Georgia CTAE: Agriculture, Food & Natural Resources Career Cluster

Plant Science & Biotechnology

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. PSB 1

- **1.1** Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities PSB 1.1
- **1.2** Demonstrate creativity by asking challenging questions and applying innovative procedures and methods. PSB 1.2
- **1.3** Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations. PSB 1.3
- **1.4** Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity. PSB 1.4
- **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. PSB 1.5
- **1.6** Present a professional image through appearance, behavior and language. PSB 1.6

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

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

Supervised Agricultural Experience Program (SAEP). PSB 2	
Define and explain the importance of plant science in biotechnology. PSB 3	**3.1** Define science and agriscience. PSB 3.1
	3.2 Demonstrate the scientific method. PSB 3.2
	3.3 Explain why agriculture is an applied science. PSB 3.3
	3.4 Describe at least three advances in agriculture resulting from agricultural research. PSB 3.4
	3.5 Compile a list of historical events related to agricultural research and development. PSB 3.5
	3.6 Distinguish between basic and applied research. PSB 3.6
	3.7 Describe the role of plants in the food chain. PSB 3.7
	3.8 Describe the role plants play in the environment. PSB 3.8
	3.9 Explain how plants are used in the food and fiber system and ornamental purposes. PSB 3.9
	3.10 Trace the origin of common crop and ornamental plants. PSB 3.10
	3.11 Discuss the economic importance of plant production. PSB 3.11
	3.12 Demonstrate proper use of the compound and dissecting microscopes. PSB 3.12
Differentiate between plants utilizing scientific plant classification. PSB 4	**4.1** Write scientific names according to set guidelines. PSB 4.1
	4.2 Distinguish the differences between the levels of the classification system. PSB 4.2
	4.3 Explain the importance of using a universal classification system. PSB 4.3
	4.4 Discuss the importance of the plant patent system. PSB 4.4
	4.5 Define and explain the dichotomous key and use it to identify unknown plants and other items. PSB 4.5
	4.6 Identify terms used to describe the characteristics of plants. PSB 4.6
	4.7 Name and describe the major plant types. PSB 4.7
	4.8 Identify plant species within the major plant types. PSB 4.8

	4.9 Discuss the differences between vascular and nonvascular plants. PSB 4.9
Identify the parts of plant cells and describe their physiology PSB 5	**5.1** Identify and describe the components of plant cells. PSB 5.1
	5.2 List the functions of plant cell components in relation to plant growth. PSB 5.2
	5.3 Distinguish between plant cells and animal cells PSB 5.3
	5.4 Summarize the three kinds of plant cell activity (division, enlargement, and differentiation). PSB 5.4
	5.5 Describe the life cycle of a plant cell. 5.6 List phases of plant growth. PSB 5.5
	5.6 List phases of plant growth. PSB 5.6
	5.7 Identify the zone of elongation and differentiation. 5.8 Identify ways that osmosis affects plants. PSB 5.7
	5.8 Identify ways that osmosis affects plants. PSB 5.8
	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. PSB 5.9
Explain technological advancements in plant development, reproduction, and protection. PSB 6	**6.1** Trace the development of modern species and varieties. PSB 6.1
	6.2 Outline a procedure that early plant breeders might have used to domesticate a wild plant species. PSB 6.2
	6.3 Define biotechnology terms including plant evolution, natural and artificial selection, genetic variation, etc. PSB 6.3
	6.4 Explain the role of biotechnology and bioengineering in modern plant production. PSB 6.4
	6.5 Compare traditional plant breeding and genetic engineering of plants. PSB 6.5
	6.6 Demonstrate plant tissue culture procedures and successfully propagate plant through plant tissue culture. PSB 6.6
	6.7 Describe the effects of growth hormones on tissue culture success. PSB 6.7
	6.8 Explain the importance of rhizobia bacteria to legumes. PSB 6.8
	6.9 Describe the importance of using legumes in agricultural operations. PSB 6.9
	6.10 Inoculate legumes with rhizobia bacteria. PSB 6.10

	6.11 Control plant growth through the application of growth inhibitors, stimulants, and cultural practices. PSB 6.11
	6.12 Identify the major plant hormones that are important to plant growth. PSB 6.12
	6.13 Explain why forcing of plants is important to the horticulture and related plant industries. PSB 6.13
	6.14 Discuss and give examples of the importance of genetic variation in the gene pool. PSB 6.14
	6.15 Debate the use of genetically modified organisms. PSB 6.15
Identify and describe plant nutritional needs. PSB 7	**7.1** Describe the role of nutrients in plant growth and development. PSB 7.1
	7.2 List primary and secondary plant nutrients. PSB 7.2
	7.3 Define plant needs for micro nutrients (trace elements). PSB 7.3
	7.4 Describe the role primary nutrients play in plant growth and development. PSB 7.4
	7.5 Explain the role of secondary and micro nutrients in plant growth and development. PSB 7.5
	7.6 Identify natural methods of supplying plants with nutrients. PSB 7.6
	7.7 Identify and prescribe artificial sources of plant nutrients. PSB 7.7
	7.8 Describe common symptoms of plants with excess nutrients and prescribe remedies. PSB 7.8
	7.9 Describe common symptoms of nutrient deficient plants and prescribe remedies. PSB 7.9
	7.10 Use concepts to solve soluble salt problems in soils. PSB 7.10
	7.11 Discuss the importance of soil tests and the application of prescribed remedies. PSB 7.11
	7.12 Conduct soil samples and interpret sample test results. PSB 7.12
	7.13 Analyze plant tissue sample. PSB 7.13
	7.14 Describe soil sampling procedures. PSB 7.14
	7.15 Identify key plant parts involved in nutrient transport. PSB 7.15
	7.16 Describe the process of nutrient transport. PSB 7.16

Evaluate soil characteristics for production capability PSB 8	**8.1** Identify functions of soils on plant production. PSB 8.1
	8.2 Identify acids and bases using the pH scale. PSB 8.2
	8.3 Describe the importance of soil pH on crops. PSB 8.3
	8.4 Recommend and describe compounds that will change the soil pH. PSB 8.4
	8.5 Identify the soil pH best suited for certain crops. PSB 8.5
	8.6 Describe the composition of an ideal soil. PSB 8.6
	8.7 List factors that contribute to soil composition. PSB 8.7
	8.8 Identify various problems with soils that effect plant growth. PSB 8.8
	8.9 Estimate the amount of organic matter in a soil sample. PSB 8.9
	8.10 Describe the effect of macro and micro animal and plant products/waste on the soil. PSB 8.10
	8.11 Discuss the major horizons of mineral soils and identify their characteristics. PSB 8.11
	8.12 Classify soil horizons by color, texture, or structural composition. PSB 8.12
	8.13 Identify the soil structural classes. PSB 8.13
	8.14 Describe the effects of soil structure on crop production. PSB 8.14
	8.15 Identify the ways humans, animals and machinery can affect soil structure. PSB 8.15
	8.16 Sort and identify the three major constituents of mineral soil. PSB 8.16
	8.17 Describe each soil constituent relative to size and other characteristics. PSB 8.17
	8.18 Describe the effect of soil texture in agricultural operations. PSB 8.18
	8.19 Identify commonly used artificial soils, listing their advantages and disadvantages. PSB 8.19
	8.20 Select an artificial soil mixture for specific uses. PSB 8.20
	8.21 List sources and characteristics of commonly used soil mix ingredients. PSB 8.21
Diagram the life cycles of plants and explain	**9.1** Describe sexual and asexual reproduction in plants. PSB 9.1

plant reproduction. PSB 9	**9.2** Identify the advantages of each type of plant propagation. PSB 9.2
	9.3 Categorize important agronomic and ornamental plants based on commercial propagation methods. PSB 9.3
	9.4 Define annual, winter annual, perennial, and biennial. PSB 9.4
	9.5 Trace the life cycle of plants and phases of growth. PSB 9.5
	9.6 Identify the male and female parts of flowering plants. PSB 9.6
	9.7 Describe the functions of each flower part. PSB 9.7
	9.8 Describe the processes of pollination and fertilization in plants. PSB 9.8
	9.9 Explain the process by which gametes are produced in both the male and female parts of the flower. PSB 9.9
	9.10 Distinguish between monoecious and dioecious plants. PSB 9.10
	9.11 Distinguish between complete and incomplete flowers. PSB 9.11
	9.12 Define cross-pollination and self-pollination. PSB 9.12
	9.13 Define fruit set and parthenocarpic fruit. PSB 9.13
	9.14 Classify the types of fruits and flowers. PSB 9.14
	9.15 Describe the formation and role fruits play in reproduction. PSB 9.15
	9.16 Discuss seed dispersal. PSB 9.16
	9.17 Identify methods of dispersal of common plants. PSB 9.17
	9.18 Identify factors necessary for seed germination. PSB 9.18
	9.19 Describe the process of germination. PSB 9.19
	9.20 Explain the importance of seed dormancy in plant survival. PSB 9.20
	9.21 Demonstrate scarify and stratify of seeds. PSB 9.21
	9.22 Describe and apply hypogeal and epigeal germination. PSB 9.22
Explain the importance of genetics in plant breeding PSB 10	**10.1** Describe Mendel's experiments in plant breeding. PSB 10.1
	10.2 Describe Law of Independent Assortment. PSB 10.2
	10.3 Discuss the difference between heterozygous and homozygous. PSB 10.3

10.4 List the seven plant characteristics of the garden pea used extensively by Mendel. PSB 10.4

10.5 Discuss the two factors that influenced Mendel to use garden peas as his plant variety for studying inheritance of plants. PSB 10.5

10.6 Predict genetic outcome using a Punnett Square. PSB 10.6

10.7 Describe the structure of a DNA (Deoxyribonucleic acid) molecule. PSB 10.7

10.8 Define DNA and RNA (Ribonucleic acid). PSB 10.8

10.9 Discuss and list examples of major advances in agronomic production due to heterosis. PSB 10.9

10.10 Determine the difference between F1 and F2 generations and describe the use of each in plant breeding. PSB 10.10

10.11 Generate crossbred plants through plant breeding. PSB 10.11

Analyze the environmental requirements of plants. PSB 11

11.1 Differentiate between climatic regions of Georgia and the United States. PSB 11.1

11.2 Explain climatic effects on soils and the resulting effect on plant production. PSB 11.2

11.3 Determine temperature and the effects of temperature on plant production. PSB 11.3

11.4 Convert temperature measurements from Fahrenheit to Celsius and Celsius to Fahrenheit. PSB 11.4

11.5 Distinguish between cool season and warm season plants. PSB 11.5

11.6 Explain the importance of temperature on germination, pollination, and other plant functions. PSB 11.6

11.7 Utilize the plant hardiness zoning classification system for plants. PSB 11.7

11.8 Measure precipitation. PSB 11.8

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. PSB 11.9

11.10 Match plants adapted to regions based on rainfall. PSB 11.10

11.11 Measure humidity and explain the importance to agriculture. PSB 11.11

11.12 Explain evaporative cooling and limitation. PSB 11.12

	11.13 Explain the effect of light on plants and agricultural production practices. PSB 11.13
	11.14 Define photoperiodism and demonstrate the use in plant production. PSB 11.14
	11.15 Distinguish between light sources, intensity, and quality and prescribe light needs for plants. PSB 11.15
	11.16 Demonstrate the effects of light colors (chromatography) and intensity on plants. PSB 11.16
	11.17 Measure wind velocity and explain the effects of wind on plants, structures, etc. PSB 11.17
	11.18 Determine the best location for orchards, greenhouses, and related essential structures based on climatic conditions. PSB 11.18
	11.19 Differentiate among the various tropisms including geotropism, phototropism, and chemotropism. PSB 11.19
	11.20 Explain why plants respond to stimuli and grow in certain directions. PSB 11.20
Explain the uses of plants in medicine, food crops, animal feeds, and ornamental applications. PSB 12	**12.1** Describe how and what plants can be used for medicinal purposes. PSB 12.1
	12.2 Describe the importance of food crops and identify food crops grown locally. PSB 12.2
	12.3 Explain the economic impact of food crops. PSB 12.3
	12.4 List major agronomic foods crops and identify the region of Georgia or the United States where each is grown. PSB 12.4
	12.5 Define the use and economic importance of ornamental plants. PSB 12.5
Propagate plants using methods of vegetative cloning and sexual reproduction. PSB 13	**13.1** Define cloning and describe the materials and methods of cloning. PSB 13.1
	13.2 Explain the benefits of cloning plants. PSB 13.2
	13.3 Prescribe plant propagation procedures based on economics and reproduction success rate. PSB 13.3
	13.4 Differentiate between sexual and asexual reproduction. PSB 13.4
	13.5 Select and utilize plant hormones in plant propagation. PSB 13.5
	13.6 Explain the stimuli and response effect of plant hormones used in plant propagation. PSB 13.6

	13.7 Propagate plants though sexual and asexual reproduction. PSB 13.7
Identify and classify weeds, prescribe control methods, and describe the economic and environmental effects that weeds have on agricultural production. PSB 14	**14.1** Define and classify weeds according to plant characteristics. PSB 14.1
	14.2 Identify the economic and aesthetic impact of weeds. PSB 14.2
	14.3 Explain how weeds compete with plants in fields, greenhouses, landscapes, etc. PSB 14.3
	14.4 Calculate the economic threshold for weed control measures to be implemented. PSB 14.4
	14.5 Describe actions, conditions, vectors, and weed characteristics that help in distribution of weed seeds. PSB 14.5
	14.6 Identify characteristics of weeds that affect treatment type and effectiveness of treatment. PSB 14.6
	14.7 Identify common weed plants and the crops/locations they infest. PSB 14.7
	14.8 Prescribe methods of weed control and the appropriate use of weed control measures. PSB 14.8
	14.9 Explain the importance of Integrated Pest Management (IPM). PSB 14.9
	14.10 Interpret and implement pesticide label application instructions. PSB 14.10
	14.11 Debate environmental concerns related to weed control. PSB 14.11
	14.12 Prescribe alternative methods to chemical weed control. PSB 14.12
	14.13 Compare and contrast advantages and disadvantages of specific weed control measures. PSB 14.13
	14.14 Discuss and explain methods of safe herbicide use. PSB 14.14
	14.15 Demonstrate the proper application method for herbicides. PSB 14.15
Identify, determine control methods, and define the environmental and economic impact insects have on plant production. PSB 15	**15.1** Explain why the study of entomology is important. PSB 15.1
	15.2 Classify insects using a dichotomous key, and reference materials. PSB 15.2
	15.3 Describe and identify body parts of insects. PSB 15.3
	15.4 Identify common agricultural pests by sight and describe the damage done by insects. PSB 15.4
	15.5 Distinguish between beneficial and harmful insects. PSB 15.5

	15.6 Describe beneficial insects and the ways in which beneficial insects control pests. PSB 15.6
	15.7 Identify common beneficial insects by sight and prescribe measures to encourage their continued presence. PSB 15.7
	15.8 Discuss the importance of insects in relation to pollination. PSB 15.8
	15.9 Describe chemical and mechanical insect control measures available to producers to protect plants. PSB 15.9
	15.10 Discuss how natural pest control measures can be utilized by producers to protect plants. PSB 15.10
	15.11 Compare and contrast the advantages and disadvantages of using insecticides with non-chemical, organic plant production. PSB 15.11
	15.12 Explain why environmentally safe insect controls are needed. PSB 15.12
	15.13 Discuss the use of Integrated Pest Management for controlling insects. PSB 15.13
	15.14 Demonstrate the safe use of pesticides. PSB 15.14
Identify diseases, related organisms, and physiological disorders affecting plants, and prescribe methods of prevention and control. PSB 16	**16.1** Discuss the impact of diseases, nematodes, and physiological disorders on plant production. PSB 16.1
	16.2 Classify the types of plant diseases and casual organism. PSB 16.2
	16.3 Prescribe methods of preventing and controlling plant disease, nematodes, and physiological disorders. PSB 16.3
	16.4 Explain factors necessary for disease infection in plants. PSB 16.4
	16.5 Diagram the life cycle of common diseases. PSB 16.5
	16.6 Explain how fungi, bacteria, and viruses are spread. PSB 16.6
	16.7 Identify common plant diseases by symptoms and signs. PSB 16.7
	16.8 Define key terms related to plant pathology. PSB 16.8
	16.9 Trace the history and importance of plant pathology. PSB 16.9
	16.10 Describe the types of nematodes and how they damage plants. PSB 16.10
	16.11 Explain how unfavorable environmental conditions can affect disease or disease-like infestations in plants. PSB 16.11
	16.12 Differentiate between pathogenic and non-pathogenic diseases. PSB 16.12

	16.13 Demonstrate the safe use of pesticides. PSB 16.13
Analyze the water-plant relationship and describe how water and other materials move through the plant. PSB 17	**17.1** Describe the three categories of water that may be present in the soil. PSB 17.1
	17.2 Describe hydraulic conductivity, infiltration, and percolation. PSB 17.2
	17.3 Distinguish between soil texture and bulk density and how they affect soil-water. PSB 17.3
	17.4 Define absorption and describe how absorption takes place. PSB 17.4
	17.5 Explain how soil solution enters root hairs. PSB 17.5
	17.6 Describe and explain the movement of water in plant cells. PSB 17.6
	17.7 Distinguish between xylem and phloem based on function. PSB 17.7
Evaluate environmentally controlled plant growth systems. PSB 18	**18.1** Discuss why environmentally-controlled structures are used and describe their advantages. PSB 18.1
	18.2 Determine the use of each of the environmentally-controlled structures based on the plants to be produced. PSB 18.2
	18.3 Diagram the environmental control components of greenhouses, cold frames, and other plant growth structures. PSB 18.3
	18.4 Describe how hydroponic systems are used in horticulture and plant science. PSB 18.4
	18.5 Describe the essential elements of a hydroponic system. PSB 18.5
Analyze the effect of plant production on the environment. PSB 19	**19.1** Explain the importance of plant processes to life on earth. PSB 19.1
	19.2 Explain the role of plants in the food chain. PSB 19.2
	19.3 Describe photosynthesis and respiration analyzing the role CO2 and O2 play. PSB 19.3
	19.4 Describe how conventional agricultural practices affect the environment. PSB 19.4
	19.5 Describe new agricultural practices that are environmentally friendly. PSB 19.5
	19.6 Compare and contrast the advantages and disadvantages of conventional versus organic farming. PSB 19.6
	19.7 Explain the importance of compost in the production of plants. PSB 19.7

19.8 **Describe how composting works and the procedures for creating a compost pile.** PSB 19.8

19.9 **Describe uses for plant by-products and the environmental benefits to using them.** PSB 19.19

19.10 **Define methods of erosion prevention and prescribe erosion control measures for a specific site in the community.** PSB 19.20