Preface

Horticulture Today was designed to meet the need for a comprehensive, thoroughly modern, and visually exciting introduction to the study of horticulture. The authors of *Horticulture Today* set out to provide learners with a breadth of horticultural knowledge while also creating awareness of green industry careers and workplace skills needed to be successful in today's green industry. To help readers achieve these goals, the authors have incorporated SAE for ALL Profiles, supplemental activities, such as interactive sidebars, Historical and STEM Connections, and Career Connections throughout the text.

The organization and content coverage of *Horticulture Today* was developed with valuable insight from a panel of expert reviewers and with the National Agriculture, Food, and Natural Resources Standards at the forefront. The textbook content also correlates to various state standards and to exam standards for Career Skills Certification™ by Precision Exams by YouScience. *Horticulture Today* is presented in 33 chapters with six logical sections to help readers develop a fundamental knowledge of plant science and build on this knowledge with ensuing topics.

The initial chapters concentrate on building leadership, communication, and business skills that can be used in both school and work environments. Chapters one and two are focused on FFA and SAE support fundamentals in leadership skills and experiential learning. Additionally, chapter three seeks to help students develop communication and critical thinking skills needed to compete in today's green industry. Chapter five focuses on horticulture business management and continues to build student professionalism, preparing them for future employment.

The second group of chapters focuses on horticultural biology. Chapter seven is dedicated to taxonomy, and chapters eight through ten cover basic biology as well as plant growth and development. Readers will develop an understanding of basic plant biology as well as how environmental controls can be used to manipulate plant growth. Plant nutrition and soils and media are discussed in chapters eleven and twelve. This highly illustrated section includes extensive coverage of deficiencies, as well as sustainable practices, building soil health, and stewardship. The third group of chapters is dedicated to plant propagation—ranging from traditional to modern micropropagation techniques.

The fourth section encompasses a myriad of horticultural practices, including greenhouse operations to field cultivation of fruits, vegetables, and ornamental plants. Readers will gain an understanding of practices ranging from traditional methods to modern-day hydroponics. The fifth section covers design practices in the landscaping, floriculture, and turfgrass industries. Hands-on, step-by-step instructions, installation procedures, and management practices are also included. The final section provides detailed coverage of integrated pest management (IPM). Individual chapters cover IPM, insects, diseases, weeds, and pesticide safety and management.

We hope you enjoy our presentation of horticulture for our modern society and continue to learn and grow as you pursue a career in the green industry or hone your skills as a home gardener.

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About the Authors

Jodi Songer Riedel

Ms. Riedel has 20 years of teaching experience in agricultural education. She has instructed and created curriculum for courses in horticulture, sustainable agriculture, forestry, and environmental and natural resources. Ms. Riedel has also instructed many student teachers and has keenly observed and learned what young teachers, especially those with limited horticultural knowledge, need to successfully instruct agricultural education courses.

In her Wakefield High School classroom, Ms. Riedel employs learning by doing. With Ms. Riedel's instruction, students:

- Have designed and installed prize-winning gardens at the state fair.
- Maintain ornamental landscapes and edible landscapes on school grounds.
- Facilitate a "Garden Army" uniting elementary, middle, and high school students to explore horticulture all year.
- Raise plants for year-round sales through their School-based Enterprise SAEs.

Ms. Riedel also organizes and supervises urban service-learning projects and Supervised Agricultural Experiences (SAEs) in Raleigh, North Carolina. Ms. Riedel funds and sustains her inspirational program and its efforts each year through grants and annual plant sales, cultivated by students. Ms. Riedel's dedication and enthusiasm earned her a Career Science Math and Technology Award through Burroughs Wellcome in 2015, which included a $175,000 grant.

Elizabeth Driscoll

Ms. Driscoll holds the position of 4-H Subject-Matter Specialist across the departments of Crop and Soil Sciences, Entomology and Plant Pathology, and Horticultural Science and Soil at North Carolina State University with the North Carolina Cooperative Extension. She has been working to connect youth and educators to issues in agriculture and natural resources in relevant and meaningful ways for over 18 years. Ms. Driscoll's 4-H "Grow For It" program focuses on developing resources and experiential projects that foster curious and wondering youth, inspire critical thinking and problem solving, build a positive science self-concept, connect kids to good food, and nurture environmental stewards of the land through gardening and agriculture.



Jodi Songer Reidel and Elizabeth Driscoll, photo courtesy of Reno Palombit

With a BS and an MS in horticultural science from Michigan State University, she actively translates agricultural research from the land-grant universities into hands-on, inquiry-based curricular resources to support county-based 4-H youth programs. Serving over 350 Cooperative Extension county field faculty in agriculture, horticulture, 4-H, and family and consumer sciences, Ms. Driscoll uses a strong train-the-trainer approach to broadly and deeply engage audiences in their own innovative delivery of agricultural programs to youth. She leads multiple precollege programs for youth, including the Horticultural Science Summer Institute and the Resource Conservation Workshop, as well as other youth leadership programs. Additionally, Ms. Driscoll works with colleagues in the North Carolina Cooperative Extension and many local partners to connect kids to healthy food in schools through school gardens, garden-enhanced food and nutrition education, and access to local food through farm-to-cafeteria projects.

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Reviewers

The author and publisher wish to thank the following industry and teaching professionals for their valuable input into the development of *Horticulture Today*.

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USDA Forest Service
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TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools



Student Text

The *Horticulture Today* textbook provides an exciting, full-color, and highly illustrated learning resource. The textbook is available in a print or online version.

Lab Workbook

The lab workbook that accompanies *Horticulture Today* provides hands-on practice with questions and lab activities. Each chapter corresponds to the text chapters and reinforces key concepts and applied knowledge.

Online Learning Suite

The Online Learning Suite provides the foundation of instruction and learning for digital and blended classrooms. An easy-to-manage shared classroom subscription makes it a hassle-free solution for both students and instructors. An online student text and lab workbook, along with rich supplemental content, brings digital learning to the classroom. All instructional materials are found on a convenient online bookshelf and accessible at home, at school, or on the go.



Online Learning Suite/ Student Text Bundle

Are you looking for a blended solution? Goodheart-Willcox offers the Online Learning Suite bundled with the printed text in one easy-to-access package. Students have the flexibility to use the printed text, the Online Learning Suite, or a combination of both components to meet their individual learning styles. The convenient packaging makes managing and accessing content easy and efficient.

Instructor Tools

LMS Integration

Integrate Goodheart-Willcox content within your Learning Management System for a seamless user experience for both you and your students. LMS-ready content in Common Cartridge® format facilitates single sign-on integration and gives you control of student enrollment and data. With a Common Cartridge integration, you can access the LMS features and tools you are accustomed to using and G-W course resources in one convenient location—your LMS.

To provide a complete learning package for you and your students, G-W Common Cartridge includes the Online Learning Suite and Online Instructor Resources. When you incorporate G-W content into your courses via Common Cartridge, you have the flexibility to customize and structure the content to meet the educational needs of your students. You may also choose to add your own content to the course.

QTI® question banks are available within the Online Instructor Resources for import into your LMS. These prebuilt assessments help you measure student knowledge and track results in your LMS gradebook. Questions and tests can be customized to meet your assessment needs.

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Online Instructor Resources (OIR)



Online Instructor Resources (OIR) provide all the support needed to make preparation and classroom instruction easier than ever. Available in one accessible location, the OIR includes Instructor Resources, Instructor's Presentations for PowerPoint®, and Assessment Software with Question Banks. The OIR is available as a subscription and can be accessed at school, at home, or on the go.

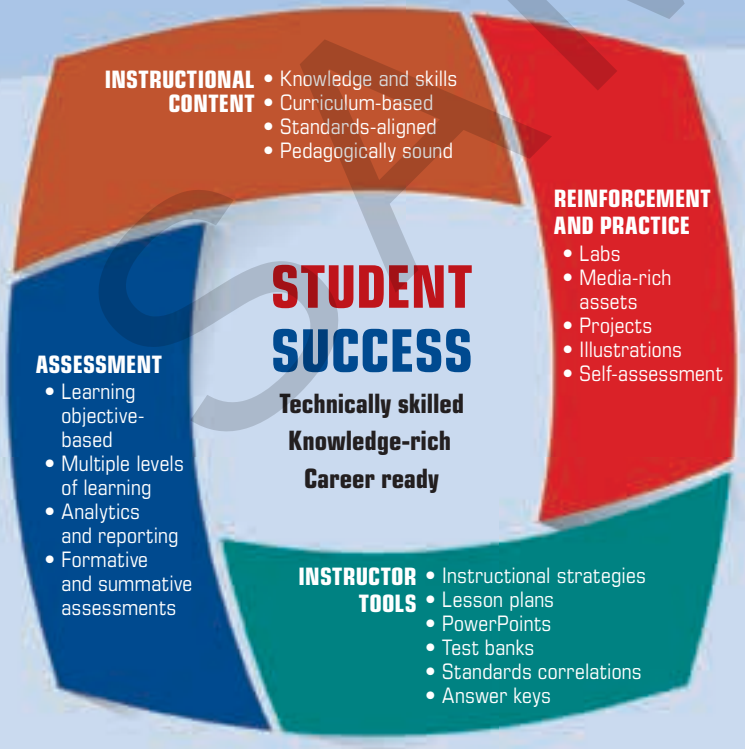
Instructor Resources One resource provides instructors with time-saving preparation tools such as answer keys, editable lesson plans, and other teaching aids.

Instructor's Presentations for PowerPoint® These fully customizable, richly illustrated slides help you teach and visually reinforce the key concepts from each chapter.

ExamView® Assessment Suite Administer and manage assessments to meet your classroom needs. The ExamView® Assessment Suite allows you to quickly and easily create, administer, and score paper and online tests. Included in the assessment suite are the ExamView® Test Generator, ExamView® Test Manager, and ExamView® Test Player. G-W test banks are installed simultaneously with the software. Using ExamView simplifies the process of creating, managing, administering, and grading tests. You can have the software generate a test for you with randomly selected questions. You may also choose specific questions from the question banks and, if you wish, add your own questions to create customized tests to meet your classroom needs.

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G-W Integrated Learning Solution



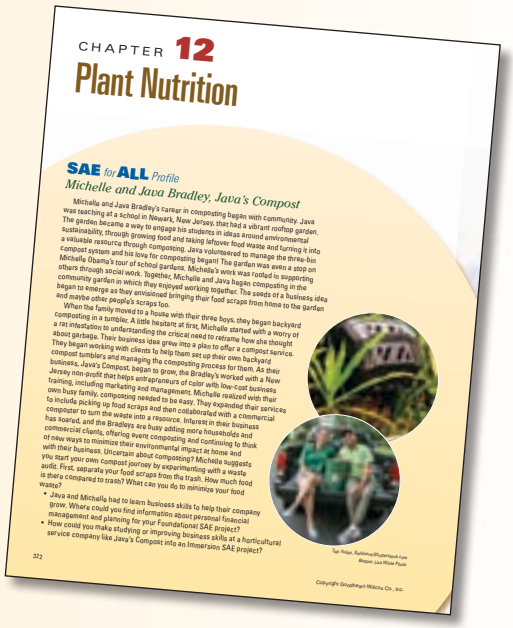
The G-W Integrated Learning Solution offers easy-to-use resources that help students and instructors achieve success.

- **EXPERT AUTHORS**
- **TRUSTED REVIEWERS**
- **100 YEARS OF EXPERIENCE**

EMPLOYABILITY SKILLS · TECHNICAL SKILLS · ACADEMIC KNOWLEDGE · INDUSTRY RECOGNIZED STANDARDS

Features of the Textbook

The instructional design includes student-focused learning tools to help students succeed. This visual guide highlights the features designed for the textbook.


CHAPTER 12
Plant Nutrition

SAE for ALL Profile
Michelle and Java Bradley, Java's Compost

Michelle and Java Bradley's career in composting began with community. Java was teaching at a school in Newark, New Jersey, that had a vibrant rooftop garden. The garden became a way to engage his students in ideas around environmental sustainability, through growing food and taking leftover food waste and turning it into a valuable resource through composting. Java volunteered to manage the three-bin compost system and his love for composting began! The garden was given a stop on Michelle Obama's tour of school gardens. Michelle's work was roofed in supporting others through social work. Together, Michelle and Java began composting in the community garden in which they enjoyed working together. The seeds of a business idea began to emerge as they envisioned bringing their food scraps from home to the garden and maybe other people's scraps too.

When the family moved to a house with their three boys, they began backyard composting in a tumbler. A little hesitant at first, Michaelle started with a worry of a rat infestation to understanding the critical need to reframe how she thought about garbage. Their beanieks idea grew into a plan to offer a compost service. They began working with clients to help them set up their own backyard compost tumblers and managing the composting process for them. As their business, Java's Compost, began to grow, the Bradley's worked with a New Jersey non-profit that helps entrepreneurs of color with low-cost business training, including marketing and management. Michelle realized with their own busy family, composting needed to be easy. They expanded their services to include picking up food scraps and then collaborated with a commercial composter to turn the waste into a resource. Interest in their business has soared, and the Bradleys are busy adding more households and commercial clients, offering more composting and continuing to think of new ways to minimize their environmental impact at home and with their business. Uncertain about composting? Michelle suggests you start your own compost journey by experimenting with a waste audit. First, separate your food scraps from the trash. How much food is there compared to trash? What can you do to minimize your food waste?

- Java and Michelle had to learn business skills to help their company grow. Where could you find information about personal financial management and planning for your Foundational SAE project?
- How could you make studying or improving business skills at a horticultural service company like Java's Compost into an Immersion SAE project?

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


Before You Read

Arrange a study session to read the chapter with a classmate. After you read each section independently, stop and tell each other what you think the main points are in the section. Continue with each section until you finish the chapter.

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

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

Chapter Objectives clearly identify the knowledge and skills to be obtained when the chapter is completed.

STEM Connections integrate all four components of STEM education as well the social sciences and language arts.


Essential Question

Why is it important to describe, name, and classify plants?

Chapter Objectives

After studying this chapter, you will be able to:

- Discuss the historical origins of the plant classification system.
- Describe the hierarchical orders of plants.
- Interpret a plant identification key.
- Describe the purpose of herbaria.
- Explore careers related to plant taxonomy.

"A practical botanist will distinguish at the first glance the plants of the different quarters of the globe and yet will be at a loss to tell by what marks he detects them."
—Carolus Linnaeus

Words to Know

angiosperm
binomial nomenclature
class
classification
common name
cotyledon
cultivar
dichotomous key
Dicotyledoneae (dicots)
domain
ecologist
family
genus
gymnosperm
herbarium
International Code of Botanical Nomenclature
Monocotyledoneae (monocot)
morphology
order
phylum
scientific name
species
specific epithet
taxonomy
variety

Have you ever compared the leaves of hickory, pecan, and walnut trees, pear, and peach? If you observed that these plants resemble each other, it is because they belong to the same plant families. Plants and all living organisms are organized by their relationships to each other. This system of grouping like organisms together is called *classification*.

A B C

Figure 7-1. Look closely at the leaves of these trees. How are they similar? How are they different? A—Pecan. B—Walnut. C—Hickory.

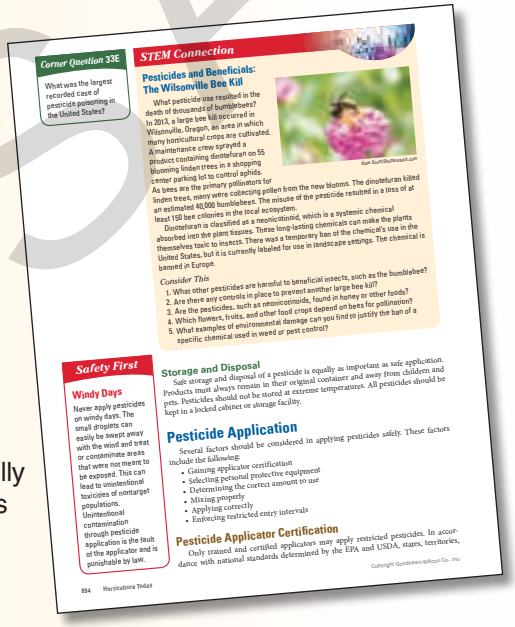
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Words to Know list the key terms to be learned in the chapter.

Illustrations clearly and simply communicate the specific topic.

Corner Questions spur conversation related to chapter content.


Corner Question 33E

What was the largest recorded case of pesticide poisoning in the United States?

STEM Connection

Pesticides and Beneficials: The Wilsonville Bee Kill

What pesticide use resulted in the death of thousands of bumblebees? In 2013, a large bee kill occurred in Wilsonville, Oregon, an area in which many horticultural crops are cultivated. A maintenance crew sprayed a product containing dinotefuran on 55 blooming linden trees in a shopping center parking lot to control aphids. As bees are the primary pollinators for linden trees, many were collecting pollen from the new blooms. The dinotefuran killed an estimated 40,000 bumblebees. The misuse of the pesticide resulted in a loss of at least 150 bee colonies in the local ecosystem.

Dinotefuran is classified as a neonicotinoid, which is a systemic chemical absorbed into the plant tissues. These long-lasting chemicals can make the plants themselves toxic to insects. There was a temporary ban of the chemical's use in the United States, but it is currently labeled for use in landscape settings. The chemical is banned in Europe.

Consider This

1. What other pesticides are harmful to beneficial insects, such as the bumblebee?
2. Are there any controls in place to prevent another large bee kill?
3. Are the pesticides, such as neonicotinoids, found in honey or other foods?
4. Are the pesticides, such as neonicotinoids, found in honey or other foods?
5. What examples of environmental damage can you find to justify the ban of a specific chemical used in weed or pest control?

Safety First

Windy Days

Never apply pesticides on windy days. The small droplets can easily be swept away with the wind and treat or contaminate areas that were not meant to be exposed. This can lead to unintentional toxicities of nontarget populations. Unintentional contamination through pesticide application is the fault of the applicator and is punishable by law.

Storage and Disposal

Safe storage and disposal of a pesticide is equally as important as safe application. Products must always remain in their original container and away from children and pets. Pesticides should not be stored at extreme temperatures. All pesticides should be kept in a locked cabinet or storage facility.

Pesticide Application

Several factors should be considered in applying pesticides safely. These factors include the following:

- Gaining applicator certification
- Selecting personal protective equipment
- Determining the correct amount to use
- Mixing properly
- Applying correctly
- Enforcing restricted entry intervals

Pesticide Applicator Certification

Only trained and certified applicators may apply restricted pesticides. In accordance with national standards determined by the EPA and USDA, states, territories,

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Safety First notes alert you to potentially dangerous materials and practices and promote safe practices.

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Career Connection features introduce students to careers in in the Green Industry.


Career Connection

Careers in Plant Biology

There are many specialties and career opportunities in the plant biology area. Careers in plant biology may vary from ecology to genetics. Positions are found in businesses, research centers, industry, and education. A bachelor's degree is required for most careers in plant biology. A graduate degree creates more career options and increased pay.

Botanist

Botanists study all forms of plants and their relationship to the environment and other living things. A botanist who enjoys the outdoors and research may search for and identify new plant species, evaluating each plant's parts and uses. Some botanists may do environmental research, studying the affect of climate change on various plant populations. Botanists who work in botanical gardens, arboretums, herbaria, and zoos may study plants and their interaction in each environment.

The annual salary range is currently $50,000 to $90,000. The salary depends primarily on the geographical location, employer, and experience. A bachelor's degree in botany or a plant science field is the minimum level of education required. As with most science-based careers, a master's degree and PhD are often necessary to be competitive in the field.

growth and development can engage young people in learning. A science teacher with a plant background can create hands-on experiences that help students understand the photosynthetic organisms around them. A bachelor's degree in plant biology, botany, horticulture, or agriculture is required. Additional coursework and experience is required to earn a teaching certificate.

A minimum of a bachelor's degree in education with courses in the sciences is necessary for grade school and high school teachers. Additional coursework and experience is required to earn a teaching certificate. Teaching science at the college level requires a master's degree in the chosen area. Science teachers may earn an annual salary of $32,000 to $75,000, depending on their level of education, experience, and geographical location.

Research Associate

Plant biology offers a broad background that can be applied in research settings with agricultural companies trying to solve key challenges in global crop production. A research associate's role engages in the discovery and development of techniques and products that will find solutions to production problems. This might include the development of novel pesticides, biological control, or molecular methods of changing plants. Applicants to these positions need strong technical, organizational, and communication skills.

A minimum of a bachelor's degree in an agriculturally related field with preference to agriculture, horticulture, plant biology, biology, or another related field is required. Since research associate positions require a master's or doctoral degree. Salaries range from $40,000 to $90,000 with opportunities to earn over $100,000.

Science Teacher

Science teachers instruct students in the concepts of science. A degree in plant biology is essential for those who wish to teach students about plant science, the environment, natural resources, and earth sciences. The ability to share information about plant

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


tasks, determine if the career would capture your interests and keep you mentally and physically healthy.

Once you have selected a broad career area, you can begin creating a school-to-career plan. A ***school-to-career plan*** is a document that consists of one or more career goals and the steps or activities needed to achieve those goals. Resources needed to achieve the goals may also be included. For example, your goal may be a career as a high school agriculture teacher. Steps you must complete to achieve the goal might include graduating from high school, getting a college degree in agricultural education, and completing a teaching internship. Resources needed would be funds to pay for college. You can begin your plan with broad goals and steps and then make the plan more specific as you learn more about what is needed.

Your plan will help you map out how to get from where you are now to where you want to be in a career. When beginning a school-to-career plan, follow these simple steps:

1. Consider your interests, abilities, and personal characteristics. It is a good idea to take a personality test (such as the Myers-Briggs personality assessment) to see what kind of personality you have.
2. Narrow the field of jobs to what is suited to your personality.
3. Study the requirements of the job.
4. Prepare a plan for this career.
5. Plan for an alternate career in case the first career does not become a reality.
6. Begin preparing for success in this career by completing educational requirements and developing needed skills.
7. Get work experience (supervised agricultural experiences, job shadowing, internships, and volunteering).

You may find it helpful to look up job listings on career websites of professions that interest you. Determine what you will need to get a particular job by looking at the job requirements posted for the applicants. Create an inventory of the skills and education you have and what you will need to secure a job like this in the future. You can then map out your school-to-career plan from this point. **Figure 5-23.**

Corner Question 5F

How many Myers-Briggs assessments, a form of personality tests, are given each year?

Did You Know?

The Florida Nursery Growers and Landscape Association offers a Certified Horticulture Professional program to recognize authorities in the horticulture industry.

Employability Practices

Professional Certifications in Horticulture

Industry certifications in horticulture demonstrate and verify an excellence and professionalism within the trade that is not exhibited by all professionals. Employers and customers look for these industry credentials and can be satisfied knowing that the individuals with these certifications are some of the best that the horticulture industry has to offer.

Two national horticultural organizations offer various professional certifications. State agencies may also offer additional certifications, so check with your state's extension agency or a member of the horticulture industry to find out more.

- **America Society of Horticultural Science.** Certified horticulturists are knowledgeable and skilled in all areas of horticulture. Those who are certified have passed a rigorous four-hour exam and must have three years of professional and/or educational experience in horticulture.
- **Master Gardener.** Each state's cooperative extension agency can offer a master gardener program. Master gardeners are home gardeners who have received a great deal of horticultural training and have volunteered in horticultural efforts in their communities. A master gardener may be more qualified as an employee than someone without horticulture training may be.
- **National Association of Landscape Professionals.** Some certifications provided by the association include landscape industry certified manager, exterior technician, interior technician, horticultural technician, lawn care manager, and lawn care technician.

Each of these certifications ensures that the person certified has undergone rigorous training and evaluation to demonstrate excellence within their specialty in the green industry.

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Chapter 5 Horticultural Business Management 125

Employability Practices provide students with tips to improve their employability skills.

AG ED Connection features introduce students to the exciting world of leadership and personal development opportunities, including career development events in a variety of areas.

FFA Connection features introduce students to the exciting world of FFA opportunities including Career Development Events in a variety of agricultural areas.


Figure 2-8. A—Researching and determining what type of plants are best for pollinators such as bees qualifies as research analytical SAE. B—Another project that qualifies as a research analytical SAE is determining what type of grass should be used for an athletic field.

way to build partnerships in the community. Scientists at your high school, local business, or college and universities may be willing to mentor you as you do this research and help you find the equipment and facility you need. The three types of research that a student can choose for an immersion SAE include:

- Experimental SAE
- Analytical SAE
- Invention SAE

Experimental Research SAE

An ***Experimental SAE*** reads much like every science experiment you have conducted since entering grade school. Your question leads the development of the

SAE Connection Beekeeping SAE

You can raise bees and rent their hives to landowners for pollination services. ***Apiarists*** (people who study and maintain bees) are paid to bring the bees to the site and maintain the hives. Farmers can negotiate for honey, or the honey can be gathered solely by the apiarist. Bees flourish, crops are pollinated, and honey is produced. Everyone wins with this green venture. It is best to learn from an experienced apiculturist. Find an apiculturist near you who can provide some guidance, and you could have a great placement SAE.

Consider This

1. What supplies would you need to set up a beehive? Are there ready-made "boxes"? Research and determine what you would need to begin this venture and determine the cost of the materials.
2. Identify the types and sizes of boxes used to house bees and describe their differences, as well as each one's purpose.
3. If time permits, create a visual presentation explaining how a person would set up a new hive.

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Chapter 2 Experiential Learning

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Ag Ed Connection Using Social Media Safely and Responsibly

You can help present yourself to prospective employers in a positive light by using social media responsibly. Unprofessional or inappropriate postings, comments, and photos made on social media can ruin employment opportunities or even get you fired. Here are a few tips to help ensure your social media profile is appropriate:

- Check your privacy settings and make certain they are on private.
- What you post can come back to haunt you. A recent study showed that up to 90% of employers and college admissions coordinators check candidates' social media profiles.
- Remove any postings that are set to public that may be considered inappropriate.
- Do your homework. Analyze the mission statement and vision statement of the company. Many companies will have different levels of tolerance regarding social media postings. Keep your profile professional and unbiased.
- Review your profile postings and images in their entirety. Postings made several years ago may not represent current beliefs.
- Tools from the social media site can be used to search for photos of yourself that have been added by others. Check these photos and ask that inappropriate images be removed.

Staying Safe Online

- Do not assume that everyone on social media is who they say they are. If you get a message from someone you do not know, do not interact with him or her until you can verify his or her identity.
- Always make sure you involve your parents or guardians in any decision you make related to bringing your virtual friends into your real life.
- Never provide personal information through social media. Sharing your home address, schedule, or other personal information on your social media pages can tell the world more about you than you may want them to know. It could even lead someone right to you.
- Always consider how much someone may figure out about you from your profile or the things you post.

- Find evidence and determine whether sources are credible
- Annotate documents with questions and comments
- Summarize the main points of information
- Evaluate information to determine whether it is credible and factual

Search

When you have chosen a topic to research or need to find the answers to a question, begin by thinking critically as soon as you begin a search for information. You may search for information using internet search engines, magazines, newspapers, books, web forums, blogs, and databases. Searching can be a daunting experience. There is

Chapter 3 Communication and Information Literacy in Horticulture

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Corner Question 3E

What North American culture is known for its rich history in storytelling?

FFA Connection Extemporaneous Speaking

In this event, a single participant is given only 30 minutes to prepare a speech that is between 4 and 6 minutes in length. The purpose of this event is for students to learn how to express themselves verbally and to prepare a speech in very little time. Participants are in official dress and are judged on content presented, tone, eye contact, mannerisms, gestures, poise, articulation, and responses to questions. Contestants can participate at the local, state, and national events.

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Extemporaneous Presentations

An extemporaneous presentation is an impromptu speech that is performed without advance preparation. There are times in industry when a business manager may have little or no time to prepare a statement or speech, **Figure 3-14.** It is common for an employee whose job is public relations to act on the company's behalf with very little preparation. This type of presentation is also often associated with competitions. The FFA and other groups offer an extemporaneous speech event to test the skills and knowledge of FFA members. This event is much like being part of a debate team where contestants are posed a question and asked to respond.

Persuasive Presentations

When the owner of a landscape design company talks to his employees on Monday morning and encourages them to find more clients and reach out to older customers, he is trying to motivate his employees. This is often referred to as a pep talk, but it is literally a mini-motivational speech.

Persuasive speeches are those that try to convince the audience to believe in something or take some action. This is no different from the times in a locker room when a coach tries to convince her team that they are unstoppable and that they can defeat their opponent. A persuasive speech can be formal or informal. One of the most memorable



Figure 3-14. The Secretary of Agriculture answers questions after a presentation. When there is little time for preparation, this is known as an extemporaneous speech. *What do you think are the most important things to focus on when giving a speech without time for preparation?*

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

Caption questions help the students connect the text to the art, while encouraging active reading and critical thinking.

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Identification Glossaries include plants, equipment, pests, disorders, diseases, and weeds from the CDE Identification lists in full-color and all in one location.



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

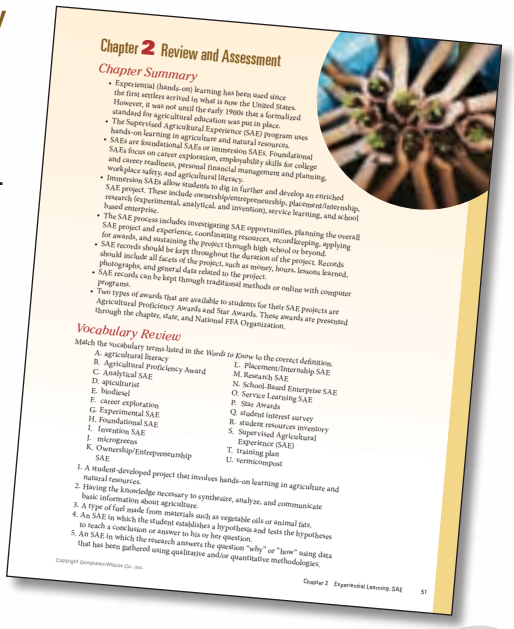


Sustainable Horticulture features highlight key items related to sustainability, energy efficiency, and environmental issues.



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



Chapter 2 Review and Assessment

Chapter Summary

- Experiential (hands-on) learning has been used since the first settlers arrived in what is now the United States. However, it was not until the early 1900s that a formalized standard for agricultural education was put in place.
- The Supervised Agricultural Experience (SAE) program uses hands-on learning in agriculture and natural resources.
- SAEs are foundational SAEs or immersion SAEs. Foundational SAEs focus on career exploration, employability skills for college and career readiness, personal financial management and planning, workplace safety, and agricultural literacy.
- Immersion SAEs allow students to dig in further and develop an enriched SAE project. These include ownership/entrepreneurship, placement/internship, research (experimental, analytical, and invention), service learning, and school based enterprise.
- The SAE process includes investigating SAE opportunities, planning the overall SAE project and experience, coordinating resources, recordkeeping, applying for awards, and sustaining the project through high school or beyond.
- SAE records should be kept throughout the duration of the project. Records should include all facets of the project, such as money, hours, lessons learned, photographs, and general data related to the project.
- SAE records can be kept through traditional methods or online with computer programs.
- Two types of awards that are available to students for their SAE projects are Agricultural Proficiency Awards and Star Awards. These awards are presented through the chapter, state, and National FFA Organization.

Vocabulary Review

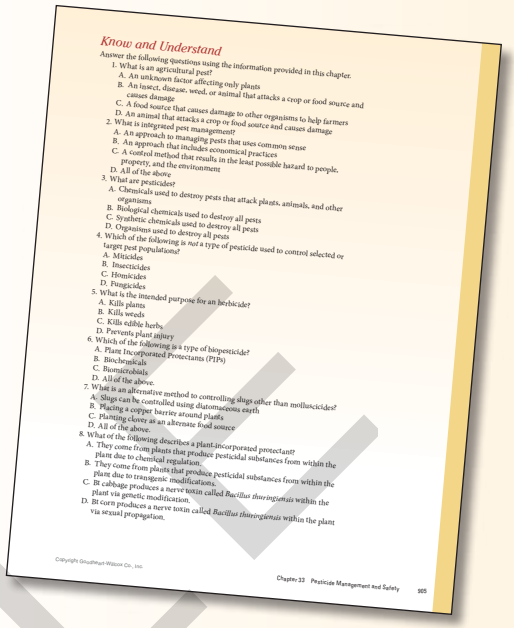
Match the vocabulary terms listed in the *Words to Know* to the correct definition.

A. agricultural literacy
B. Agricultural Proficiency Award
C. Analytical SAE
D. apiculturist
E. biodiesel
F. career exploration
G. Experimental SAE
H. Foundational SAE
I. Invention SAE
J. microgreens
K. Ownership/Entrepreneurship SAE
L. Placement/Internship SAE
M. Research SAE
N. School-Based Enterprise SAE
O. Service Learning SAE
P. Star Awards
Q. student interest survey
R. student resources inventory
S. Supervised Agricultural Experience (SAE)
T. training plan
U. vermicompost

1. A student-developed project that involves hands-on learning in agriculture and natural resources.
2. Having the knowledge necessary to synthesize, analyze, and communicate basic information about agriculture.
3. A type of fuel made from materials such as vegetable oils or animal fats.
4. An SAE in which the student establishes a hypothesis and tests the hypotheses to reach a conclusion or answer to his or her question.
5. An SAE in which the research answers the question "why" or "how" using data that has been gathered using qualitative and/or quantitative methodologies.

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Vocabulary Review matching activities reinforce vocabulary development and retention. All key terms are included in the text glossary and are connected to numerous online review activities.



Know and Understand

Answer the following questions using the information provided in this chapter.

1. What is an agricultural pest?
   A. An unknown factor affecting only plants
   B. An insect, disease, weed, or animal that attacks a crop or food source and causes damage
   C. A food source that causes damage to other organisms to help farmers
   D. An animal that attacks a crop or food source and causes damage
2. What is integrated pest management?
   A. An approach to managing pests that uses common sense
   B. An approach that includes economical practices
   C. A control method that results in the least possible hazard to people, property, and the environment
   D. All of the above
3. What are pesticides?
   A. Chemicals used to destroy pests that attack plants, animals, and other organisms
   B. Biological chemicals used to destroy all pests
   C. Synthetic chemicals used to destroy all pests
   D. Organisms used to destroy all pests
4. Which of the following is not a type of pesticide used to control selected or target pest populations?
   A. Miticides
   B. Insecticides
   C. Herbicides
   D. Fungicides
5. What is the intended purpose for an herbicide?
   A. Kills plants
   B. Kills weeds
   C. Kills edible herbs
   D. Prevents plant injury
6. Which of the following is a type of biopesticide?
   A. Plant Incorporated Protectants (PIPs)
   B. Biochemicals
   C. Biomicrobials
   D. All of the above.
7. What is an alternative method to controlling slugs other than molluscicides?
   A. Slugs can be controlled using diatomaceous earth
   B. Placing a copper barrier around plants
   C. Planting clover as an alternate food source
   D. All of the above.
8. What of the following describes a plant-incorporated protectant?
   A. They come from plants that produce pesticidal substances from within the plant due to chemical regulation.
   B. They come from plants that produce pesticidal substances from within the plant due to transgenic modifications.
   C. Bt cabbage produces a nerve toxin called *Bacillus thuringiensis* within the plant via genetic modification.
   D. Bt corn produces a nerve toxin called *Bacillus thuringiensis* within the plant via sexual propagation.

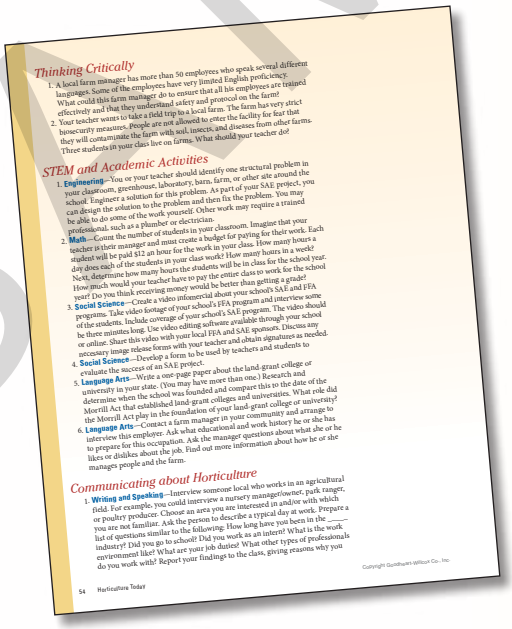
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Know and Understand review questions allow you to demonstrate knowledge, identification, and comprehension of lesson material.

Thinking Critically questions develop higher-order thinking, problem solving, personal, and workplace skills.

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

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.



Thinking Critically

1. A local farm manager has more than 50 employees who speak several different languages. Some of the employees have very limited English proficiency. What could this farm manager do to ensure that all his employees are trained effectively and that they understand safety and protocol on the farm?
2. Your teacher wants to take a field trip to a local farm. The farm has very strict biosecurity measures. People are not allowed to enter the facility for fear that they will contaminate the farm with seed, insects, and diseases from other farms. Three students in your class live on farms. What should your teacher do?

STEM and Academic Activities

1. **Engineering**—You or your teacher should identify one structural problem in your classroom, greenhouse, laboratory, barn, farm, or other site around the school. Engineer a solution for this problem. As part of your SAE project, you can design the solution to the problem and then fix the problem. You may be able to do some of the work yourself. Other work may require a trained professional, such as a plumber or electrician.
2. **Math**—Count the number of students in your classroom. Imagine that your teacher is their manager and must create a budget for paying for their work. Each student will be paid $12 an hour for the work in your class. How many hours a day does each of the students in your class work? How many hours in a week? Next, determine how many hours the students will be in class for the school year. How much would your teacher have to pay the entire class to work for the school year? Do you think receiving money would be better than getting a grade?
3. **Social Science**—Create a video influencial about your school's SAE and FFA programs. Take video footage of your school's FFA program and interview some of the students. Include coverage of your school's SAE program. The video should be three minutes long. Use video editing software available through your school or online. Share this video with your local FFA and SAE sponsors. Discuss any necessary image release forms with your teacher and obtain signatures as needed.
4. **Social Science**—Develop a form to be used by teachers and students to evaluate the success of an SAE project.
5. **Language Arts**—Write a one-page paper about the land-grant college or university in your state. (You may have more than one.) Research and determine when the school was founded and compare this to the date of the Morrill Act that established land-grant colleges and universities. What role did the Morrill Act play in the foundation of your land-grant college or university?
6. **Language Arts**—Contact a farm manager in your community and arrange to interview this employer. Ask what educational and work history he or she has to prepare for this occupation. Ask the manager questions about what she or he likes or dislikes about the job. Find out more information about how he or she manages people and the farm.

Communicating about Horticulture

1. **Writing and Speaking**—Interview someone local who works in an agricultural field. For example, you could interview a nursery manager/owner, park ranger, or poultry producer. Choose an area you are interested in and/or with which you are not familiar. Ask the person to describe a typical day at work. Prepare a list of questions similar to the following: How long have you been in the _____ industry? Did you go to school? Did you work as an intern? What is the work environment like? What are your job duties? What other types of professionals do you work with? Report your findings to the class, giving reasons why you

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Communicating about Agriculture questions and activities help integrate reading, writing, listening, and speaking skills while extending your knowledge on the chapter topics.



would or would not want to pursue a career similar to that of the person you interviewed. (Do not forget to send a note thanking the person for their time and help.)

2. **Reading and Writing**—Select an agricultural product, and then determine how you could improve upon it to create a niche market. Write a product description outlining the comparative advantage that your new product would have.
3. **Writing and Speaking**—Using the product you created in question two, create a 5- to 10-minute presentation to pitch your idea to potential investors, similar to television shows where business hopefuls share their ideas in order to secure money from wealthy investors. Be prepared to share your presentation with the class.

SAE for ALL Opportunities

1. **Foundational: Career Exploration and Planning SAE**—SAEs provide you countless opportunities to learn about careers. Before you begin your career exploration, you need to explore who you are first. Ask your teacher for help in conducing a personal assessment. Consider completing a Myers-Briggs personality test or speaking with your school's career counselor to determine who you are as a person and who you could be as a future employee. Once you have completed this process, you should explore careers that match your personality and your skills. Use something like CareerOneStop from the US Department of Labor and use their assessment tools to find a career that works for you.
2. **Immersion: Entrepreneurship SAE**—Research caring for and feeding red wiggler worms before purchasing wigglers. Prepare a bin with the proper substrate. Begin with one bin of worms and feed them your kitchen scraps. Harvest the worms castings and sell them to gardeners. Harvest some of the worms to sell to local fishers. Add more bins and watch your business grow. Contact the school cafeteria to ask for more food scraps to feed your worms.
3. **Immersion: Placement SAE**—Contact your local farm bureau and set up a paid or unpaid internship. Learn about agricultural communication and the numerous other jobs at the Farm Bureau office.
4. **Immersion: Service Learning SAE**—Identify a youth organization in your community that could benefit from a garden mentoring program. Find students at your school to buddy with the children and help mentor the children while they also increase the youths' agricultural literacy.
5. **Immersion: School-Based Enterprise SAE**—Work with a team of students to build and sell beehives or raise queen bees for local farmers or landowners wishing to improve plant pollination or the ecosystem.
6. **Immersion: Research SAE**—Research how to grow microgreens. Grow a few different varieties and perform a taste test with students, staff at your school, family, and community members. Analyze the results and present the information to a local restaurant owner who is using or wants to use microgreens.

SAE for ALL Check-In

- How much time have you spent on your SAE this week?
- Have you logged your SAE hours?
- What challenges are you having with your SAE?
- How can your instructor help you?
- Do you have the equipment you need?

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

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To see how *Horticulture Today* correlates to credentialing and certification standards, visit the Correlations tab at www.g-w.com/horticulture-today-2023.

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New to This Edition

Goodheart-Willcox understands the importance of the three-circle model of instruction used in Agriculture Education, and we know the value of supervised agricultural experiences (SAEs)! During the revision of this title, we spoke with agriculture educators and students across the country—asking them how we can better support their SAE for ALL efforts. As a result, SAE for ALL Profiles are featured at the beginning of every chapter, providing students with SAE inspiration and a glimpse into their exciting potential future in the agriculture industry! With this feature, we highlight current and former students of agriculture education, as well as industry icons!

In addition to the new SAE for ALL Profiles and the exciting new design, the second edition of *Horticulture Today* has new and updated Career Connections that include salaries and job outlooks for the next decade. The authors have also included new hands-on activities that promote teamwork and leadership skills, as well as activities on harvest and storage issues for keeping produce fresh.

The new edition of *Horticulture Today* features new and revised end-of-chapter questions and activities, including critical thinking questions and STEM and academic activities. There are also new SAE for ALL Opportunities to provide students with creative new ideas for all types of SAE projects and a quick check-in for SAE progress.



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