Agriculture, Food & Natural Resources Career Cluster
Plant Science and Biotechnology
Course Number: 02.44100

Course Description:
Plant science is a basic component of the agriscience pathway. This course introduces students to the scientific theories, principles, and practices involved in the production and management of plants for food, feed, fiber, conservation and ornamental use. Classroom and laboratory activities are supplemented through supervised agricultural experiences and leadership programs and activities.

Course Standard 1

AFNR-PSB-1

The following standard is included in all CTAE courses adopted for the Career Cluster/Pathways. Teachers should incorporate the elements of this standard into lesson plans during the course. The topics listed for each element of the standard may be addressed in differentiated instruction matching the content of each course. These elements may also be addressed with specific lessons from a variety of resources. This content is not to be treated as a unit or separate body of knowledge but rather integrated into class activities as applications of the concept.

Standard: Demonstrate employability skills required by business and industry.
The following elements should be integrated throughout the content of this course.

1.1 Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities.

Person-to-Person Etiquette	Telephone and Email Etiquette	Cell Phone and Internet Etiquette	Communicating At Work	Listening
Interacting with Your Boss	Telephone Conversations	Using Blogs	Improving Communication Skills	Reasons, Benefits, and Barriers
Interacting with Subordinates	Barriers to Phone conversations	Using Social Media	Effective Oral Communication	Listening Strategies
Interacting with Co-workers	Making and Returning Calls		Effective Written Communication	Ways We Filter What We Hear
Interacting with Suppliers	Making Cold Calls		Effective Nonverbal Skills	Developing a Listening Attitude
	Handling Conference Calls		Effective Word Use	Show You Are Listening
	Handling Unsolicited Calls		Giving and Receiving Feedback	Asking Questions
				Obtaining Feedback
				Getting Others to Listen

Nonverbal Communication	Written Communication	Speaking	Applications and Effective Résumés
Communicating Nonverbally	Writing Documents	Using Language Carefully	Completing a Job Application
Reading Body Language and mixed Messages	Constructive Criticism in Writing	One-on-One Conversations	Writing a Cover Letter
Matching Verbal and Nonverbal communication		Small Group Communication	Things to Include in a Résumé
Improving Nonverbal Indicators		Large Group Communication	Selling Yourself in a Résumé

Nonverbal Feedback		Making Speeches	Terms to Use in a Résumé
Showing Confidence Nonverbally		Involving the Audience	Describing Your Job Strengths
Showing Assertiveness		Answering Questions	Organizing Your Résumé
		Visual and Media Aids	Writing an Electronic Résumé
		Errors in Presentation	Dressing Up Your Résumé

1.2 Demonstrate creativity by asking challenging questions and applying innovative procedures and methods.

Teamwork and Problem Solving	Meeting Etiquette
Thinking Creatively	Preparation and Participation in Meetings
Taking Risks	Conducting Two-Person or Large Group Meetings
Building Team Communication	Inviting and Introducing Speakers
	Facilitating Discussions and Closing
	Preparing Visual Aids
	Virtual Meetings

1.3 Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations.

Problem Solving	Customer Service	The Application Process	Interviewing Skills	Finding the Right Job
Transferable Job Skills	Gaining Trust and Interacting with Customers	Providing Information, Accuracy and Double Checking	Preparing for an Interview	Locating Jobs and Networking
Becoming a Problem Solver	Learning and Giving Customers What They Want	Online Application Process	Questions to Ask in an Interview	Job Shopping Online
Identifying a Problem	Keeping Customers Coming Back	Following Up After Submitting an Application	Things to Include in a Career Portfolio	Job Search Websites
Becoming a Critical Thinker	Seeing the Customer's Point	Effective Résumés:	Traits Employers are Seeking	Participation in Job Fairs
Managing	Selling Yourself and the Company	Matching Your Talents to a Job	Considerations Before Taking a Job	Searching the Classified Ads
	Handling Customer Complaints	When a Résumé Should be Used		Using Employment Agencies
	Strategies for Customer Service			Landing an Internship
				Staying Motivated to Search

1.4 Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity.

Workplace Ethics	Personal Characteristics	Employer Expectations	Business Etiquette	Communicating at Work
Demonstrating Good Work Ethic	Demonstrating a Good Attitude	Behaviors Employers Expect	Language and Behavior	Handling Anger
Behaving Appropriately	Gaining and Showing Respect	Objectionable Behaviors	Keeping Information Confidential	Dealing with Difficult Coworkers
Maintaining Honesty	Demonstrating Responsibility	Establishing Credibility	Avoiding Gossip	Dealing with a Difficult Boss
Playing Fair	Showing Dependability	Demonstrating Your Skills	Appropriate Work Email	Dealing with Difficult Customers
Using Ethical Language	Being Courteous	Building Work Relationships	Cell Phone Etiquette	Dealing with Conflict

Showing Responsibility	Gaining Coworkers' Trust		Appropriate Work Texting	
Reducing Harassment	Persevering		Understanding Copyright	
Respecting Diversity	Handling Criticism		Social Networking	
Making Truthfulness a Habit	Showing Professionalism			
Leaving a Job Ethically				

1.5 Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply team work skills.

Expected Work Traits	Teamwork	Time Management
Demonstrating Responsibility	Teamwork Skills	Managing Time
Dealing with Information Overload	Reasons Companies Use Teams	Putting First Things First
Transferable Job Skills	Decisions Teams Make	Juggling Many Priorities
Managing Change	Team Responsibilities	Overcoming Procrastination
Adopting a New Technology	Problems That Affect Teams	Organizing Workspace and Tasks
	Expressing Yourself on a Team	Staying Organized
	Giving and Receiving Constructive Criticism	Finding More Time
		Managing Projects
		Prioritizing Personal and Work Life

1.6 Present a professional image through appearance, behavior and language.

On-the-Job Etiquette	Person-to-Person Etiquette	Communication Etiquette	Presenting Yourself
Using Professional Manners	Meeting Business Acquaintances	Creating a Good Impression	Looking Professional
Introducing People	Meeting People for the First Time	Keeping Phone Calls Professional	Dressing for Success
Appropriate Dress	Showing Politeness	Proper Use of Work Email	Showing a Professional Attitude
Business Meal Functions		Proper Use of Cell Phone	Using Good Posture
Behavior at Work Parties		Proper Use in Texting	Presenting Yourself to Associates
Behavior at Conventions			Accepting Criticism
International Etiquette			Demonstrating Leadership
Cross-Cultural Etiquette			
Working in a Cubicle			

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence L9-10RST 1-10 and L9-10WHST 1-10:

Georgia Standards of Excellence ELA/Literacy standards have been written specifically for technical subjects and have been adopted as part of the official standards for all CTAE courses.

Course Standard 2

AFNR-PSB-2

Explore, develop, and implement the comprehensive program of agricultural education, learn and demonstrate safe working habits in the agriculture lab and work sites, demonstrate selected competencies in leadership through the FFA and agricultural industry organizations, and develop plans for a Supervised Agricultural Experience Program (SAEP).

2.1 Explain the role of the Agricultural Education program and the FFA in personal development.
2.2 Demonstrate knowledge learned through a SAEP.
2.3 Develop leadership and personal development skills through participation in the FFA.
2.4 Explore career opportunities in horticulture/plant science through the FFA and Agricultural Education Program.
2.5 Explore the professional agricultural organizations associated with the course content.

Course Standard 3

AFNR-PSB-3

Define and explain the importance of plant science in biotechnology.

3.1 Define science and agriscience.
3.2 Demonstrate the scientific method.
3.3 Explain why agriculture is an applied science.
3.4 Describe at least three advances in agriculture resulting from agricultural research.
3.5 Compile a list of historical events related to agricultural research and development.
3.6 Distinguish between basic and applied research.
3.7 Describe the role of plants in the food chain.
3.8 Describe the role plants play in the environment.
3.9 Explain how plants are used in the food and fiber system and ornamental purposes.
3.10 Trace the origin of common crop and ornamental plants.
3.11 Discuss the economic importance of plant production.
3.12 Demonstrate proper use of the compound and dissecting microscopes.

Course Standard 4

AFNR-PSB-4

Differentiate between plants utilizing scientific plant classification.

4.1 Write scientific names according to set guidelines.
4.2 Distinguish the differences between the levels of the classification system.
4.3 Explain the importance of using a universal classification system.
4.4 Discuss the importance of the plant patent system.
4.5 Define and explain the dichotomous key and use it to identify unknown plants and other items.
4.6 Identify terms used to describe the characteristics of plants.
4.7 Name and describe the major plant types.
4.8 Identify plant species within the major plant types.
4.9 Discuss the differences between vascular and nonvascular plants.

Course Standard 5

AFNR-PSB-5

Identify the parts of plant cells and describe their physiology.

5.1 Identify and describe the components of plant cells.
5.2 List the functions of plant cell components in relation to plant growth.
5.3 Distinguish between plant cells and animal cells.

5.4 Summarize the three kinds of plant cell activity (division, enlargement, and differentiation).
5.5 Describe the life cycle of a plant cell.
5.6 List phases of plant growth.
5.7 Identify the zone of elongation and differentiation.
5.8 Identify ways that osmosis affects plants.
5.9 Describe how water moves into and out of plant cells.
5.10 Define important terms and functions related to plant cells including osmosis, diffusion, etc.

Course Standard 6

AFNR-PSB-6
Explain technological advancements in plant development, reproduction, and protection.

6.1 Trace the development of modern species and varieties.
6.2 Outline a procedure that early plant breeders might have used to domesticate a wild plant species.
6.3 Define biotechnology terms including plant evolution, natural and artificial selection, genetic variation, etc.
6.4 Explain the role of biotechnology and bioengineering in modern plant production.
6.5 Compare traditional plant breeding and genetic engineering of plants.
6.6 Demonstrate plant tissue culture procedures and successfully propagate plant through plant tissue culture.
6.7 Describe the effects of growth hormones on tissue culture success.
6.8 Explain the importance of rhizobia bacteria to legumes.
6.9 Describe the importance of using legumes in agricultural operations.
6.10 Inoculate legumes with rhizobia bacteria.
6.11 Control plant growth through the application of growth inhibitors, stimulants, and cultural practices.
6.12 Identify the major plant hormones that are important to plant growth.
6.13 Explain why forcing of plants is important to the horticulture and related plant industries.
6.14 Discuss and give examples of the importance of genetic variation in the gene pool.
6.15 Debate the use of genetically modified organisms.

Course Standard 7

AFNR-PSB-7
Identify and describe plant nutritional needs.

7.1 Describe the role of nutrients in plant growth and development.
7.2 List primary and secondary plant nutrients.
7.3 Define plant needs for micro nutrients (trace elements).
7.4 Describe the role primary nutrients play in plant growth and development.
7.5 Explain the role of secondary and micro nutrients in plant growth and development.
7.6 Identify natural methods of supplying plants with nutrients.
7.7 Identify and prescribe artificial sources of plant nutrients.
7.8 Describe common symptoms of plants with excess nutrients and prescribe remedies.
7.9 Describe common symptoms of nutrient deficient plants and prescribe remedies.
7.10 Use concepts to solve soluble salt problems in soils.
7.11 Discuss the importance of soil tests and the application of prescribed remedies.
7.12 Conduct soil samples and interpret sample test results.
7.13 Analyze plant tissue sample.

7.14 Describe soil sampling procedures.
7.15 Identify key plant parts involved in nutrient transport.
7.16 Describe the process of nutrient transport.

Course Standard 8

AFNR-PSB-8
Evaluate soil characteristics for production capability.

8.1 Identify functions of soils on plant production.
8.2 Identify acids and bases using the pH scale.
8.3 Describe the importance of soil pH on crops.
8.4 Recommend and describe compounds that will change the soil pH.
8.5 Identify the soil pH best suited for certain crops.
8.6 Describe the composition of an ideal soil.
8.7 List factors that contribute to soil composition.
8.8 Identify various problems with soils that effect plant growth.
8.9 Estimate the amount of organic matter in a soil sample.
8.10 Describe the effect of macro and micro animal and plant products/waste on the soil.
8.11 Discuss the major horizons of mineral soils and identify their characteristics.
8.12 Classify soil horizons by color, texture, or structural composition.
8.13 Identify the soil structural classes.
8.14 Describe the effects of soil structure on crop production.
8.15 Identify the ways humans, animals and machinery can affect soil structure.
8.16 Sort and identify the three major constituents of mineral soil.
8.17 Describe each soil constituent relative to size and other characteristics.
8.18 Describe the effect of soil texture in agricultural operations.
8.19 Identify commonly used artificial soils, listing their advantages and disadvantages.
8.20 Select an artificial soil mixture for specific uses.
8.21 List sources and characteristics of commonly used soil mix ingredients.

Course Standard 9

AFNR-PSB-9
Diagram the life cycles of plants and explain plant reproduction.

9.1 Describe sexual and asexual reproduction in plants.
9.2 Identify the advantages of each type of plant propagation.
9.3 Categorize important agronomic and ornamental plants based on commercial propagation methods.
9.4 Define annual, winter annual, perennial, and biennial.
9.5 Trace the life cycle of plants and phases of growth.
9.6 Identify the male and female parts of flowering plants.
9.7 Describe the functions of each flower part.
9.8 Describe the processes of pollination and fertilization in plants.
9.9 Explain the process by which gametes are produced in both the male and female parts of the flower.
9.10 Distinguish between monoecious and dioecious plants.
9.11 Distinguish between complete and incomplete flowers.
9.12 Define cross-pollination and self-pollination.
9.13 Define fruit set and parthenocarpic fruit.
9.14 Classify the types of fruits and flowers.
9.15 Describe the formation and role fruits play in reproduction.
9.16 Discuss seed dispersal.

9.17 Identify methods of dispersal of common plants.
9.18 Identify factors necessary for seed germination.
9.19 Describe the process of germination.
9.20 Explain the importance of seed dormancy in plant survival.
9.21 Demonstrate scarify and stratify of seeds.
9.22 Describe and apply hypogeal and epigeal germination.

Course Standard 10

AFNR-PSB-10
Explain the importance of genetics in plant breeding.

10.1 Describe Mendel's experiments in plant breeding.
10.2 Describe Law of Independent Assortment.
10.3 Discuss the difference between heterozygous and homozygous.
10.4 List the seven plant characteristics of the garden pea used extensively by Mendel.
10.5 Discuss the two factors that influenced Mendel to use garden peas as his plant variety for studying inheritance of plants.
10.6 Predict genetic outcome using a Punnett Square.
10.7 Describe the structure of a DNA (Deoxyribonucleic acid) molecule.
10.8 Define DNA and RNA (Ribonucleic acid).
10.9 Discuss and list examples of major advances in agronomic production due to heterosis.
10.10 Determine the difference between F1 and F2 generations and describe the use of each in plant breeding.
10.11 Generate crossbred plants through plant breeding.

Course Standard 11

AFNR-PSB-11
Analyze the environmental requirements of plants.

11.1 Differentiate between climatic regions of Georgia and the United States.
11.2 Explain climatic effects on soils and the resulting effect on plant production.
11.3 Determine temperature and the effects of temperature on plant production.
11.4 Convert temperature measurements from Fahrenheit to Celsius and Celsius to Fahrenheit.
11.5 Distinguish between cool season and warm season plants.
11.6 Explain the importance of temperature on germination, pollination, and other plant functions.
11.7 Utilize the plant hardiness zoning classification system for plants.
11.8 Measure precipitation.
11.9 Determine the amount of annual precipitation in the various parts of Georgia, and the United States and describe the limitations of plant production based on rainfall.
11.10 Match plants adapted to regions based on rainfall.
11.11 Measure humidity and explain the importance to agriculture.
11.12 Explain evaporative cooling and limitation.
11.13 Explain the effect of light on plants and agricultural production practices.
11.14 Define photoperiodism and demonstrate the use in plant production.
11.15 Distinguish between light sources, intensity, and quality and prescribe light needs for plants.
11.16 Demonstrate the effects of light colors (chromatography) and intensity on plants.
11.17 Measure wind velocity and explain the effects of wind on plants, structures, etc.
11.18 Determine the best location for orchards, greenhouses, and related essential structures based on climatic conditions.

11.19 Differentiate among the various tropisms including geotropism, phototropism, and chemotropism.
11.20 Explain why plants respond to stimuli and grow in certain directions.

Course Standard 12

AFNR-PSB-12
Explain the uses of plants in medicine, food crops, animal feeds, and ornamental applications.

12.1 Describe how and what plants can be used for medicinal purposes.
12.2 Describe the importance of food crops and identify food crops grown locally.
12.3 Explain the economic impact of food crops.
12.4 List major agronomic foods crops and identify the region of Georgia or the United States where each is grown.
12.5 Define the use and economic importance of ornamental plants.

Course Standard 13

AFNR-PSB-13
Propagate plants using methods of vegetative cloning and sexual reproduction.

13.1 Define cloning and describe the materials and methods of cloning.
13.2 Explain the benefits of cloning plants.
13.3 Prescribe plant propagation procedures based on economics and reproduction success rate.
13.4 Differentiate between sexual and asexual reproduction.
13.5 Select and utilize plant hormones in plant propagation.
13.6 Explain the stimuli and response effect of plant hormones used in plant propagation.
13.7 Propagate plants though sexual and asexual reproduction.

Course Standard 14

AFNR-PSB-14
Identify and classify weeds, prescribe control methods, and describe the economic and environmental effects that weeds have on agricultural production.

14.1 Define and classify weeds according to plant characteristics.
14.2 Identify the economic and aesthetic impact of weeds.
14.3 Explain how weeds compete with plants in fields, greenhouses, landscapes, etc.
14.4 Calculate the economic threshold for weed control measures to be implemented.
14.5 Describe actions, conditions, vectors, and weed characteristics that help in distribution of weed seeds.
14.6 Identify characteristics of weeds that affect treatment type and effectiveness of treatment.
14.7 Identify common weed plants and the crops/locations they infest.
14.8 Prescribe methods of weed control and the appropriate use of weed control measures.
14.9 Explain the importance of Integrated Pest Management (IPM).
14.10 Interpret and implement pesticide label application instructions.
14.11 Debate environmental concerns related to weed control.
14.12 Prescribe alternative methods to chemical weed control.
14.13 Compare and contrast advantages and disadvantages of specific weed control measures.
14.14 Discuss and explain methods of safe herbicide use.
14.15 Demonstrate the proper application method for herbicides.

Course Standard 15

AFNR-PSB-15

Identify, determine control methods, and define the environmental and economic impact insects have on plant production.

15.1 Explain why the study of entomology is important.
15.2 Classify insects using a dichotomous key, and reference materials.
15.3 Describe and identify body parts of insects.
15.4 Identify common agricultural pests by sight and describe the damage done by insects.
15.5 Distinguish between beneficial and harmful insects.
15.6 Describe beneficial insects and the ways in which beneficial insects control pests.
15.7 Identify common beneficial insects by sight and prescribe measures to encourage their continued presence.
15.8 Discuss the importance of insects in relation to pollination.
15.9 Describe chemical and mechanical insect control measures available to producers to protect plants.
15.10 Discuss how natural pest control measures can be utilized by producers to protect plants.
15.11 Compare and contrast the advantages and disadvantages of using insecticides with non-chemical, organic plant production.
15.12 Explain why environmentally safe insect controls are needed.
15.13 Discuss the use of Integrated Pest Management for controlling insects.
15.14 Demonstrate the safe use of pesticides.

Course Standard 16

AFNR-PSB-16

Identify diseases, related organisms, and physiological disorders affecting plants, and prescribe methods of prevention and control.

16.1 Discuss the impact of diseases, nematodes, and physiological disorders on plant production.
16.2 Classify the types of plant diseases and casual organism.
16.3 Prescribe methods of preventing and controlling plant disease, nematodes, and physiological disorders.
16.4 Explain factors necessary for disease infection in plants.
16.5 Diagram the life cycle of common diseases.
16.6 Explain how fungi, bacteria, and viruses are spread.
16.7 Identify common plant diseases by symptoms and signs.
16.8 Define key terms related to plant pathology.
16.9 Trace the history and importance of plant pathology.
16.10 Describe the types of nematodes and how they damage plants.
16.11 Explain how unfavorable environmental conditions can affect disease or disease-like infestations in plants.
16.12 Differentiate between pathogenic and non-pathogenic diseases.
16.13 Demonstrate the safe use of pesticides.

Course Standard 17

AFNR-PSB-17

Analyze the water-plant relationship and describe how water and other materials move through the plant.

17.1 Describe the three categories of water that may be present in the soil.
17.2 Describe hydraulic conductivity, infiltration, and percolation.
17.3 Distinguish between soil texture and bulk density and how they affect soil-water.
17.4 Define absorption and describe how absorption takes place.
17.5 Explain how soil solution enters root hairs.
17.6 Describe and explain the movement of water in plant cells.
17.7 Distinguish between xylem and phloem based on function.

Course Standard 18

AFNR-PSB-18

Evaluate environmentally controlled plant growth systems.

18.1 Discuss why environmentally-controlled structures are used and describe their advantages.
18.2 Determine the use of each of the environmentally-controlled structures based on the plants to be produced.
18.3 Diagram the environmental control components of greenhouses, cold frames, and other plant growth structures.
18.4 Describe how hydroponic systems are used in horticulture and plant science.
18.5 Describe the essential elements of a hydroponic system.

Course Standard 19

AFNR-PSB-19

Analyze the effect of plant production on the environment.

19.1 Explain the importance of plant processes to life on earth.
19.2 Explain the role of plants in the food chain.
19.3 Describe photosynthesis and respiration analyzing the role CO_2 and O_2 play.
19.4 Describe how conventional agricultural practices affect the environment.
19.5 Describe new agricultural practices that are environmentally friendly.
19.6 Compare and contrast the advantages and disadvantages of conventional versus organic farming.
19.7 Explain the importance of compost in the production of plants.
19.8 Describe how composting works and the procedures for creating a compost pile.
19.9 Describe uses for plant by-products and the environmental benefits to using them.
19.10 Define methods of erosion prevention and prescribe erosion control measures for a specific site in the community.