Preface

Principles of Agriculture, Food, and Natural Resources is a modern, user-friendly, highly visual introductory text for next-generation agriculture students. Today's students must understand fundamental information about producing food and fiber, while stewarding our natural resources, and applying that agricultural knowledge to real-world situations. Written for current agriculture students, this textbook features hundreds of high-quality images, pedagogical tools, and extensive online and print supplements for students and instructors.

The world of agriculture continues to change, and a fresh approach to organizing and presenting information is warranted. Today, fewer of our students live on farms. Consequently, these students have fewer direct experiences with agriculture, and the agriculture they do know often begins with food rather than the land.

Our presentation covers the most relevant topics with sufficient detail for beginner agricultural education students. Our goals are to provide a foundational understanding of agriculture and to motivate students to study agricultural topics more deeply through future courses.

We have drawn on current research in creating a learning design that helps students process and retain information. We understand that a logical progression of information is essential for learning. Educators, educational researchers, and instructional designers also tell us that presenting information in small chunks supports our working memory when processing it. In addition, giving students opportunities to process small pieces of information and interact with them—in reviews and assessments that foster comprehension, application, analysis, synthesis, evaluation, and creation—is critical for learning success*. These learning principles guided the development of *Principles of Agriculture, Food, and Natural Resources*.

Our text is organized and written with the National Council's Agriculture, Food, and Natural Resources Content Standards at the forefront, ensuring all necessary content is covered. Our organization was carefully considered. A panel of expert reviewers in agricultural education provided insights, information, debate, and validation of our content, structure, and approach. Each chapter includes multiple, focused lessons supported by features designed to help students acquire knowledge and demonstrate mastery. Each lesson opens with an academic literacy integration activity designed to help students engage more deeply with the content. Novice teachers will find our content presentation easy to navigate and helpful for planning the academic year. Certainly, experienced teachers can add more content to expand or tailor lessons. Furthermore, each lesson offers many ideas for critical thinking, STEM engagement, career profiles, FFA activities, SAE for ALL involvement, and Communicating about Agriculture. These areas challenge students to engage with the content on a deeper level than most traditional agricultural texts.

With the incorporation of virtual learning and instruction, we provide the content needed in the formats you prefer. The student textbook and lab workbook are available in print or digital formats supported by professional, user-friendly online resources, including a student Digital Companion that features online vocabulary games, animations, and additional interactive activities. Teachers have a full-service resource at their disposal to engage students in their classroom and online. Instructor support includes teaching resources, visual presentations, and a digital assessment suite. A video library also enhances the text and numerous supplements by bringing concepts to life. We hope you enjoy our presentation of the most important aspects of agriculture and welcome you to join us on our journey of enlightening young minds to the opportunities and challenges of feeding a growing world population.

*North Carolina Association of Educators (NCAE) 2024

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About the Authors

Dr. John Rayfield is a professor and serves as the Program Coordinator for Agricultural Education in the Department of Agricultural Education and Communications at Texas Tech University. Dr. Rayfield earned his bachelor's degree in agricultural education from Auburn University, his master's degree in agricultural extension from the University of Georgia, and his doctorate in agricultural education from Texas Tech University. In 2001, his school's FFA chapter was recognized as the Outstanding Middle School Program in the nation by the National FFA. Dr. Rayfield has been recognized at many levels for his teaching, research, and service to agricultural education. He is a Texas Tech Integrated Scholar, an Auburn University College of Education Outstanding Alumnus, and the *Journal of Agricultural Education* Author of the Year. Dr. Rayfield is actively involved in livestock showing and judging. He serves as superintendent for the National 4-H Livestock Judging Contest and judges junior and open livestock shows across the United States.

Dr. Kasee Smith is an associate professor in the Department of Agricultural Education, Leadership, and Communications at the University of Idaho. She teaches undergraduate and graduate courses focused on preparing school-based agricultural educators and strengthening connections between people, food, and agricultural systems.

Dr. Smith earned her bachelor's degree in agricultural education from Utah State University and taught high school agricultural education for 11 years. Her program emphasized full integration of classroom and laboratory instruction, Supervised Agricultural Experiences, and FFA. Recognized as a National FFA Model of Innovation chapter, her program produced numerous national proficiency award recipients and Career and Leadership Development Event winners. During her secondary teaching career, Dr. Smith received the Region I Ideas Unlimited Award and a National Association of Agricultural Educators Teacher Turn the Key Award. She also served as an officer in the Utah Association of Agricultural Educators and on the Utah State Department of Education Instructional Materials Review Committee and led multiple curriculum development initiatives.

Dr. Smith earned her doctoral degree from Texas A&M University and joined the University of Idaho faculty in 2016. Her work centers on teacher preparation, experiential learning, work-ready skill development, and instructional communication in agricultural education. She continues preparing educators across the Pacific Northwest and lives on a working agricultural operation in northern Idaho, where her family manages cattle, sheep, and forage crop production alongside an equestrian facility.

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Dr. Travis Park is a professor of agricultural education at North Carolina State University, where he instructs the teaching methods course and coordinates student teaching. He assists with Developing Educational Leaders and Teachers of Agriculture (DELTA), an alternative licensure professional development program for agriculture teachers in North Carolina. Dr. Park earned his bachelor's and master's degrees from Purdue University in agricultural education. Upon graduation, he received the 1996 G. A. Ross Award, which recognizes the outstanding senior graduating class. After Purdue, Dr. Park taught agriculture at Tri-County High School in Wolcott, Indiana, for five years, during which his program was recognized as one of the top agriculture programs in the nation. The Tri-County FFA Chapter was a national three-star chapter for most of his tenure. Dr. Park earned his doctoral degree from the University of Florida in 2005. He is the Program Coordinator for Agricultural Education in the Department of Agricultural and Human Sciences, he is a Fellow of the American Association for Agricultural Education, and he has served as President of the National Council for Agricultural Education. Dr. Park is the National Director for Agricultural Education, National FFA Adviser, and Chair of the National FFA Board of Directors. His research focuses on agricultural literacy, teacher professional development, and engagement with agriculture. Dr. Park is an avid backpacker, gardener, and beekeeper.

Dr. Barry Croom has over 38 years of experience in agricultural and extension education. He is currently a professor in agricultural leadership, education, and communication at the University of Georgia and the undergraduate program coordinator for the University of Georgia Tifton campus. His interest in the field began as a high school junior when he coached his first dairy judging team for the local junior high school FFA program. Dr. Croom began his professional career as a high school agricultural education teacher. While teaching full-time, he earned his master's in agricultural education. While a high school teacher, Dr. Croom was chosen by the National FFA Organization to develop and present in-service workshops to teachers nationwide. His students received state and national recognition for academic achievement. He has earned both the American FFA Degree and the Honorary American FFA Degree from the National FFA Organization. In 1996, Dr. Croom became an extension associate responsible for the statewide FFA Program at North Carolina State University.

After earning his doctoral degree in 1999, Dr. Croom advanced through various roles to become an Alumni Distinguished Undergraduate Professor at North Carolina State University. He has served as an agriculture teacher, teacher educator, extension associate, state education staff member, professor, and university administrator. Dr. Croom has taught courses in leadership, communication, experiential learning, instructional methodology, educational program planning, and youth development. He maintains a research program that focuses on effective teaching, career and technical education policy, and historical studies in agricultural and extension education.

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Reviewers

The author and publisher would like to thank the following industry and teaching professionals for their valuable input in the development of *Principles of Agriculture, Food, and Natural Resources.*

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American Hereford Association
American Maine Anjou Association
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American Pet Products Association (APPA)
American Simmental Association, www.simmental.org
American Southdown Association
APHA/Paint Horse Journal
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New to This Edition

In addition to the exciting new design, the third edition of *Principles of Agriculture, Food, and Natural Resources* includes updated statistics and Career Connections with salaries and job outlooks for the next decade. The authors have also included new hands-on activities that promote teamwork and leadership skills.

The new edition of *Principles of Agriculture, Food, and Natural Resources* features new and revised end-of-chapter questions and activities, including Analyze and Apply, Critical Thinking, and STEM and academic activities. New SAE for ALL Opportunities provide creative ideas for all types of SAE projects and a quick check-in for SAE progress.

Credentialing Partners and Support

Goodheart-Willcox appreciates the value of industry credentials, certifications, and accreditation. We are pleased to partner with leading organizations to support students and programs in achieving credentials. Integrating industry-recognized credentialing into a career and technical education (CTE) program provides many benefits for students and the institution. By achieving third-party certificates, students gain confidence, have proof of a measurable level of knowledge and skills, and earn a valuable achievement to include in their résumés. For educators and administrators, industry-recognized credentials and accreditation validate learning, enhance the credibility of programs, and provide valuable data to measure student performance and help guide continuous program improvement.

Principles of Agriculture, Food, and Natural Resources is correlated to the Production Agriculture credential offered by NOCTI and to the Agricultural Science YouScience® Industry Certification.

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Goodheart-Willcox is pleased to partner with NOCTI and Nocti Business Solutions (NBS), a leading provider of industry certification solutions for skill verification nationwide. With over 55 years of experience, NOCTI/NBS is a valuable partner within both the CTE community and industry to improve America's workforce. Goodheart-Willcox has created correlations between select products and the standards and competencies that are the basis for NOCTI/NBS credentials, to the benefit of states, instructors, and students working toward NOCTI/NBS credentials.

NOCTI/NBS certifications (knowledge-based and skill-based) are developed by national teams of subject matter experts as part of the process that meets personnel accrediting standards and requirements under ISO 17024, resulting in credentials measuring skills and competencies critical for learner success outside the classroom. NOCTI/NBS offers test development, test delivery, and psychometric services to support skill verification, using the latest tools and methods to provide relevant and helpful solutions for workforce development. For more information about NOCTI, visit www.nocti.org.

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CASE 4 Learning

Goodheart-Willcox is pleased to partner with CASE 4 Learning (CASE), an initiative of the National Council for Agricultural Education (The Council). CASE 4 Learning is a leading provider of curriculum and professional development for career and technical education (CTE) programs nationwide. With over 15 years of experience, it is a valuable partner in the CTE community's efforts to improve America's workforce.

Goodheart-Willcox has created correlations between select curricular products and the concepts and performance objectives that make up the CASE curriculum, which benefit states and instructors preparing students for agricultural careers.

National subject matter committees develop the CASE curriculum and professional development programming. Teachers attending a CASE professional development event become certified to use the curriculum. Teacher certification is essential to ensuring the quality of a student's learning experience and the teacher's understanding of using CASE's activity, project, and problem-based model to teach content using inquiry-based instruction. In addition, the curriculum is aligned with the National AFNR Standards developed by the National Council for Agricultural Education. For more information about teacher certification, standard alignments, student assessment, and credentialing, visit www.case4learning.org.

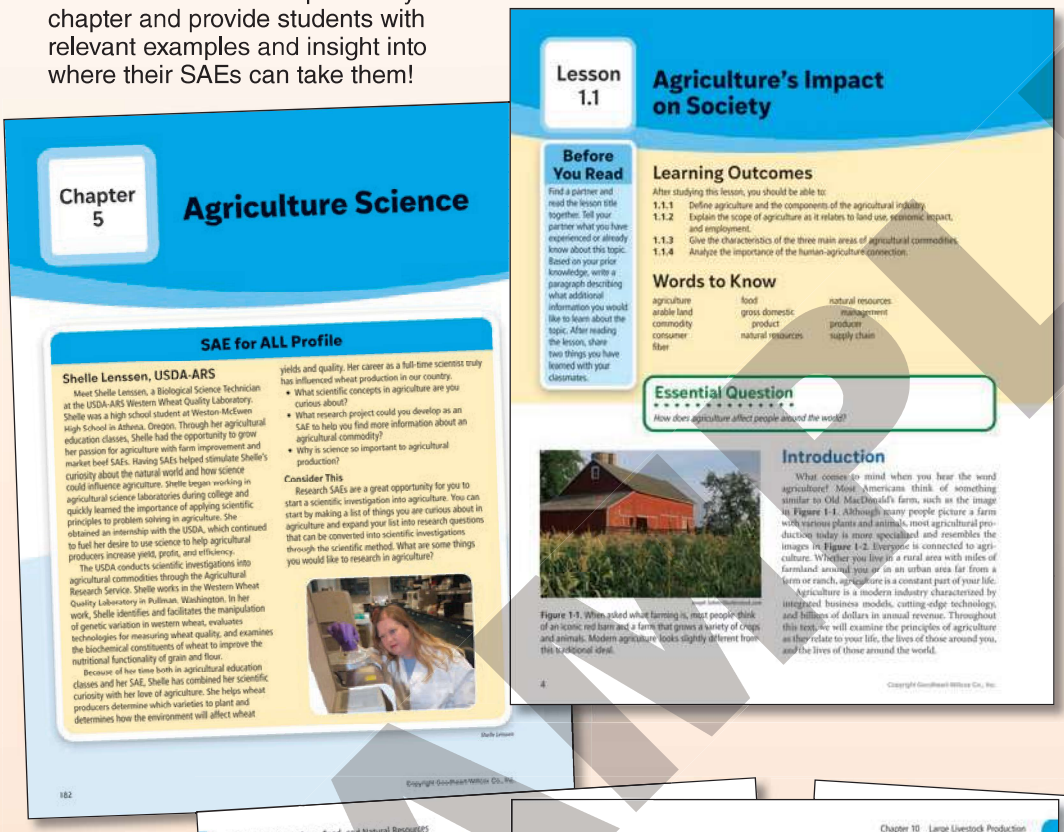
To see how *Principles of Agriculture, Food, and Natural Resources* correlates to credentialing and certification standards, visit the Correlations tab at https://www.g-w.com/principles-agriculture-food-natural-resources-2028.

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Guided Tour

The instructional design includes student-focused learning tools that promote student success. This visual guide highlights the features designed for the textbook.

SAE for ALL Profiles open every chapter and provide students with relevant examples and insight into where their SAEs can take them!


Chapter 5

Agriculture Science

SAE for ALL Profile

Shelle Lenssen, USDA-ARS

Meet Shelle Lenssen, a Biological Science Technician at the USDA-ARS Western Wheat Quality Laboratory. Shelle was a high school student at Weston-McEwen High School in Athena, Oregon. Through her agricultural education classes, Shelle had the opportunity to grow her passion for agriculture with farm improvement and market beef SAEs. Having SAEs helped stimulate Shelle's curiosity about the natural world and how science could influence agriculture. Shelle began working in agricultural science laboratories during college and quickly learned the importance of applying scientific principles to problem solving in agriculture. She obtained an internship with the USDA, which continued to fuel her desire to use science to help agricultural producers increase yield, profit, and efficiency.

The USDA conducts scientific investigations into agricultural commodities through the Agricultural Research Service. Shelle works in the Western Wheat Quality Laboratory in Pullman, Washington. In her work, Shelle identifies and facilitates the manipulation of genetic variation in western wheat, evaluates technologies for measuring wheat quality, and examines the biochemical constituents of wheat to improve the nutritional functionality of grain and flour.

Because of her time both in agricultural education classes and her SAE, Shelle has combined her scientific curiosity with her love of agriculture. She helps wheat producers determine which varieties to plant and determines how the environment will affect wheat yields and quality. Her career as a full-time scientist truly has influenced wheat production in our country.

- What scientific concepts in agriculture are you curious about?
- What research project could you develop as an SAE to help you find more information about an agricultural commodity?
- Why is science so important to agricultural production?

Consider This

Research SAEs are a great opportunity for you to start a scientific investigation into agriculture. You can start by making a list of things you are curious about in agriculture and expand your list into research questions that can be converted into scientific investigations through the scientific method. What are some things you would like to research in agriculture?

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Lesson 1.1

Agriculture's Impact on Society

Before You Read

Find a partner and read the lesson title together. Tell your partner what you have experienced or already know about this topic. Based on your prior knowledge, write a paragraph describing what additional information you would like to learn about the topic. After reading the lesson, share two things you have learned with your classmates.

Learning Outcomes

After studying this lesson, you should be able to:

1.1.1 Define agriculture and the components of the agricultural industry.
1.1.2 Explain the scope of agriculture as it relates to land use, economic impact, and employment.
1.1.3 Give the characteristics of the three main areas of agricultural commodities.
1.1.4 Analyze the importance of the human-agriculture connection.

Words to Know

agriculture, arable land, commodity, consumer, fiber, food, gross domestic product, natural resources, natural resources management, producer, supply chain

Essential Question

How does agriculture affect people around the world?

Figure 1-1. When asked what farming is, most people think of an iconic red barn and a farm that grows a variety of crops and animals. Modern agriculture looks slightly different from this traditional ideal.

Introduction

What comes to mind when you hear the word agriculture? Most Americans think of something similar to Old MacDonald's farm, such as the image in Figure 1-1. Although many people picture a farm with various plants and animals, most agricultural production today is more specialized and resembles the images in Figure 1-2. Everyone is connected to agriculture. Whether you live in a rural area with miles of farmland around you or in an urban area far from a farm or ranch, agriculture is a constant part of your life.

Agriculture is a modern industry characterized by integrated business models, cutting-edge technology, and billions of dollars in annual revenue. Throughout this text, we will examine the principles of agriculture as they relate to your life, the lives of those around you, and the lives of those around the world.

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Before You Read literacy integration activities at the beginning of each lesson encourage the development of confidence and skill in literacy and learning

Learning Outcomes clearly identify the knowledge and skills to be obtained when the chapter is completed. These outcomes are labeled and correlated to related assessment elements to facilitate reporting and remediation

Words to Know lists the key terms to be learned in the lesson

Essential Questions provoke deep thought, lively discussion, and new understanding

Introduction provides an overview and preview of the lesson content

Full-color illustrations of animal breeds present a means of studying small and large livestock animals for the identification portion of FFA CDEs


Principles of Agriculture, Food, and Natural Resources

Bos taurus Cattle B

Angus—Angus cattle originated in Scotland, specifically in the sh naturally *polled* (hornless). Angus cattle are known for their mater 50 states of the nation, and the American Angus Association's bran recognized worldwide.

Charolais—Charolais is one of the oldest French cattle breeds. rates and heavy muscling. Most Charolais cattle are naturally crossbreeding programs to produce smoky-gray calves that per

Chianina—Chianina cattle originated in Italy and are amo with black skin pigment. In the United States, Chianina are are recognized for their exceptional growth. The terms Ch associated with modern-day Chianina-influenced cattle.

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Chapter 10 Large Livestock Production

Bos taurus Dairy Cattle Breeds

Ayrshire—Ayrshire cattle originated in the county of Ayr in Scotland before the 1800s. They were first imported into the United States in 1822. Ayrshires are red and white and are known for their udder quality, efficiency, and longevity. They are moderate in size, with mature cows weighing around 1,200 lb. They produce high-quality milk, which is popular in various dairy products.

Brown Swiss—The Brown Swiss, which originated in Switzerland, is likely the oldest of all dairy breeds. They are known for their ability to adapt to different environments. Brown Swiss were imported into the United States in 1869. The Brown Swiss shown here is predominantly brown with a black nose encircled by a white ring. Brown Swiss are large-framed cattle. Mature cows typically weigh between 1,400 and 1,500 lb. They are known for their docile temperament. The high protein content of their milk makes it highly desirable in the cheese industry.

Guernsey—Guernsey cattle, whose history can be traced back over 1,000 years, are from the Isle of Guernsey off the coast of France. French monks developed the breed through crossbreeding. They were first imported to the United States in 1831. Guernsey cattle are fawn-colored and have white markings. Mature cows are small to medium in size, weighing about 1,100 to 1,200 lb. They produce milk that is high in fat content and has a golden color. Guernsey cattle mature early, adapt well, and are docile.

Holstein—Holstein is the most popular breed of dairy cattle in the United States and is the world's largest dairy breed. They make up more than 90% of the dairy cattle in this country. Holstein cattle originated in the Netherlands over 2,000 years ago. One of the provinces where they were developed is called Friesland. In other countries, Holsteins are called Friesians. They are large-framed cattle, with mature cows weighing over 1,400 lb, and recognized for their high-volume milk production. The average Holstein cow produces more than 23,000 lb of milk annually.

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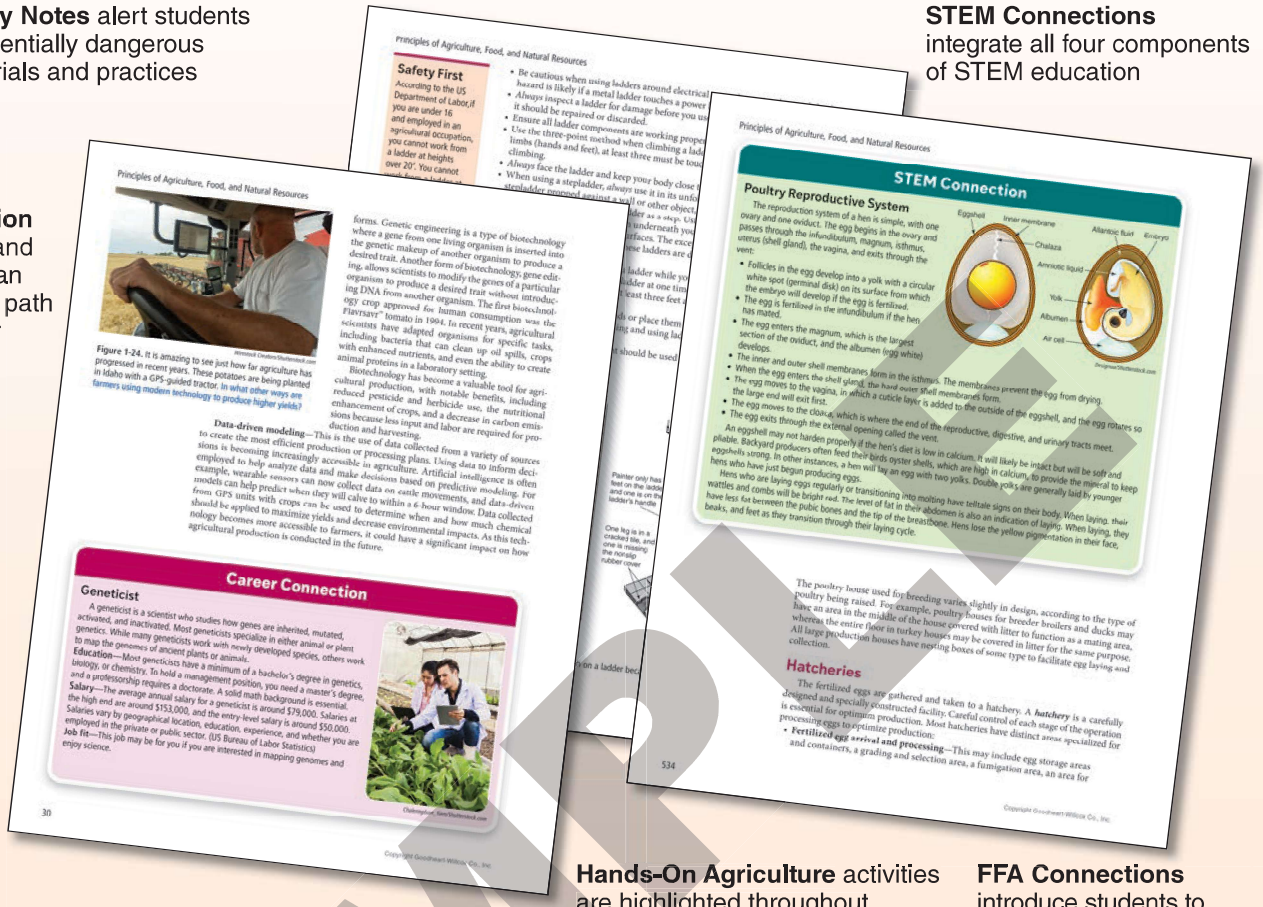
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Safety Notes alert students to potentially dangerous materials and practices

STEM Connections integrate all four components of STEM education

Career Connection features and profiles can provide a path for career success

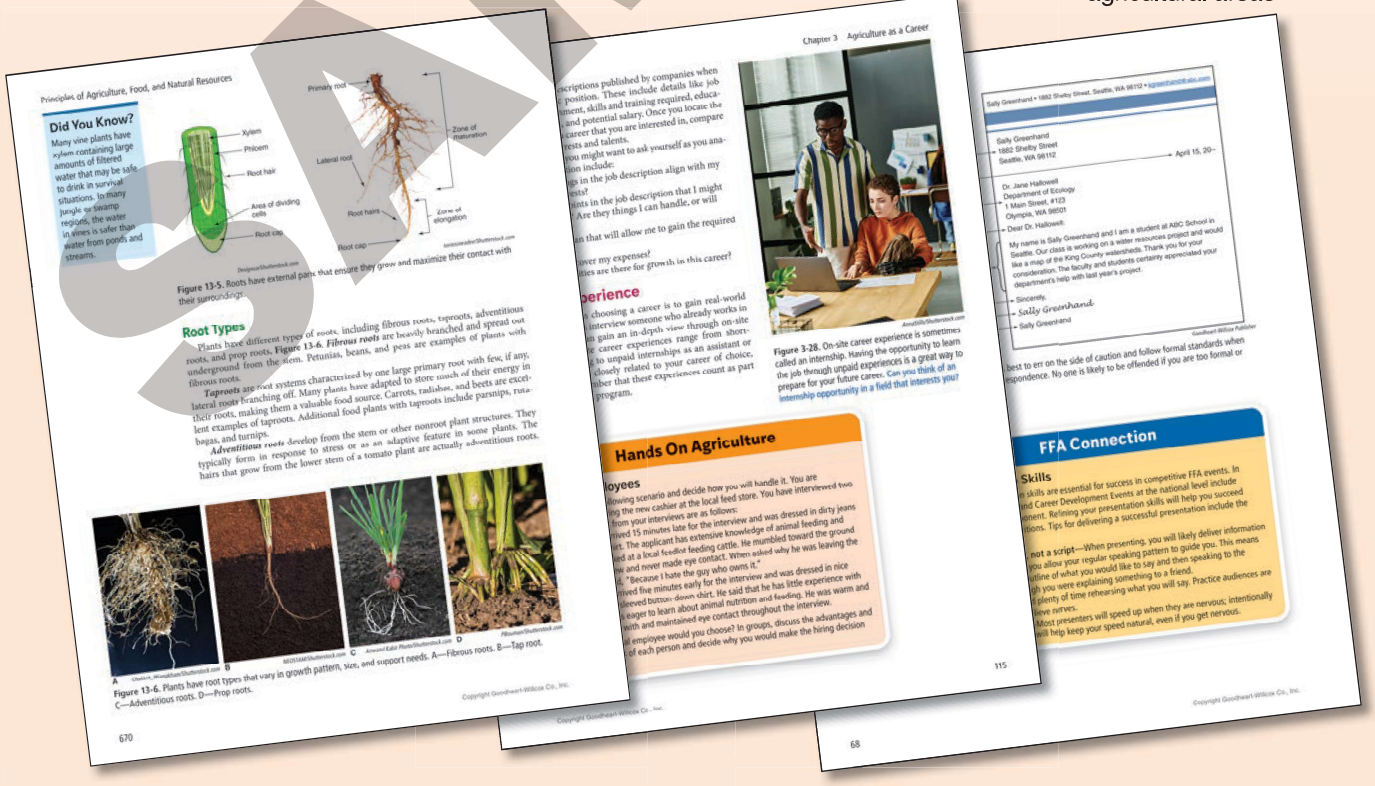


Did You Know? features point out interesting and helpful facts about the agricultural industry

Illustrations have been designed to clearly and simply communicate the specific topic

Hands-On Agriculture activities are highlighted throughout the textbook to provide clear instructions for hands-on service activities. You can refer back to these procedures easily

FFA Connections introduce students to the exciting world of FFA opportunities, including Career Development Events in a variety of agricultural areas



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SAE Connections help students make real-life connections to a variety of new and interesting SAE opportunities

Caption Questions help connect the text to the artwork, while encouraging active reading and critical thinking

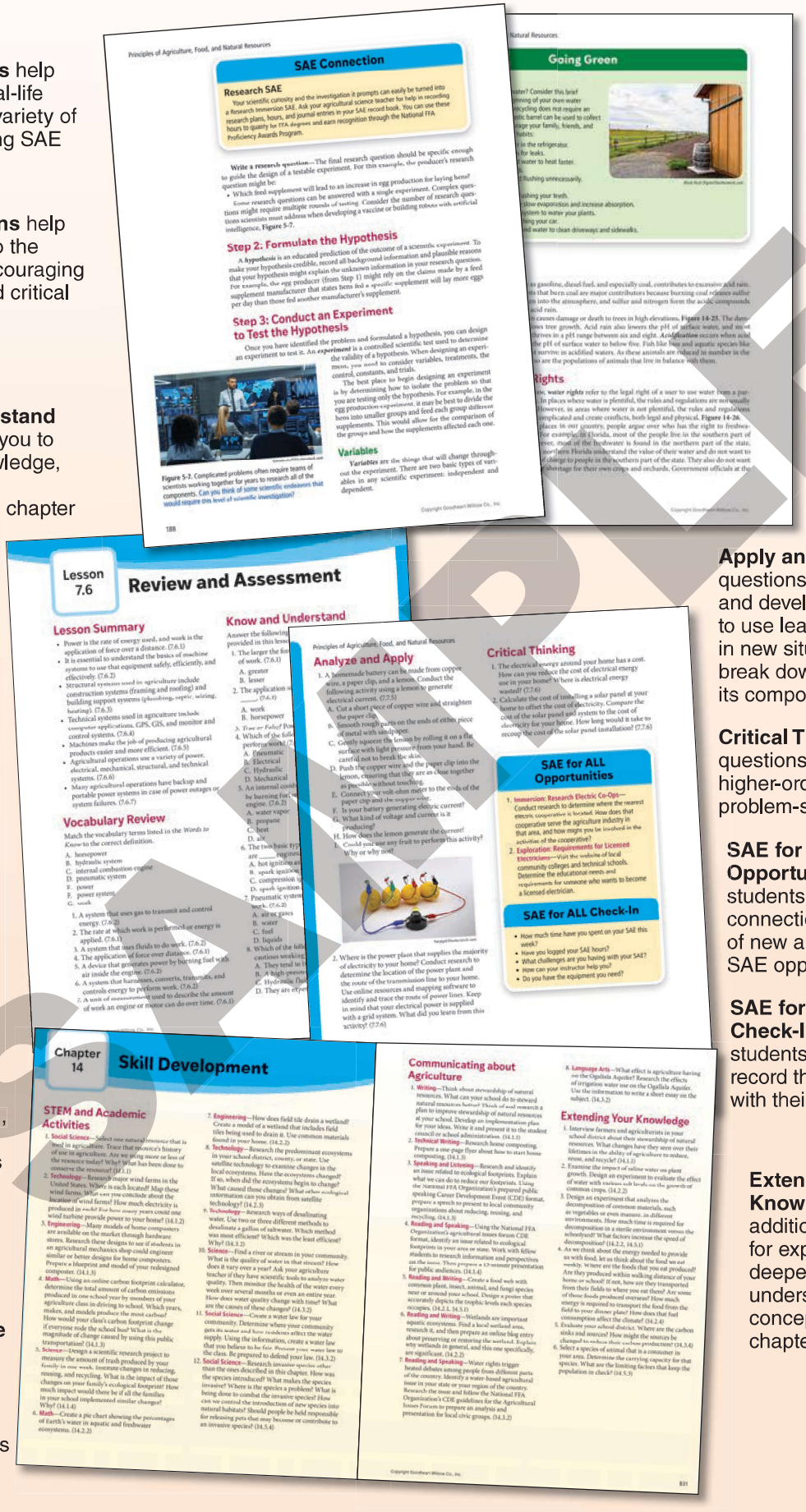
Know and Understand questions enable you to demonstrate knowledge, identification, and comprehension of chapter material

Summary feature provides an additional review tool for you and reinforces key learning objectives

Vocabulary Review matching activities reinforce vocabulary development and retention

STEM and Academic Activities are provided in the areas of science, technology, engineering, math, social science, and language arts to extend your learning and help you analyze and apply knowledge

Communicating about Agriculture questions and activities helps integrate reading, writing, listening, and speaking skills



Going Green notes highlight key items related to sustainability, energy efficiency, and environmental issues

Apply and Analyze questions extend learning and develop your abilities to use learned material in new situations and to break down material into its components

Critical Thinking questions develop higher-order thinking and problem-solving abilities

SAE for ALL Opportunities help students make real-life connections to a variety of new and interesting SAE opportunities

SAE for ALL Check-In reminds students to review and record their progress with their SAEs

Extending Your Knowledge provides additional activities for exploring and deepening the understanding of key concepts from each chapter

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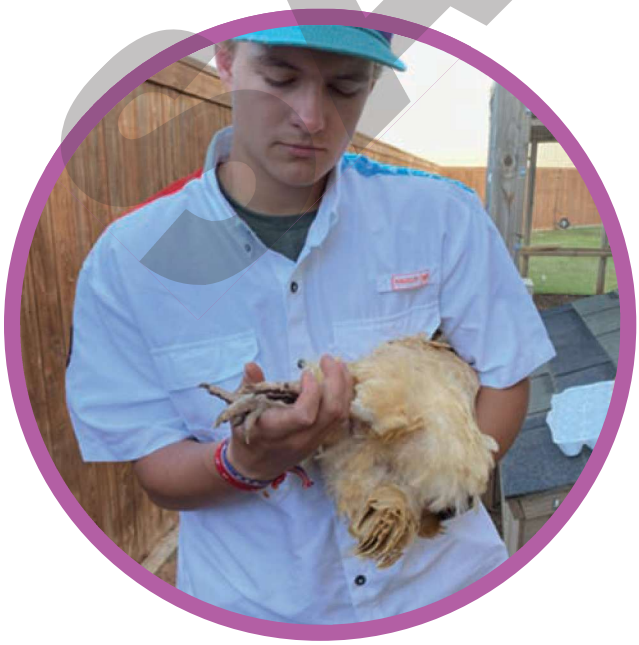
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