallic luster or shine. Metals are good conductors of heat and can be formed into many shapes. Nonmetals do not have luster, are brittle, and are not good conductors of heat. Metalloids are a section of the nonmetals that have characteristics of metals and nonmetals. They tend to be semiconductors of electricity and are found along the metalloid line that separates the Periodic Table of the Elements into metals and nonmetals.

8. Identify the three main parts of an atom and where they are located in the atom.

Parts of an atom are the nucleus (central part of an atom), neutrons (in the nucleus), and protons (in the nucleus).

9. What is a compound? How is a compound related to the Law of Definite Composition?

A compound is a substance made of two or more elements. The Law of Definite Composition states that all compounds have a definite composition by mass.

10. Identify the four main types of chemical reactions.

The four main types of chemical reactions are composition, decomposition, single replacement, and double replacement.

11. What is a mixture? Give examples.

A mixture is a substance that has parts with different properties. The parts could be physically separated from the others.

12. What is organic chemistry? What two major areas are involved?

Organic chemistry is the study of carbon, which includes the study of substances containing carbon as well as the study of ways in which organisms use carbon in their structures. All organic compounds contain carbon and involve covalent bonding.

13. Explain the differences between solutions, solvents, and solutes.

A solution is a mixture of two or more substances. The dissolving material (often a liquid) is the solvent. The material that is dissolved is the solute.

14. How do suspensions, colloids, and emulsions differ?

Suspensions, colloids, and emulsions are mixtures of two or more compounds. Colloids, which contain solid material in a liquid (e.g., clay particles in water) are usually easy to filter out. Emulsions are colloids made of two liquids (e.g., oil and water mixed together).

15. Explain the following as related to agriscience: filtration, surfactants, and agitation.

Filtration is used to remove solids from a suspension, such as trash from fuel, dust from the air, and chemical vapors in the air. Surfactants are wetting agents that help oil and water mix, such as water containing a pesticide that is applied to the waxy leaves of plants. Agitation is used to keep suspensions mixed well by moving the liquid around. Agitation is used in pesticide sprayers to keep a good mix of chemicals and water.

16. What are acids, bases, and salts? How do they relate to each other?

Acids are compounds that give up protons to water molecules to form hydronium ions and that have a pH below 7.0. Bases are compounds that produce hydroxide ions in water and accept protons. The pH of bases is above 7.0. Salts are compounds formed when acids and bases are combined. They have a pH of about 7.0. Acids and bases can be reacted to and form salts.

17. What important agriscience chemical reactions occur in oxidation and food preservation.

An important agriscience chemical reaction that includes oxidation is the rusting of metals used in farm structures and equipment. Painting the metals and using galvanized metals will help reduce rusting. Several methods of food preservation, including pickling and salting, involve the use of chemicals.

18. Identify the two kinds of measurements used in chemistry in agriscience?

Chemistry measurements in agriscience include linear measurements (distance between two or more points), area measurements (multiply linear measurements), volume measurements (total size), and weight measurements (heaviness). In agriscience, linear and area measurements are common.

EVALUATING

1=f, 2=e, 3=d, 4=a, 5=c, 6=b, 7=j, 8=h, 9=i, 10=g,11=k,12=m, 13=n, and 14=l

24

PHYSICS IN AGRISCIENCE

CHAPTER SUMMARY

The study of the principles of physics includes several areas related to the use of energy and matter. Some of these areas focus on getting more work accomplished with less human effort.

The major areas of physics are mechanics, heat, sound, magnetism and electricity, light, and electron and nuclear physics. One of the important areas in agriscience is mechanics, which is often known as mechanical technology.

Work and power are important concepts in agriscience. Moving an object through a distance when there is some resistance to the movement is known as work. Force is the push or pull exerted on an object in doing work. The ability to do work is called energy.

Power is the rate at which work is done. Time is a factor because the object is moved by force in a certain amount of time. Horsepower is often used in assessing the power of motors and engines. One horsepower is equal to 550 foot-pounds of work per second.

Motion is a part of both work and power. It entails moving or changing the position of something. Motion is rectilinear (straight) or curvilinear (circular). Speed is the rate of motion. Increasing the speed of an object over time is called acceleration. Decreasing the speed of an object over time is called deceleration.

Machines are devices that help transmit power, force, and motion. All equipment and machinery is made of six simple machines. The six simple machines are lever, wheel and axle, pulley, inclined plane, wedge, and screw. Wedges and screws are sometimes considered forms of inclined planes.

Mechanical advantage explains why machines are useful. It is the way in which a machine multiplies the force it receives. Work is a product of force and distance. Machines do not increase both force and distance. A machine does no more work than the amount of work put into it.

Thermal energy is the energy produced by heat. Internal-combustion engines burn fuels that produce heat. Fuels may be gasoline, diesel fuel, liquefied petroleum gas, and others.

Electrical energy involves current electricity. The two forms of current electricity are direct current (DC) and alternating current (AC). Electrical current is measured in amperes, volts, and watts. Some materials, such as copper and aluminum, are excellent conductors of electrical current; others, such as glass and rubber, are insulators and do not conduct electrical current. Many types of electrical controls and circuits are used.

Two forms of compression power are used in agriscience: hydraulic power and pneumatic power. Hydraulics involves using liquids at rest and in motion. Pneumatics involves using compressed air in both simple (tire pump) and complex (air-driven hammer) applications.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are designed to help students learn and understand the fundamental principles of physics and their applications. The emphasis is on simple mechanical power and related areas, including thermal energy, electricity, and compression.

Upon completion of Chapter 24, the student will be able to:

1. Identify and explain areas of physics in agriscience.
2. Explain work, power, and motion.
3. Identify simple machines and relate each to agriscience.
4. Explain mechanical advantage.
5. Describe the use of thermal energy.
6. Explain the use of electrical power.
7. Describe the use of compression power.

INTEREST APPROACH

The “mechanical world” is often of high interest to students. This is a good point to use in beginning the interest approach. After students have read the introductory part of Chapter 24, have them explain how mechanical power allows a person to get more work done with less effort. A good example is to relate how using a shovel to dig the soil compares with using a

large tractor with a disc or a plow. Other examples of machinery can also be given. Ask students to explain how farming has changed as a result of mechanical power. (Teachers may wish to review the objectives at this time.)

Another interest approach may focus on welding as the application of heat to fuse two pieces of material. Many students want to learn how to weld and will find the subject of welding of high interest. A welding demonstration might be used (be sure all safety practices are followed). Relate welding back to the study of physics.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

A variety of instructional strategies can be used in the teaching plans for the chapter. In all cases, students should read the chapter before class instruction. Teachers may have students read the chapter in its entirety or in various sections at the time they are being covered in class.

Use presentation and discussion to cover the meaning of physics and the areas of physics. List the key terms on the writing surface. Have the students provide the definitions and examples, and then write them on the writing surface.

Work and power are important physics concepts that require careful explanation for many students. Write the key words on the writing surface, and then have students provide the definitions and examples. Write the formulas on the writing surface, and then demonstrate how they are used. Also demonstrate the use of the factor label method of problem solving. Ask the students to give examples of problems for work, power, horsepower, speed, and acceleration and deceleration.

After students have read the section of the chapter in the text on simple machines, list the types of simple machines on the writing surface. Have students define and explain each type. Demonstrate the use of various simple machines in class. Let students use the machines to do work and to compare what it would be like if they were to do work without the machines.

Students should carefully read the section of the chapter in the text on mechanical advantage. Write the key terms on the writing surface, and then have students explain them. Use examples to give students additional practice in mechanical advantage calculations.

After students have read the section of the chapter in the text on thermal energy, use presentation and discussion to cover the content. Stress how heat engines use thermal energy. Give examples of fuels that are commonly used by heat engines, such as gasoline and diesel.

Have students read the section of the chapter in the text on electrical energy. List the key terms on the writing surface, and then have students explain them. Bring small power tools to class so that students can practice reading the labels that describe the electrical usage. Have students prepare a simple electrical circuit. The Activity Manual offers simple and safe examples.

Cover the content on compression power, using presentation and discussion methods. Use examples of hydraulics and pneumatics in making explanations. Ask students to describe where they have seen compression power at work.

REVIEW AND EVALUATION

Review and evaluation will likely involve some of the same instructional strategies. Have students define the terms at the beginning of the chapter and answer the questions at the end of the chapter. Activities in the Activity Manual are excellent for helping students review the chapter content.

Evaluation can include observations of student performance on the review activities as well as on written and oral tests. Items for a written test can be drawn from the computer test bank.

SAFETY

The objectives of the chapter can be achieved with few safety hazards in the learning environment. Enriching the instruction beyond the minimum objectives will provide excellent learning opportunities but may present safety problems. The Activity Manual illustrates appropriate safety practices involved with the activities. Using low-risk demonstration and practice activities will minimize the hazards. For example, rather than wiring a regular AC circuit, students can wire a small circuit energized by a low-voltage dry-cell battery. Teachers should be on the alert for safety problems and instruct the students accordingly.

ADDITIONAL RESOURCES

The textbook and the Activity Manual provide sufficient information for students to achieve the objectives of the chapter. Many models, specimens, and other materials will help enrich the instruction. Materials on electricity and electrical codes may also serve as enrichment tools. High school physics textbooks and physical science books may be very useful with this lesson.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. What is physics? What areas are included?

Physics is the study of matter and energy and how they relate to each other. The major areas are mechanics, heat, sound, magnetism, electricity, light, and electron and nuclear physics.

2. What is work? Power? Distinguish between the two.

Work is moving an object through a distance when there is some resistance to the movement. Power is the rate at which work is done. Power differs from work in that power involves time and work does not.

3. Calculate the amount of work if 5 pounds of force are used to push a lawn mower 500 feet.

It would take 2,500 foot-pounds.

4. Calculate the amount of power if it takes six minutes to push the lawn mower in question three.

It would be 6.94 foot-pounds per second.

5. What is horsepower?

Horsepower is the amount of power to do 550 foot-pounds of work per second. The term was originally used to compare the power of a steam engine to the power of a horse.

6. What is motion? Speed?

Motion is moving or changing position. Speed is the rate of motion.

7. How does speed relate to the time required to do a job?

Speed relates to how long it takes to do a certain job. Jobs may be done in less time if a faster speed is used. However, faster speeds are not always practical.

8. What are the six simple machines? Name examples of the use of each.

The six types of simple machines are lever (pry bar), wheel and axle (bit brace), pulley (block and tackle), inclined plane (ramps), wedge (hatchet or axe) and screw (c-clamp).

9. What is mechanical advantage?

Mechanical advantage is the way in which machines multiply force.

10. What is a heat engine? Why is heat important in the engine?

A heat engine is a common internal combustion engine. Heat is produced when the fuel is burned, causing an expansion of the gases in the cylinder of the engine. As the gases expand, a piston is moved. The piston is connected to a crankshaft, which is made to turn by the motion of the piston.

11. What is current electricity? What are the two kinds, and how do they differ?

Current electricity is the kind of electricity that is caused by flowing electrons. The two kinds are alternating and direct current. Alternating current (AC) regularly reverses its direction of flow. Direct current (DC) flows in one direction.

12. How is electrical current measured?

Electrical current is measured as amperes (rate of flow), voltage (potential energy), and wattage (amount supplied or used). Combinations of the three may also be used to measure electric current.

13. Distinguish between an electric current conductor and an electric current insulator.

A conductor is any substance that allows electrons to flow freely. An insulator is any material that does not conduct electricity.

14. Why is a GFCI important?

A GFCI (ground fault circuit interrupter) is a device that is designed to protect people from shock when they are using electricity in a wet area or around water.

15. What is hydraulic power? How is it used in agriscience?

Hydraulic power involves transmitting force through liquids, allowing them to perform work. Hydraulic power may be used in agriscience to lift heavy objects as well as to move equipment and devices and in other ways.

16. **What is pneumatic power? How is it used in agriscience?**

Pneumatic power is the use of compressed air. Compressed air is used to inflate tires, operate tools, spray paint, and move materials.

EVALUATING

1=f, 2=j, 3=e, 4=a, 5=d, 6=c, 7=b, 8=h, 9=g, 10=i, 11=l, and 12=k

25

MECHANICS IN AGRISCIENCE

CHAPTER SUMMARY

Agricultural mechanics is the use of machinery, tools, and associated electronic devices to perform agricultural jobs. It includes the design, construction, operation, and repair of agricultural engines and implements as well as areas of agricultural structures, land and water management, and electrical applications.

Considerable emphasis is on mechanization, which is the use of machinery to replace human labor. Today, machinery has “smart” devices, such as computers, sensors, and controllers to operate, monitor, and record field conditions and applications. Global positioning systems are often integrated with these “smart” devices. Much of the work in agriculture is carried out with powered implements. Some implements are complex. Others lack complexity, but they require careful attention during operation. Tilling, planting, applying, harvesting, and other functions are performed by mechanized inventions.

The materials used in agricultural mechanics are primarily those in structures, tractors, and implements. Structures include sheds, barns, bins, growing houses, fences, corrals, and warehouses. The kinds of materials include those of wood, metal, glass, and plastic. Lumber is a widely used wood material. Mild steel is commonly used in agriculture. Fasteners are often used to secure materials in position.

Plans are needed before work is initiated on a project. Most plans are comprised of project drawings and a bill of material. A drawing that is prepared to scale includes all portions of the project drawn in relationship to its actual size. A bill of material is an itemized list of the materials needed for a project.

A wide assortment of hand and power tools are used in agricultural mechanics. Some are for use with wood; others are specific to metals. A few are used with projects made with various materials, such as a screwdriver. Knowing the names of tools and the jobs they are designed to do is essential for efficient and safe work. Knowing how to take proper care of tools is also important. Power tools have additional concerns in terms of safety concerns.

Welding is the fusion of two pieces of metal or plastics. The focus in this chapter is on metal. Heat for welding is from two sources: electricity and gas. Electricity is widely used, with shielded arc welding being more popular. The arc formed between the electrode and the metal being welded creates tremendous heat that melts the metals so they fuse together. Proper equipment for arc welding is essential, including safety equipment (e.g., a helmet with the appropriate lens). Gas welding typically involves using acetylene and oxygen to produce a very hot flame. Gas is also widely used in cutting metals. Proper flame adjustment is important for the desired heat.

Most all agricultural activities require water. Designing, installing, and maintaining adequate water supply and disposal systems requires the use of specialists in such areas. Knowing the fundamentals of supply and disposal systems helps in relating to the specialists and in maintaining the systems.

Internal combustion engines require preventive maintenance care. Most all engines if two-stroke cycle or four-stroke cycle require maintenance of the air system. Filters should be in place and requlary serviced to assure clean air for engine operation. Four-stroke cycle engines require servicing of the lubrication system.

Two-stroke cycle engines require the use gasoline to which needed lubricant has been properly added. Always use information in the operator's manual to guide servicing of engines.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the broad nature of agricultural mechanics skills and to begin the process of developing such skills. Upon completion of Chapter 25, the student will be able to:

1. Explain the meaning and areas of agricultural mechanics.
2. Identify materials used in agricultural mechanics.
3. Discuss the roles of a plan and bill of material.
4. Select fasteners for a job.
5. Identify common hand and power tools used in agricultural mechanics.
6. Use woodworking skills to construct a project.
7. Use welding and cutting skills to fabricate metals.
8 Describe water and sewer service needs for agricultural facilities.
9. Perform routine maintenance on small internal combustion engines.

INTEREST APPROACH

Many students tend to have high interests in agricultural mechanics work. Use this interest to build on in creating readiness for this chapter. Begin by having students read the introductory paragraphs of the chapter. Call on one or more students to summarize the meaning of the paragraphs. Follow this by asking them to carefully observe Figure 25–1. Ask for comments about the nature of the work and the safety that should be considered. Next, review the objectives for the chapter and begin covering the content.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

A variety of instructional strategies can be used in the teaching plans for Chapter 25. In all cases, students should read the chapter before class instruction. Teachers may have students read the chapter in its entirety or in various sections at the time they are being covered in class.

Use presentation and discussion to cover the meaning of agricultural mechanics and the areas that are included. List the key terms on the writing surface. Then have the students provide the definitions and examples. List their responses on the writing surface. Cover concepts associated with power and equipment, particularly equipment used in mechanized agriculture.

Cover the section “Materials Used in Agricultural Mechanics.” Have students read portions of the section sequentially. Use student input to outline major points on the writing surface. Bring specimens of materials into the class.

Cover the section “Plans and Bills of Material.” After reading, refer students to Figure 25–18, and call on one or more students to explain how the drawing would be useful in constructing the sawhorse as a project. Demonstrate how a bill of material is prepared. Appendix J in the textbook has a sample format for a bill of material.

Begin the section “Fasteners” by having students read the content in the textbook. Use student input to summarize major concepts on the writing surface. Bring specimens of fasteners to class, including various sizes and kinds. Discuss how they are identified and measured.

Upon completion of the section on fasteners, cover “Hand and Power Tools.” Have students read the section, and use their input to summarize the content on the writing surface. Bring examples of tools to class. Have students learn to identify tools by sight. In some cases, time may be taken in the lab to allow students to learn how to hold and use tools. Be sure to include proper tool care and safety in the instruction.

Cover the section “Welding” by having students read it. Provide suggestions as the content is summarized on the writing surface. Welding can be approached as the application of physics principles. Review the line drawings, and refer to the photographs in the chapter. Call on individuals to explain what is shown. Bring examples of equipment into class, and demonstrate how it is used. Allow students to hold the electrode holder and welding rods. Have students try on gloves, a helmet, and other safety devices. Depending on skill development, laboratory practice may be included with this part of the chapter.

Next, move into the section “Water Supply and Disposal.” Have students read the section as homework or supervised study. Use student input to outline salient points. Ask students to explain why water is so important in agriculture and identify sources of water for agriculture. Ask students to describe factors in water system design. Refer students to Figure 25-49 and review

the components and layout of a water system in a home (can be applied to a simple agricultural building). Next, go over local regulations on water (use a county sanitarian or other individual as a resource person).

Cover the section on "Small Engine Maintenance" by first having students read the section and then using input from students to outline salient points. Have them identify the two main systems that may be serviced: lubrication and air. Distinguish between a two-stroke cycle and a four-stroke cycle engine. Demonstrate servicing of the systems in the lab on small engines. If time permits, involve students in these activities on engines. Be sure to stress important safety areas and have students implement safety practices.

REVIEW AND EVALUATION

Review and evaluation will likely involve some of the same instructional strategies. Have students define the terms at the beginning of the chapter and answer the questions at the end of the chapter. Activities in the Activity Manual are excellent for helping students review the chapter content.

Evaluation can include observations of student performance on the review activities as well as on written and oral tests. Test items for a written test can be drawn from the computer test bank.

SAFETY

The objectives of the chapter can be achieved with few safety hazards in the learning environment. Enriching the instruction beyond the minimum objectives will provide excellent learning opportunities but may present safety problems. The Activity Manual illustrates appropriate safety practices involved with the activities. Using low-risk demonstrations and practice activities will minimize the hazards. For example, rather than wiring a regular A/C circuit, students can wire a small circuit energized by a low-voltage, dry cell battery. Teachers should be on the alert for safety problems and should instruct the students accordingly.

Depending on depth of instruction in welding, safety is a very important area. Cover all safety issues. Have students demonstrate that they understand them and that they have the ability to respond appropriately. Hand and power tools pose special safety hazards as well. Be sure all safety practices are taught, and make sure students can demonstrate mastery. Safe disposal of used lubricating oil as well as waste water should be covered as a part of safety content.

ADDITIONAL RESOURCES

The textbook and the Activity Manual provide sufficient information for students to achieve the objectives of the chapter. Many models, specimens, and other materials will help enrich instruction. Materials on electricity and electrical codes may also serve as enrichment tools.

Textbooks that will be very useful are *Introduction to Agricultural Mechanics* and *Modern Agricultural Mechanics* (available from Pearson Education). The latter book covers welding in more depth and offers considerable information on safety.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is agricultural mechanics?**

   Agricultural mechanics is the use of machinery, tools, and other devices and procedures to perform agricultural jobs.

2. **What are the two kinds of power provided by tractors? Distinguish between the two.**

   The two kinds of power provided by tractors are drawbar and PTO power. Drawbar pulling is power to pull a load across the ground. PTO power is a rotating power that turns a shaft or a wheel.

3. **What are the four major kinds of agricultural equipment? Distinguish between the four kinds.**

   The four major kinds of agricultural equipment are tillage, seeding, application, and harvesting. Tillage equipment prepares and otherwise loosens or manages the soil. Seeding equipment plants seeds. Application equipment applies materials (e.g., fertilizer or pesticide) to plants and land. Harvesting equipment reaps, picks, or otherwise gathers products.

4. **What is lumber?**

   Lumber is pieces of wood made by sawing logs.

5. **What is the distinction between rough and dressed lumber? Green and seasoned lumber?**

Rough lumber is the quality of lumber when first sawed; it has not be sent through a planing machine. Green lumber is sawed from logs that were recently harvested and have not dried. The lumber will be seasoned to lower the moisture content.

6. **What is plywood?**

Plywood is wood product made by gluing thin layers of wood together.

7. **What is mild steel? Why is it widely used in agriculture?**

Mild steel is a strong and economical metal. It contains 0.10 to 0.50 percent carbon. It is used because of its malleable properties and because it is readily welded.

8. **What is fabrication?**

Fabrication is the process of making an implement from metal, plastic, or another material.

9. **What is meant when a plan is prepared to scale?**

Scale means that the object and its parts are drawn in proportion to its actual size.

10. **What kinds of fasteners are used?**

Frequently used fasteners are nails, screws, and bolts.

11. **What is a tool? Distinguish between hand and power tools. List examples of each.**

A tool is an implement used to perform a mechanical job. A hand tool is a small, powerless type of instrument. A power tool is somewhat larger to quite large and has power from an electric motor or another source. Examples of hand tools are pliers, hammers, and open-end wrenches. Examples of power tools are drill presses, radial arm saws, and grinders.

12. **What general procedures should be followed with woodworking projects?**

General procedures must be followed with woodworking projects. Begin with a plan; prepare a bill of material; obtain materials using a plan; mark cuts to make; cut properly; assemble the project; use fasteners appropriately; and finish the project. (Note: Student answer may reflect some variation from this list.)

13. **What is welding? What are the sources of heat for welding?**

Welding is fusing two pieces of metal or plastic together. Heat from welding is usually from electric arcs or gas flames.

14. **What is shielded arc welding? How is it done?**

Shielded arc welding is using an electric arc between a coated electrode and the metal being welded to create heat. It involves using an arc welding machine and a metal that is grounded to create the arc. The arc is moved along the line being welded to create a puddle of metal that fuses the pieces together.

15. **What two gases are used in common gas welding and cutting? Why are these used?**

The two gases used in welding are oxygen and acetylene. These are used because they are relatively convenient and create intense heat.

16. **Why is water supply so important in agriculture?**

An adequate supply of good water is needed for plants and animals to grow and be productive. Water is needed for irrigation, cleaning, drinking, and other uses.

17. **What are the two main areas of service with a small internal combustion engine?**

The two main areas of service with small internal combustion engines are the lubrication system and the air intake system.

EVALUATING

1=g, 2=i, 3=j, 4=f, 5=b, 6=a, 7=e, 8=d, 9=h, and 10=c.

PART SEVEN: CONSUMERS AND PRODUCTS

26

AGRICULTURAL ECONOMICS: MANAGEMENT AND MARKETING

CHAPTER SUMMARY

Goods are created, owned, and exchanged as a function of an economic system.

Economics is the study of decisions about the production, distribution, and consumption of goods and services. Agricultural economics utilizes economics from an agricultural perspective. It focuses on making choices to produce and distribute food and fiber to meet human need. All economics involves four factors of production: land, labor, capital, and management. A good is a product or material that satisfies human wants. A service is a non-physical product that satisfies human wants. Grain is a good; veterinary care of an animal is a service. All economic activity involves cost; cost is the value of a sacrificed alternative to other goods or services that are available. People make decisions based on the limited amount of money they have available, such as "Will I buy food or a show ticket?" Producers need to have a profit following their efforts. Profit is the amount that remains from the sale of products or services after all costs have been paid.

The free enterprise or capitalism system is used in the United States. This system provides for individuals to own property and to profit from it. People are free to organize and to conduct business. Sole proprietorships, partnerships, and corporations are major ways of doing business. Cooperatives and hybrid approaches are sometimes used, such as limited liability companies (LLC). Supply and demand is said to shape prices in a free market system. However, leaders of the United States have learned that governmental regulations are often essential to prevent abuses and to keep the system in balance.

Marketing is a key to success in any business venture, including those in areas of agriculture, horticulture, and forestry. Marketing is based on providing the goods and services that people want and are willing to buy. It is obvious that marketing begins with decisions about what to produce and all of the functions needed to get the product to the consumer in the desired form. Instruction in marketing typically involves all of the steps between production and consumer receipt.

Marketing channels are the ways in which products are moved from the producer to the consumer. Five agricultural marketing channels are roadside and retail markets, central locations—packing sheds and elevators, processing plants, custom orders and vertical integration, and niche marketing.

Products vary in the functions required to get them to the consumer. The functions involve processes that prepare the products. The common functions are harvesting and assembling, grading, transporting, processing, packaging, storing, advertising and promoting, and selling and distributing.

Marketing infrastructure includes roads, trucks, special equipment, processing plants, and many other areas that support and make marketing possible. Without a marketing infrastructure for a product, producers usually will not produce it.

People (as consumers) make choices. Producers must consider consumer preferences so that a product desired by consumers will be produced. A demand must exist if a good or service is to be sold. Consumer choices are related to standard of living. Standard of

living is the level of choice about both essential and nonessential goods and services that people make.

Agricultural industry increasingly uses agricultural trade among nations as a source of products as well as a market for production. An export is a product sold into another country. An import is a good brought into a country from another country. Exports and imports create a balance of trade. Some nations set tariffs on goods to help limit or manage the importation of products. Trade agreements may also be used. In the United States, products must be labeled with country of origin information.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help students develop a fundamental knowledge and understanding of the technology involved in agricultural marketing. The emphasis is on the channels and functions in agricultural marketing. The role of infrastructure and communication is also stressed.

Upon completion of Chapter 26, the student will be able to:

1. Explain the meaning and importance of agricultural economics.
2. Discuss free enterprise and ways of doing business.
3. Describe the role of agricultural marketing.
4. Explain the ways agricultural products are marketed.
5. List and explain the major functions in agricultural marketing.
6. Describe the importance of marketing infrastructure.
7. Assess the role of consumers and their preferences.
8. Relate the importance of international trade.

INTEREST APPROACH

Many different strategies can be used in developing an interest approach. One is to have the students name some of their favorite foods and then to trace these foods from the point of production through all of the steps until they are consumed.

The Technology Connection may be of interest to students. Relate decisions by consumers to health and weight. If available, students can use a body-fat skinfold caliper to assess their own situation.

Another interest approach is to have the students read the introductory part of the chapter. Afterward, have them give examples of products they have tried to purchase at a store only to find that the store was out of the products. Ask the students to offer possible explanations of why this happened. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

The objectives for the chapter will require the use of presentation and discussion methods as well as student reading in the text and student completion of activities in the Activity Manual. Several strategies for teaching plans are suggested here. Regardless of the approach, strive for mastery of the content associated with the objectives.

Following presentation of the objectives, have students read “Agricultural Economics Basics.” Follow this with discussion that involves student input on the major concepts. Some of the concepts may be abstract; therefore, take the needed time and use local examples to aid understanding.

Next, have students read “Free Enterprise: The Setting for Agricultural Marketing.” Afterward, use student input to outline concepts on the writing surface, including economic system, free enterprise, ways of doing business, and supply and demand. Relate the important role of management.

Have students read the section “Marketing Technology and Consumer Demand.” List the key terms on the writing surface, and then have students explain each of them. Emphasize the definition of “agricultural marketing technology” and the concepts involved.

After students have read the section “How Agricultural Products Are Marketed,” list the marketing channels or methods on the writing surface. Then have the students offer descriptions of the different channels. List the major characteristics of each channel on the writing surface. Have students give local examples of each. Also, have students name the kinds of plants and animals that are marketed through the local channels. Students in supervised experience programs may be involved in marketing, and their experiences could be most beneficial in providing local firsthand information.

Have students read the section “Marketing Functions.” Then ask different students in the class to explain the functions. Write the names of the functions on the writing surface, and then list descriptive information, based on a student discussion regarding what they have learned from the text. Ask students to identify products in the local area and the functions involved in preparing them for the consumer. Take a field trip to a

cattle auction or to a grain elevator to observe what takes place as the products are assembled.

Marketing infrastructure may require careful attention to local situations to help students understand the areas involved. After the students have read the chapter, use presentation and discussion methods to list and draw out key information. List the components of the local agricultural marketing infrastructure for the various plants and animals that are produced.

Have students read the section “Communication in Agricultural Marketing.” List key terms on the writing surface, and then have students provide an explanation of each of the terms. Use examples in the local media, or have a marketing specialist serve as a resource person in the class.

Next, have students read the section "People Make Choices." Use their input to outline major concepts. Ask how choices relates to decisions in their family about the products they buy and the foods they consume.

Move into the section "International Trade." After students have read the section in supervised study or as homework, use their input to outline major concepts on the writing surface. An activity could have students reviewing products in a supermarket to determine which are imported and the country of origin.

Activities in the Activity Manual will be helpful to the students in achieving the objectives.

Individual students may wish to prepare a marketing plan for the National FFA Marketing Plan Project Competition.

REVIEW AND EVALUATION

Review and evaluation can involve several of the same activities. Review can encompass terms at the beginning of the chapter, questions at the end of the chapter, and activities in the Activity Manual. Students can also be asked to explain each of the objectives.

Evaluation can consist of the review activities as well as a written or oral test. The performance of students in marketing activities related to their supervised experience programs can be observed. In addition, evaluation can involve how students plan and develop their individual marketing plans for the National FFA Marketing Plan Project Competition.

SAFETY

The objectives of the chapter can be achieved without safety hazards in the learning environment. However, safety hazards may be present on field trips or in other places where students are given the opportunity to observe marketing on a firsthand basis.

ADDITIONAL RESOURCES

Additional resources can be used to enrich the instruction and to provide real-world experiences in agricultural marketing technology. Local newspapers and radio and television stations regularly give market reports of the major crops and livestock products. Bulletins obtained from an agricultural college or university may help localize the instruction in agricultural marketing.

Information on the Marketing Plan Project Competition is available from the National FFA Organization in Indianapolis, Indiana (**www.ffa.org**).

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What are marketing and agricultural marketing technology?**

   Marketing is providing the goods and services that people want. Agricultural marketing technology encompasses all of the processes involved in providing people with what they want, in the form in which they want it, and when they want it.

2. **Why are consumers important?**

   Consumers are important because they buy and use what has been produced. They demand certain products.

3. **What methods are used in agricultural marketing? Briefly describe each method. Give an example of a plant or animal product that could be marketed using each method.**

   The methods used in agricultural marketing are known as channels or links to the consumer. The methods are roadside and retail markets—producers sell directly to producers from small stores on farms or in nearby towns (fresh vegetables); central locations—places where products are delivered for grading and shipping to processors (livestock); processing plants—facilities that

convert raw products into forms wanted by consumers (beef); custom orders and vertical integration—with custom orders, buyers contract with producers to grow a certain plant or animal for them, while in vertical integration, nonfarm processing plants provide all of the supplies to growers who are under contract and paid by the processing plants (chickens); and niche marketing—special markets that use small quantities of valued products (goats). (Note: Students can name many different products for each of the methods of marketing.)

4. What functions are involved in marketing? Briefly describe each function. Give examples of what may be done to different products during the functions.

The functions in marketing are:

a. *Harvesting and assembling—Harvesting and assembling vary considerably but involve gathering crops and animals from the fields and pastures and then collecting them into batches for the next function in marketing (cattle may be rounded up and transported to an auction sale).*
b. *Grading—Sorting products for uniformity (eggs are graded on the basis of shell shape, size and presence of dirt).*
c. *Transporting—Moving the produce from one place to another (poles are hauled on trucks to a mill).*
d. *Processing—Making changes in a product that prepares it for consumption (tomatoes may be peeled, cooked and canned).*
e. *Packaging—Placing products in containers (eggs may be placed in cartons).*
f. *Storing—Keeping products until they are needed (fresh vegetables need refrigeration).*
g. *Advertising and promoting products—Using forms of communication media to encourage people to buy a product (newspaper ads may be used to tell people about a product).*
h. *Selling—Changing the ownership of a product, which may occur several times between the producer and the consumer (all products).*
i. *Distributing—Getting what is needed to the right place at the right time (trucks may be used to make deliveries).*

5. What is marketing infrastructure? What are the major areas of agricultural marketing infrastructure?

Marketing infrastructure encompasses all of the things that support and make marketing possible. The major areas are harvesting infrastructure, transportation infrastructure, assembling and processing facilities, finances, and people with the required skills.

6. What is free enterprise? List major characteristics.

Free enterprise (capitalism) is an economic system that allows an individual to organize and go about business activity with a minimum of government regulations. Individuals own the property used in production as well as what is produced.

7. What are the ways of doing business in the United States? Briefly explain each.

The ways of doing business are sole proprietorship—business owned by one person; partnership—business owned by two or more individuals; and corporation—an artificial entity in which individuals own shares. In addition, cooperatives are associations that serve the needs of members.

8. What is the supply and demand curve? How does the curve relate to price?

The supply and demand curve is a graphical approach to illustrating the interaction of supply and demand in establishing price. The quantity of a product bought at a given price occurs where the two curves cross.

9. What is management?

Management is the use of resources to achieve the objectives of a business or an enterprise.

10. What is an economic system?

An economic system is the way in which goods are created, owned, and exchanged.

EVALUATING

1=i, 2=h, 3=a, 4=b, 5=c, 6=d, 7=j, 8=f, 9=e, and 10=g.

27

PROCESSING AGRICULTURAL PRODUCTS

CHAPTER SUMMARY

Most all products undergo some processing before reaching the consumer. More and more consumers expect to be able to obtain appropriately processed products. Processing is preparing food, fiber, and wood for people to use. Meeting the needs of people requires considerable preparation of many plant and animal products.

Food processing includes all of the procedures involved in preparing food for people. The procedures used vary with the product and the desired form. The procedures overlap the functions in marketing. The major procedures in preparing food are grading, fabricating, preserving, portioning, preparing in convenient forms, and packaging. Some foods undergo much more processing than others. Fresh, slicer tomatoes have had little processing done to them. In contrast, wieners have had considerable processing in their manufacture.

Fiber processing involves turning raw fiber into cloth and other fabrics. The method used depends on the nature of the fiber.

Wood processing is used to make many different kinds of products, such as paper, lumber, and plywood. Specialty products may be made from very valuable timber. For example, fine furniture is made from walnut or cherry wood.

Food preservation is used to keep food from spoiling. Spoilage occurs when food becomes unsafe to eat and the flavor changes. Most spoilage is due to the growth of microorganisms in the food. Rodents, insects, undesired growth, chemical contamination, foreign objects, impurity, and improper preservation also spoil food.

Common methods of food preservation are canning, freezing, fermenting, drying, curing, refrigerating, irradiating, aseptic packaging, and pickling. Other methods used to preserve food include fumigants, chemical additives, pasteurization, jelly and jam, and cooking. Some foods are better suited to certain methods. For example, tomatoes are more often canned than frozen.

Cotton and wool are the major natural fibers that are processed. With cotton, processing begins with ginning, which separates the lint and seed. After ginning, the lint is classed, woven, dyed, and manufactured into various products. The processing of wool involves similar steps, beginning with shearing, continuing with grading and weaving, and ending with manufacturing.

Timber is made into many wood products. Lumber is a commonly used product made from logs that are fabricated into boards of various dimensions. Logs are sawed into boards, which are seasoned, planed, and treated to prevent decay and attack by pests. Different steps must be taken to convert raw wood into pulp and then into paper. Other wood products are made with different manufacturing procedures.

Safety and product regulations are important in all processing. Sanitation is particularly important with food products. Processing often creates a large amount of waste, which requires proper disposal. Food processing facilities are inspected by government agency and industry officials to ensure a wholesome product.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help students develop a fundamental knowledge and understanding of the processing technology used with food, fiber, and wood. The emphasis is on food processing and preservation.

Upon completion of Chapter 27, the student will be able to:

1. Explain the meaning and importance of processing.
2. Explain the meaning and prevention of spoilage in food.
3. List and describe methods of food preservation.
4. Describe methods in processing fiber products.
5. Describe methods in processing wood products.
6. Identify safety regulations in food processing.

INTEREST APPROACH

The curiosity of young people about the foods they eat allows for use of a variety of strategies in the interest approach.

One strategy is to have the students read the introductory part of the chapter. Afterward, ask various individuals to explain why people want food, fiber, and wood products that have been processed. Ask them if they know of places in the local community where food, fiber, or wood is processed. Student discussion of food products and forms can be used as the basis of later instruction.

Use the chapter introduction and include discussion of Figure 27–2. Ask students to carefully study the image. Ask what is being processed and what the person is looking at in the photo. It is a milk processing facility, and the person is looking at a device that keeps a continuous recording of the adjustment of the machine to perform its particular function. (Teachers may wish to review the objectives at this time.)

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

To master the objectives, the students should read the chapter in the textbook, complete the activities in the Activity Manual, and participate in class presentation and discussion.

Have students read the section "Processing." List the key terms on the writing surface, and then have the students explain the terms. Distinguish between the processing of food, fiber, and wood products. On the writing surface, list the procedures used in food processing. Then have students explain the meaning of each.

After students have read "Food Preservation," list key terms on the writing surface. Then have students explain the terms. Describe spoilage and the sources of food spoilage. Review the methods used to preserve food. List the methods on the writing surface, and have students explain the general meaning of each. List examples of foods preserved by each of the methods. Enrichment activities could include a field trip to a processing plant, the processing of food in the laboratory, and a survey of the ways in which foods are preserved in the local supermarket.

Have students read the section "Processing Fiber Products." List the key terms on the writing surface, and then have students describe what is involved. Distinguish between cotton and wool processing. Have students give examples of articles of clothing they own that are made of these products, and have them describe the qualities of each.

After students have read the section "Processing Wood and Timber Products," ask them to name different wood products found in the classroom. Discuss the general procedures used in their production. Take a field trip to a sawmill to observe the fabrication of logs into lumber or to a lumberyard to observe the manufactured products.

A simple hands-on activity with lumber will help students develop construction skills. This will include computing a bill of materials, using wood, and identifying and using fasteners. This will involve:

- Identifying or preparing a simple plan or sketch of a project made of wood
- Preparing a bill of material—a listing and description of materials needed to construct a project
- Demonstrating the proper and safe use of hand tools and fasteners with the project

After students have read the section "Safety and Regulations in Processing," ask them to explain the meaning of safety and then to give examples of safety hazards that could exist in a processing plant. List the key terms on the writing surface, and then have the students explain them. Ask the students to explain why sanitation is important.

REVIEW AND EVALUATION

Review and evaluation should focus on the achievement of the chapter objectives.

Review can consist of having the students explain each of the objectives, define the terms at the beginning of the chapter, and answer the end-of-chapter questions. Activities in the Activity Manual can also be included.

Evaluation can involve the review activities as well as the "Evaluating" section or an oral or written test. The results of the evaluation can be used for re-teaching, as appropriate.

SAFETY

The objectives of the chapter can be achieved with few safety hazards. However, the activities beyond the classroom may pose numerous safety hazards. Before students participate in these activities, the importance of safety should be stressed.

In some cases, regulations may prohibit students under a certain age from visiting various processing sites. For

example, students under age 18 may be prohibited from entering the grounds of a lumberyard or a sawmill area.

Safety precautions are included in the Activity Manual.

ADDITIONAL RESOURCES

The objectives of the chapter can be achieved with few additional resources. In some cases, bulletins and pamphlets on food preservation may be helpful. The book *The Meat We Eat* is a great resource on meat processing (available from Pearson Higher Education). Two Web sites for HACCP information are Food Safety and Inspection Service—**www.fsis.usda.gov** and Center for Food Safety and Applied Nutrition—**http://vm.cfsan.fda.gov**.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in their answers.

1. **What is processing? Why is it important?**

   Processing is preparing food, fiber, and wood for people to use. People want things that are ready to use. They do not want to spend a lot of time preparing what they use.

2. **What are the five major steps in processing food?**

   The major steps in processing food are grading, fabricating, preserving, portioning, and preparing in convenient forms and packaging.

3. **What is food preservation? Why is it important?**

   Food preservation is the treating of food to keep it from spoiling. Many foods will spoil if they are not properly prepared. People cannot eat spoiled food because it can make them sick. In severe cases, consumption of spoiled food can result in death.

4. **What is spoilage? What causes food to spoil?**

   Spoilage occurs when food becomes unsafe to eat and the flavor changes. Food is spoiled by microorganisms, rodents, insects, undesired growth, chemical contamination, foreign objects, impurity, and improper preservation.

5. **What major methods of food preservation are used? List and briefly describe each.**

   The major methods of food preservation are:

   a. *Canning—placing food in a container with an airtight seal and then heating the container to kill all microorganisms*
   b. *Freezing—using low temperatures that freeze the water in food products, which slows and prevents the growth of microorganisms*
   c. *Fermenting—using the action of certain microorganisms to preserve food*
   d. *Drying—removing the moisture from food products*
   e. *Curing—adding substances (e.g., salt and sugar) to foods to prevent spoilage*
   f. *Refrigeration—keeping food products at a temperature slightly above freezing to prevent the growth of spoilage organisms*
   g. *Irradiation—treating food with electrically charged particles that destroy spoilage organisms*
   h. *Aseptic packaging—sterilizing the food and its container*
   i. *Pickling—placing foods in salt solutions to prevent the growth of microorganisms*

6. **How are fibers processed? List and briefly describe the steps involved for cotton and wool.**

   Cotton processing consists of ginning (separating seed from lint); classing (grading lint); weaving (cleaning, spinning, and other finishing steps); and manufacturing (cutting and sewing into garments and other products). Wool processing entails shearing (cutting the wool from the sheep); grading (assessing the quality of the wool); weaving (cleaning, weaving, and dying); and manufacturing (cutting and sewing into products). In some cases, wool and cotton are made into knit products. In such cases, the fibers are woven into yarn that is knitted into the finished products.

7. **How is lumber processed? What steps are involved?**

   Lumber is processed by sawing logs into boards. The steps involve saw milling (cutting the logs into boards); seasoning (drying the moisture from boards); planing (smoothing the boards and then sizing to uniform dimensions); and treating (using preservatives to prevent decay; not all lumber is treated).

8. **How is paper made?**

Paper is made by breaking wood into pulp with chemical or grinding actions. The pulp is screened and then washed to remove impurities. Machines with rollers squeeze out the moisture and form the pulp into large sheets. The fibers bond together when the paper is dried.

9. **What wood products are made in addition to lumber and paper?**

The major wood products made in addition to lumber and paper are plywood, veneer, and furniture.

10. **What safety and sanitation procedures should be followed in processing?**

The safety and sanitation procedures to be followed depend on the kind of product being made. Processing often involves using machinery and equipment that could cause injury. Safety clothing, boots, and eye protection should often be worn. Sanitation involves keeping the place where food is processed clean.

EVALUATING

1=i 2=a, 3=j, 4=e, 5=h, 6=g, 7=f, 8=b, 9=d, and 10=c

PART EIGHT: AGRISCIENCE EDUCATION AND YOU

28

EDUCATION AND EXPERIENCE IN AGRICULTURE

CHAPTER SUMMARY

Today, more than one million students are enrolled in agriculture in the secondary schools of the United States. The classes have increased in popularity in recent years. Some of the increase can be attributed to changes in curriculum, an increased science emphasis, and more appealing activities. Agricultural education is instruction in agriculture and related subjects, such as horticulture, forestry, biotechnology, wildlife, veterinary science, and natural resources.

The three integral components of agricultural education classes are:

1. Classroom and lab instruction—This is the organized instruction by the teacher. Students often use textbooks as learning tools. Equipment and lab facilities are provided as needed for a particular area of instruction. For example, a class in small animal care would need a small animal lab with the equipment necessary to care for the animals.
2. Supervised experience—Supervised experience (SE) is the practical application of classroom and lab instruction. SE may occur during the school day, but it is usually after school hours. SE provides a good foundation for success in FFA. (In some schools, SE is known as SAE—supervised agricultural experience.)
3. FFA—This is the student organization portion of agricultural education. Time during a class period may be devoted to FFA. Most of the activities are outside regular class hours. Many FFA awards are built on success in supervised experience.

Supervised experience (SE), often called supervised agricultural experience (SAE) or supervised occupational experience (SOE), is the planned application of skills learned in classes. The goal is to make learning relevant. Each student's experience is based on his or her interests and needs. Records are kept to show the skills learned and, in some cases, the income gained. Several types are used: exploratory, research/experimentation, ownership, and placement.

Some students also participate in improvement projects and supplementary practices. Students, parents, and others need to be aware of the benefits and opportunities of supervised experience. Planning is a key to success, particularly as related to certain FFA awards and events. Students should maintain good records of their experiences. Performance records as well as financial records are needed. Some local schools and states have prescribed record systems that are used. These should have the capability to provide various financial statements, such as profit and loss statements and balance sheets.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the opportunities for entrepreneurship in agriscience. Information is provided to help in planning an education for a career in agriscience.

Upon completion of Chapter 28, the student will be able to:

1. Explain agricultural education and its three components.

2. Explain the purpose, benefits, and types of supervised experience.
3. Describe how to plan, manage, and advance in supervised experience.
4. Discuss the records needed with supervised experience.

INTEREST APPROACH

The interest approach should focus on getting the students involved with chapter content. Begin with the introductory paragraphs on the first page of the chapter. Have students read the information silently, and then discuss it in class. Call on students to explain the meaning of the various paragraphs. Ask students to relate examples of bad information, such as a road sign that is incorrect with directions or kit instructions that contain an error.

Some students may be aware of supervised experience and the nature of agricultural education. These may serve to gain their interest. You may also inquire as to why students think so many students are enrolled in agricultural education classes in the United States.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

The instructional strategies should focus around student involvement and mastery of the content associated with the objectives. Following the interest approach and review of the objectives, have students read the first section, "Education in Agriculture," as homework, in supervised study, or aloud in class. Afterward, have students provide information that summarizes the main content. List the salient information on the writing surface. Relate the information to local opportunities for agricultural education. In some cases, a field trip to a local postsecondary school or a visit from a teacher or admissions counselor would be effective in achieving the objectives.

Continue using a sequential procedure to cover succeeding sections in the chapter. Note that the major headings are parallel with the chapter objectives.

Use a local employer as a resource person to discuss the expectations employers hold for employees. This can relate to placement supervised experience. Students can offer examples of good and poor situations in class as related to job performance. The same procedures may be workable with citizenship except to use a government official or civic leader to discuss citizenship.

With the focus of this chapter on supervised experience, use this opportunity to engage each student in planning supervised experiences for themselves.

REVIEW AND EVALUATION

Use the appropriate sections at the end of the chapter for review and evaluation. Actively involve students in all cases. Have students read and explain or discuss the "Main Ideas." Have students answer (orally or in writing) the questions at the end of the chapter. Use classroom observation or the reading of written answers to assess student mastery and the need for re-teaching.

Use the "Evaluating" section to assess student performance. Students can prepare answers as homework, during supervised study, or aloud as a group in class.

SAFETY

Always know applicable safety standards and help students internalize the appropriate safety practices. Overall, the content of this lesson would pose few safety hazards, though fundamentals of safety are introduced.

ADDITIONAL RESOURCES

Additional resources include the Activity Manual that accompanies the textbook as well as brochures, pamphlets, video tapes, and related materials, including electronic forms available for use with a computer. A resource person may be found in the local community to help in achieving chapter objectives.

Web resources may be useful. Students may explore the Web site of the National FFA Organization: www.ffa.org/.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more detailed information, the use of complete sentences, and other details in the answers.

1. What is agricultural education?

Agricultural education is instruction in agriculture and related subjects.

2. **What are the three components of agricultural education classes?**

   The three components of agricultural education classes are classroom and lab instruction, supervised experience, and FFA.

3. **What is supervised experience? What are the four main types?**

   Supervised experience or SAE is the planned application of skills learned in classes. The four main types are exploratory, research/experimentation, ownership, and placement.

4. **What is a training agreement?**

   A training agreement is a written statement that lists the terms under which the supervised experience is to be carried out.

5. **What is a training plan?**

   A training plan is a list of the activities included in a supervised experience.

6. **What are three areas of management in supervised experience programs? Briefly explain each.**

   Three areas of management in supervised experience are assuming responsibility—being a responsible person; expanding the program—developing a bigger and better program; and keeping records—written document of supervised experience.

7. **What is recordkeeping?**

   Recordkeeping is the act of recording supervised experience and other activities. Record books or computer programs may be used.

8. **What two main types of records are kept of supervised experience?**

   The two main types of records kept of supervised experience are performance and financial.

9. **What is owner equity? Why is it important with ownership supervised experience?**

   Owner equity is the sum remaining after liabilities have been subtracted from assets. Ownership supervised experience involves inventory.

10. **What kinds of business financial statements may be used?**

    Three kinds of business financial statements are profit and loss statement, balance sheet, and cash flow statement.

11. **What is inventory? What two major ways are used in keeping inventory?**

    Inventory is an itemized list of current assets. Two ways of keeping inventory are physical and perpetual.

12. **What is depreciation?**

    Depreciation is an accounting process that spreads the cost of assets over the useful life of the asset.

EVALUATING

1=i, 2=j, 3=d, 4=h, 5=a, 6=b, 7=c, 8=e, 9=g, and 10=f

29

STUDENT ORGANIZATIONS

CHAPTER SUMMARY

One of the special features of agricultural education is that it is more than regular classroom learning and teaching. It involves activities that extend beyond the classroom and into many areas of life. FFA is the organization for students enrolled in agriculture classes. There are many activities worthy of student participation. Career development events (CDEs) are often closely

tied to classroom studies. Achieving FFA degrees of membership requires commitment and dedication to work. Details on these are spelled out in the *Official FFA Manual*, which is published each year and is available online through the Web site of the National FFA Organization or at http://issuu.com/nationalffaorganization/docs/2013omfinal_for_ffa.org. FFA is organized from the local or chapter level through the state level to the national level. Student learning begins in local chapters. Quality programs of activities are needed. Members should be actively involved in carrying out the activities.

FFA is known for its important roles in the lives of young people. It helps them develop self confidence, set goals, and aspire to achieve. FFA recognizes young people for excellence while they are still in high school and as they enter life beyond high school. Involvement makes FFA a valuable student organization.

FFA develops leadership and personal skills and promotes career success. Its purposes and how it functions have emerged throughout its existence. FFA promotes learning and achievement. The emphasis is on skills for career success and personal development. These skills help build self confidence, character, citizenship, and healthy lifestyles. As previously mentioned, each year the National FFA Organization produces the *Official FFA Manual*. This publication provides information about FFA. Every FFA member and advisor should have access to a current edition of the manual because its contents do change from time to time.

The latest information on FFA and its programs is available through the state FFA advisor's office or through the National FFA Organization (www.ffa.org). It is important to refer to the National FFA Career Development Events page of the National FFA Organization. This provides details about each career development event for a period of several years.

INSTRUCTIONAL OBJECTIVES

The objectives in this chapter focus on providing information on student organizations, particularly the National FFA Organization.

Upon completion of Chapter 29, the student will be able to:

1. Identify organizations for students enrolled in agricultural education.
2. Describe the purpose, objectives, and nature of FFA.
3. Trace the history of FFA.
4. Explain how FFA is organized.
5. Identify important factors in a successful FFA chapter.
6. Name and explain awards and events in FFA.
7. Identify membership degrees and requirements for advancing.

INTEREST APPROACH

The interest approach can use the first page of the chapter in the textbook or another approach developed by the teacher. Have students read the paragraphs on the first page as homework or during supervised study. Next, call on students to explain the information in class. Present the objectives for the chapter and begin covering chapter content sequentially beginning with the first major heading.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Select instructional strategies that involve students using the textbook and internalizing the covered concepts. The major strategy will be to have students read, listen, respond, write, and practice chapter content in some way. Evaluation is ongoing and must occur to maximize student achievement. The content of this chapter serves as the foundation for supervised experience and FFA involvement.

Have students read each section of the chapter. Discuss the content, and ask students to provide information. Students should take notes and should be able to apply the information in some manner. Regulations followed in the local school should be presented, discussed, and interpreted for students.

An FFA alumni member or current FFA chapter officer can be used to provide information supportive of supervised experience and FFA. Proper FFA dress, how to set up a meeting room, and how to hold a chapter meeting may be included. Be sure all students have online access to the *Official FFA Manual*.

REVIEW AND EVALUATION

Review and evaluate student progress throughout the lesson. Have students discuss, respond, and be involved in other ways to ensure mastery. The "Reviewing" section at the end of the chapter will be useful. The "Evaluating" section will help assess student mastery of terms covered in the chapter.

Use personal observation of student progress throughout the instruction to re-teach and otherwise take steps to assure student mastery.

Assessing supervised experience will require on-site observation and can be done as part of the routine supervision that is provided.

SAFETY

Few safety hazards exist as part of this lesson. Of course, safety areas arise in SE and FFA. Safety should always be stressed as students carry out supervised experience. Many supervised experiences have potential safety hazards. These should be identified prior to the student beginning the experience and with the necessary steps to make sure the students practice safety.

ADDITIONAL RESOURCES

A number of resources from the National FFA Organization or the state FFA executive secretary will be useful. All students should have access to an *Official FFA Manual*.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, and other details in the answers.

1. **What is the purpose of FFA?**

   FFA promotes learning and achievement with emphasis on skills for career success and personal development.

2. **Who can be a member of FFA?**

   Active membership can be held by students 12 to 21 years of age. The student must be enrolled in an agricultural education program, attend meetings, work toward degree advancement, and pay dues.

3. **What are the degrees of active FFA membership? Explain each.**

   The degrees of active FFA membership are:

   - *Discovery FFA Degree—Grades 7-8 enrolled in an agriculture class*
   - *Greenhand FFA Degree—High school students enrolled in agriculture classes*
   - *Chapter FFA Degree—Students who have completed 180 hours of agriculture instruction, and supervised experience must have earned $150 or worked 45 hours after class time*
   - *State FFA Degree—Students who have completed two years of FFA membership and agriculture instruction; a minimum of $1000 earned or 300 hours worked for SE*
   - *American FFA Degree—For students who have been out of high school for a year, been an FFA member for 36 months, completed three years of agriculture instruction, earned at least $7500, or a combination of hours worked and money*

4. **Why is the *Official FFA Manual* important to members?**

   This publication provides information about FFA. It is updated each year with the latest information about events and activities.

5. **Briefly trace the history of FFA in a few paragraphs.**

   In 1917, the U.S. Congress passed the Smith-Hughes Act, which provided funds for agricultural education. The first Future Farmers of Virginia club was started in 1926, and it grew in other states. In 1928, students from 18 states gathered in Kansas City, Missouri, to form the new FFA. Within a few years, FFA had expanded to all states. The first FFA office was in the U.S. Office of Education in Washington, D.C. In 1959, a new building became the headquarters in Alexandria, Virginia. In 1969, delegates at the National Convention voted to admit girls. In 1988, delegates voted to change the name from Future Farmers of America to National FFA Organization because FFA was more than just farming. No doubt, the admission of girls has been the greatest FFA advance in its history. In 1998, the FFA headquarters was moved to Indianapolis, Indiana.

6. **What makes a strong FFA chapter? List any three basic features, and explain why they are important.**

   A few basics in a strong chapter are knowing about FFA, involving all members, preparing a program of activities, securing and managing finances, electing good officers, having the

needed equipment, keeping records, meeting regularly, and gaining support. These features enable a chapter to remain organized, to expand membership, and to increase support.

7. **What officers are typically elected by a local chapter?**

   The officers include president, vice-president, secretary, treasurer, reporter, sentinel, and advisor. Some chapters may have a historian, parliamentarian, and chaplain.

8. **What is a program of activities? Why is a good program of activities important to a local chapter?**

   A program of activities (POA) is an annual plan of the goals and procedures for an FFA chapter. All members should have a role in preparing a POA because all are involved in carrying it out. A good POA can increase interest, membership, and support.

9. **What are career development events?**

   Career development events (CDEs) are competitive activities that measure individuals and teams in the application of classroom-acquired knowledge. They should be based on the agriculture curriculum.

10. **What are the general requirements for the State FFA Degree?**

    The general requirements for the State FFA Degree are two years of FFA membership and completion of at least two years of agriculture instruction. A minimum of $1,000 must have been earned in SE or 300 hours should have been worked. Good records are needed. Only a small number of FFA members receive this degree. (Be sure to refer to the latest edition of the Official FFA Manual in case requirements have changed.)

EVALUATING

1=i, 2=a, 3=d, 4=g, 5=f, 6=e, 7=b, 8=c, 9=j, and 10=h

30

LEADERSHIP DEVELOPMENT

CHAPTER SUMMARY

Leadership is a relationship among people in which influence is used to meet individual or group goals. It is the ability to guide other people to achieve a desired outcome. This often involves organizing people, materials, and activities to accomplish goals.

Personal growth is usually a major part of leadership development. Leadership is far more than the act of "taking charge." It involves important ideas and values. Through studies in agricultural education and FFA, students have the opportunity to develop leadership qualities.

Leaders and followers are needed for leadership to occur. A leader is a person who helps other individuals or groups achieve goals. The leader of a group is not always in an elected position, and students should recognize this. The leader role emerges by virtue of an individual's personal qualities. A follower is an individual who conforms to or accepts the ideas of leaders. Followers strive to assure that the goals of the leader are achieved. No one can be a leader without followers. Leaders must have certain traits if they are to fulfill the leadership role. Leadership traits can be taught and learned. They are useful in many different situations.

Leaders need good communication skills. Communication is the process of exchanging information. If information is not accurately exchanged, the process is not working properly. Fortunately, people can take steps toward improved communication. Teachers can help students develop communication skills. Communication is a process involving a sender and a receiver joined by a message and a medium. Feedback allows the sender to assess the effectiveness of the communication effort.

Public speaking is a type of communication that uses oral methods of conveying information. Spoken

words are enhanced with nonverbal symbols, such as gestures and visuals. Good preparation is needed to be an effective public speaker. People who give speeches need to understand the communication process. They need to use the process in preparing and in making their speeches. FFA has several avenues for students and members to participate in developing public speaking abilities. These can begin in the class and in chapter levels.

Meetings are often used in FFA and other areas of agriculture. A meeting is the assembly of a group of people for a particular purpose. It is usually to conduct business or to learn about some particular topic. A good meeting is held to cover matters in an efficient and effective manner. Some individuals develop skills in being good presiders. This includes the ability to use parliamentary procedure.

INSTRUCTIONAL OBJECTIVES

The objectives of this chapter are intended to help learners understand the meaning and importance of leadership and to begin the process of developing important leadership skills.

Upon completion of Chapter 30, the student will be able to:

1. Identify important leadership qualities.
2. Discuss the role of communication in leadership.
3. Demonstrate speaking skills.
4. Demonstrate parliamentary procedure skills.
5. Demonstrate meeting organization and management skills.

INTEREST APPROACH

Since this chapter focuses on areas that are widely discussed in the media, student interest should already exist, at least to some degree. The interest approach could be localized to particular natural resource problems in the community, or it could address a worldwide situation.

One approach is to use the introductory section of the chapter. After students have read it, have them offer thoughts about the meaning and nature of leadership. This can be associated with the personal growth of individuals as they mature into adulthood. Another approach involves using a resource person who is qualified to discuss the meaning and development of leadership abilities.

Move from the interest approach into the chapter. Go over the chapter objectives. Have students read sections of the chapter to begin developing insight into the nature of leadership and leadership skills.

INSTRUCTIONAL STRATEGIES AND TEACHING PLANS

Follow the interest approach with a presentation and discussion of the chapter content. Students could also read sections of the chapter and participate in discussion. In addition, the Activity Manual has useful hands-on learning activities.

Begin by helping students learn and understand the "Leadership Qualities," as covered in four areas in the textbook: Internal Traits, Technical Traits, Conceptual Traits, and Interpersonal Traits. Review internal, technical, conceptual, and interpersonal traits of leadership. List these on the writing surface. Discuss each, using student input to clarify information and to build understanding. Place the definitions on the writing surface, and then ask students to explain them.

Move into the section "Communications." Have students read this section. Outline major concepts on the writing surface, using student input. Spend some time comparing and contrasting verbal and nonverbal communication. Ask students to offer examples they have observed of good and poor communication. Have them indicate why there was a difference and what could have been done to improve communication. Ask them if blockages existed.

Move into the section "Public Speaking Skills." Go over the local FFA public speaking events and expectations. Cover the chapter content on kinds of speeches, how to be a good speaker, and how to prepare and deliver a speech. Students may be assigned to prepare a short speech and to deliver it in front of the class.

Move into the section "Parliamentary Procedure Skills." Ask students if they know what it is and why it is used. Students should read the section. Outline major concepts on the writing surface. Use student input to develop the outline. Students should take notes. Review the FFA parliamentary procedure activities of the local chapter. Have students practice using parliamentary procedure abilities.

Move into the section "Meetings." Have students read the information. Then go over the content in class. Place key points on the writing surface. Use student input in summarizing the key points. Have students prepare an order of business for a fictional meeting. Assign individuals to take minutes in an FFA meeting.

REVIEW AND EVALUATION

The chapter summary and the end-of-chapter review questions can be used in reviewing and evaluating student learning. The end-of-chapter questions can also be used in re-teaching important concepts, as needed. Laboratory activities in the Activity Manual provide excellent hands-on review of the chapter.

Achievement can also be evaluated by using written or oral tests and supervised experience programs. Forming the students into action groups to help solve problems in the local community would help reinforce learning. Using the "Exploring" activities in the text would be beneficial.

SAFETY

The objectives of the chapter do not include learning outcomes that pose specific safety problems. The conduct of some of the learning activities could present hazardous situations to students. Activities in the Activity Manual are coded to alert students to possible areas of danger. Students should be aware of the safety practices around water, in dealing with wastes, and on field trips to collect information.

ADDITIONAL RESOURCES

Additional resources could be used to enrich the content from the perspective of the local community. The latest materials on FFA speaking and parliamentary procedure activities may be useful.

ANSWERS

END-OF-CHAPTER QUESTIONS

Brief answers to the end-of-chapter review questions are presented here. The answers are intended to be only guidelines for the teacher. Teachers may require more complete information, the use of complete sentences, or other details in the answers.

1. **What is leadership?**

   Leadership is a relationship among people in which influence is used to meet individual or group goals.

2. **What are four general qualities or traits of leaders? Briefly explain each.**

   Four general qualities or traits of leaders are internal traits—personal characteristics such as work ethic and high moral values; technical traits—leadership qualities that are more readily developed (e.g., lead discussions and organize events); conceptual traits—thinking skills (e.g., the ability to analyze or recognize opportunities); and interpersonal traits—skills in getting along with other people.

3. **What is communication?**

   Communication is the process of exchanging information.

4. **What are the components of the communication process? Briefly explain each.**

   The four components of the communication process are source, message, channel, and receiver. The source is the initiator of the message. The message is an ordered set of symbols that make an idea. The channel is the linkage between the sender and the receiver, and the receiver is the interpreter or recipient of a message.

5. **What is nonverbal communication?**

   Nonverbal communication is the exchange of information without words.

6. **What is public speaking?**

   Public speaking is a type of communication that uses oral methods of conveying information. The spoken words are sometimes enhanced with visuals.

7. **What kinds of speeches may be used? Distinguish among each.**

   The common kinds of speeches are prepared, which are developed well ahead of time and with delivery practiced; extemporaneous, which are somewhat prepared ahead of time but not in detail and notes may be used; impromptu, which involve no preparation; and recitation, which are prepared and fully memorized.

8. **What are the important guidelines to help a person become a good public speaker? List and briefly explain any two.**

   The important guidelines to help someone become a good public speaker are be prepared, be organized, use a good voice, stay within the

time limit, use a good introduction, be enthusiastic, use proper facial expressions, use notes, maintain eye contact, observe other speakers, and be knowledgeable. Note: Students may select and discuss any two of these following information presented in the textbook.

9. What should be considered in delivering a public speech? Name and explain any two pointers on delivery.

Consider the following in delivering a prepared speech: practice ahead of time, be sincere, have a good voice, use good posture, maintain eye contact, and follow time guidelines. Note: Students may select and explain any two using information presented in the textbook.

10. What is parliamentary procedure? Why is it important?

Parliamentary procedure is a method of conducting meetings in an orderly manner. It is important because it allows everyone an opportunity to participate in debating issues and in making decisions.

11. What is a main motion?

A main motion is a motion that brings business before an assembly.

12. What is voting? How are votes taken?

Voting is a procedure that allows people to make their choices known about issues or matters. Votes are taken in several ways. Voice, rising, secret ballot, and roll call are the most widely used voting methods.

13. What is an order of business?

An order of business is a step-by-step plan for conducting a meeting. It is a list of all known items to be considered in a meeting.

14. What are meeting minutes?

Minutes are the official written record of the business of a meeting.

EVALUATING

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