

BIOLOGICAL PLANT SCIENCES

Curriculum Content Framework

Please note: All assessment questions will be taken from the knowledge portion of these frameworks.

Curriculum Advisory Committee

Gene Collins — Siloam Springs High School
Tim Cunningham — Calico Rock High School
Andy Guffey — Arkansas Farm Bureau
Joseph Ham — Greenwood High School
Dr. Jeff Horne — Southern Arkansas University
Travis Justice — Arkansas Farm Bureau
Mike Rogers — Siloam Springs High School
William Tapp — Gravette High School
Jennifer Turner — Ozark High School

Facilitated By

Agricultural Education Staff
Arkansas Department of Workforce Education —
Marion Fletcher, Bruce Lazarus, Dr. Ann Horne, and Patti Priest

Project Consultants

Dr. Jasper S. Lee and Daniel J. Pentony
Center for Agricultural and Environmental Research & Training (CAERT), Inc.
Danville, Illinois 61832

Spring 2006

Curriculum Content Framework

BIOLOGICAL PLANT SCIENCES

Grade Levels: 10, 11, 12

Course Code:

Prerequisite: None

Course Description: This course is a scientific approach to plant science using scientific principles and applied management practices. Emphasis is on genetics, scientific experimentation and reporting, and advanced plant science systems. Opportunities are provided for students to participate in supervised experience and FFA.

	Page
Unit 1: Biological Science in Our Lives (6 hours)	1
Unit 2: Safety in the Biological Plant Sciences (5 hours)	5
Unit 3: Conducting Experiments and Research (10 hours)	7
Unit 4: Summarizing and Reporting Research (8 hours)	10
Unit 5: Plant Genetics and Heritability (8 hours)	12
Unit 6: Plant Growth Processes (10 hours)	14
Unit 7: Plant Reproduction (10 hours)	16
Unit 8: Hydroponics Systems (8 hours)	18
Unit 9: Plant Tissue Culture (10 hours)	20
Unit 10: Biological Engineering (7 hours)	22
Unit 11: Plants and Chemicals (8 hours)	24
Glossary	26

Unit 1: Biological Science in Our Lives 6 Hours

Terminology: agronomy, biological plant science, botany, entomology, forestry, horticulture, soil science

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
1.1 Define terms	1.1.1	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
1.2 Discuss areas of science that are a part of the biological plant sciences	1.2.1 List and differentiate areas of the biological plant sciences to include biology and botany as well as those in agriculture (agronomy, horticulture, forestry, soil, entomology, and others)	Foundation	Reading	Comprehends written information for main ideas [1.3.7]
	1.2.2 Review college offerings (catalog or online) in areas of the biological plant sciences to determine the nature of the subjects and educational opportunities	Personal Management	Career Awareness, Development, and Mobility	Explores career opportunities [3.1.6] Identifies education and training needed to achieve goals [3.1.8]
1.3 Identify ways in which the biological plant sciences affect our everyday lives	1.3.1 Collect magazine and newspaper articles related to the topic	Foundation	Reading	Adjusts reading strategy to purpose and type of reading (skimming and scanning) [1.3.1]
	1.3.2 Prepare a poster or bulletin board that depicts the biological plant sciences in our lives	Thinking	Creative Thinking	Applies information and concepts derived from printed materials [1.3.3]
	1.3.3 Plan an experiment that involves the plant biological sciences			Draws conclusions from what is read [1.3.12]
1.4 List career opportunities in the plant biological sciences	1.4.1 Research a career in the plant biological sciences to determine educational requirements, working conditions, and salary	Foundation	Writing	Uses imagination to create something new [4.1.1]
				Develops visual aids to create audience interest [4.1.4]
				Makes connections between seemingly unrelated ideas [4.1.6]
				Applies rules of grammar, punctuation, capitalization, and spelling [1.6.3]

	<p>1.4.2 Prepare a written report on a career in the plant biological sciences</p> <p>1.4.3 Provide an oral report on a career in the plant biological sciences</p> <p>1.4.4 Create a current, business-style resume</p>	<p>Personal Management</p>	<p>Career Awareness, Development, and Mobility</p>	<p>Checks, edits, and revises document for correct information, appropriate emphasis, form, grammar, spelling, and punctuation [1.6.5]</p> <p>Evaluates written information for appropriateness/content/clarity [1.6.9]</p> <p>Develops skills to locate, evaluate, and interpret career information [3.1.4]</p> <p>Explores career opportunities [3.1.6]</p> <p>Identifies continuing changes in male/female roles at home and work [3.1.7]</p> <p>Identifies education and training needed to achieve goals [3.1.8]</p>
--	--	----------------------------	--	---

1.5	Discuss FFA and supervised experience opportunities for students interested in the plant biological sciences	1.5.1	Use the Official FFA Manual, National FFA Organization Web site, and other resources to identify opportunities	Foundation	Reading	Comprehends written information for main ideas [1.3.7]
		1.5.2	Plan and/or expand supervised experience to include areas of the biological plant sciences		Listening	Evaluates oral information/presentation [1.2.2]
		1.5.3	Shadow a plant scientist in his or her work for a day			Listens for content [1.2.3]
		1.5.4	Keep appropriate records of all activities			Listens for long-term contexts [1.2.7]
				Personal Management	Speaking	Asks questions to clarify information [1.5.3] Asks questions to obtain information [1.5.4]
					Career Awareness, Development, and Mobility	Analyzes impact of work on individual and family life [3.1.1] Monitors progress toward goal attainment [3.1.10] Analyzes own knowledge, skills, and ability [3.1.2] Identifies education and training needed to achieve goals [3.1.8] Sets well-defined and realistic personal/career goals (short-term and long-term) [3.1.11]

Unit 2: Safety in the Biological Plant Sciences

5 Hours

Terminology: hazard, laboratory accident, material safety data sheets, occupational safety, personal protective equipment (PPE), personal safety, plant allergy, safety

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
2.1 Define terms	2.1.1	Foundation	Reading	Applies/Understands technical words that pertain to subject [1.3.6] Uses written resources (books, dictionaries, directories) to obtain factual information [1.3.23]
		Thinking	Knowing How to Learn	Develops personal learning strategies—note taking, clustering related items, flash cards, etc. [4.3.2] Locates appropriate learning resources to acquire or improve knowledge and skills [4.3.3]
2.2 Discuss the meaning and importance of safety and safe work in the biological plant sciences	2.2.1 Relate examples of safety hazards in the biological plant sciences	Foundation	Reading	Distinguishes between fact and opinion [1.3.11]
	2.2.2 Identify plant allergies and the precautions to follow to minimize risk		Speaking	Asks questions to obtain information [1.5.4]
2.3 Identify hazards in the biological plant sciences	2.3.1 Identify hazardous situations in the biological plant sciences and implement appropriate safety measures to eliminate or reduce the risk of the hazards	Foundation	Reading	Analyzes and applies what has been read to specific task [1.3.2]
	2.3.2 Identify laboratory risks and take actions to minimize the hazards	Personal Management Skills	Integrity/Honesty/Work Ethic	Complies with safety and health rules in a given work environment [3.2.2]
2.4 Describe the importance of personal safety in the biological plant sciences	2.4.1 Identify and properly use appropriate PPE, including protective clothing and safety footwear	Thinking Skills	Problem Solving	Comprehends ideas and concepts related to safety with animals [4.4.1]
	2.4.2 Calculate the cost of PPE for an individual involved in the biological plant sciences	Foundation	Arithmetic/Mathematics	Calculates dollar amounts [1.1.7]
	2.4.3 Work together with others to promote safety in the biological plant sciences	Interpersonal	Negotiation	Works to resolve conflict between two or more individuals [2.5.3]

2.4.4	Take a test that documents an understanding of safety in the biological plant sciences			
-------	--	--	--	--

		Thinking	Problem Solving	Comprehends ideas and concepts related to scientific research [4.4.1] Draws conclusions from what is read and gives practical solutions [4.4.3]
--	--	----------	-----------------	--

3.3	Explain how the research process is applied to lab and field experiments	3.3.1	Conduct a simple experiment following approved methods	Foundation	Science	Applies knowledge to complete a practical task [1.4.3]
		3.3.2	Observe safety practices in the conduct of experiments			Applies a scientific principle to solve a problem [1.4.8]
		3.3.3	Identify appropriate experiments with plants	Interpersonal	Teamwork	Contributes to group with ideas, suggestions, and effort [2.6.2]
		3.3.4	Identify appropriate measurements for the experiment			Works effectively with others to reach a common goal [2.6.6]
				Personal Management	Integrity/ Honesty/ Work Ethic	Complies with safety and health rules in a given work environment [3.2.2]
3.4	Discuss the collection of data	3.4.1	Collect and record data in a log book or appropriate computer program	Foundation	Writing	Evaluates written information for appropriateness/content/clarity [1.6.9]
		3.4.2	Compile, tabulate, and analyze data to draw meaning from the experiment		Arithmetic/ Mathematics	Uses common measuring devices/tools to measure biological plant sciences experiments [1.1.37] Applies computation skills to biological plant sciences experiments [1.1.5]

Unit 4: Summarizing and Reporting Research 8 Hours

Terminology: abstract, background, bibliography, conclusion, finding, procedure, recommendation, style

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
4.1 Define terms	4.1.1	Foundation	Reading	Applies/Understands technical words that pertain to subject [1.3.6]
4.2 Explain the difference between findings, conclusions, and recommendations	4.2.1 Review a report of experimental research and identify the findings, conclusions, and recommendations	Foundation	Writing	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6]
	4.2.2 Note the treatment of data, including tables and graphs			Presents answers/conclusions in a clear and understandable form [1.6.13]
	4.2.3 Explain why a report must stay within the findings of an experiment and not go beyond what was observed			Personal Management
4.3 Discuss the components and preparation of a research report	4.3.1 Identify the major parts of a research report	Foundation	Writing	Records data [1.6.16]
	4.3.2 Prepare a research paper on the experiment from Unit 3 following appropriate style			Summarizes written information [1.6.17]
	4.3.3 Demonstrate the correct use of tables, graphs, and other approaches to illustrate findings			Writes appropriate entries [1.6.22]
	4.3.4 Construct a bibliography/reference page, table of contents, and title page for a research report	Thinking	Seeing Things in the Mind's Eye	Imagines the flow of work activities from narrative descriptions [4.6.1]
	4.3.5 Produce a professionally-appearing report using computer word processing			Visualizes a finished product [4.6.4]
	4.3.6 Bind the report to have a professional document			

Unit 5: Plant Genetics and Heritability

8 Hours

Terminology: allele, chromosome, DNA, dominant gene, F1 hybrid, gene, genotype, heritability, heterozygous, homozygous, hormone, hybrid vigor (heterosis), incomplete dominance, mutation, phenotype, Punnett Square, recessive gene

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce			
Knowledge	Application	Skill Group	Skill	Description	
5.1	Define terms	5.1.1	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
5.2	Discuss the role and importance of genetics and heritability in the biological plant sciences	5.2.1	Foundation	Science	Describes/Explains scientific principles related to dominant and recessive genes [1.4.14]
		5.2.2	Interpersonal	Speaking	Applies/Uses technical words as appropriate to audience [1.5.2] Participates in conversation, discussion, and group presentations [1.5.8]
5.3	Illustrate the importance of the various plant breeding schemes	5.2.2		Coaching	Helps others learn new skills [2.1.3]
		5.3.1	Foundation	Reading	Uses appropriate materials and techniques as specified [1.3.20]
		5.3.2	Thinking	Knowing How to Learn	Uses written resources (books, dictionaries, directories) to obtain factual information [1.3.23] Locates appropriate learning resources to acquire or improve knowledge and skills [4.3.3] Processes new information as related to workplace [4.3.5]

Unit 6: Plant Growth Processes

10 Hours

Terminology: gravitropism, legume, nitrogen fixation, photosynthesis, phototropism, respiration, theotropism, translocation, transpiration, tropism

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do			ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce			
Knowledge		Application	Skill Group	Skill	Description	
6.1	Define terms	6.1.1	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]	
6.2	Discuss processes and requirements for plant growth	6.2.1	Foundation	Science	Acquires and processes scientific data [1.4.1]	
		6.2.2			Analyzes environmental issues (ecology, pollution, waste management) [1.4.2]	
		6.2.3			Describes/Explains scientific principles related to nitrogen fixation [1.4.14]	
		6.2.4	Thinking		Seeing Things in the Mind's Eye	Organizes and processes images—symbols, pictures, graphs, objects, etc. [4.6.2]
		6.2.5				Visualizes a system's operation from schematics [4.6.3]
		6.2.6				
		6.2.7				
6.3	Discuss plant anatomy and physiology	6.3.1	Foundation	Reading	Applies information to new situations [1.3.5]	
		6.3.2			Applies/Understands technical words that pertain to subject [1.3.6]	
		6.3.3	Personal Management	Organizational Effectiveness	Applies knowledge to implement work-related system or practice [3.3.4]	
		6.3.4			Comprehends the organization's modes of operation [3.3.5]	

Unit 7: Plant Reproduction 10 Hours

Terminology: asexual reproduction, budding, cutting, fertilization, germination, grafting, hybrid, layering, ovary, ovule, pollen, pollination, propagation, scarification, seed, sexual propagation, stigma, stratification

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do			ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description	
7.1 Define terminology	7.1.1	Foundation	Reading	Applies/Understands technical words that pertain to subject [1.3.6]	
7.2 Discuss the meaning and use of sexual and asexual plant reproduction	7.2.1 List advantages and disadvantages of sexual and asexual reproduction	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]	
	7.2.2 Identify examples in the local community, school greenhouse, or other location of the use of sexual and asexual plant reproduction	Thinking	Decision Making	Evaluates information/data to make best decision [4.2.5]	
7.3 Describe plant parts and processes involved in sexual reproduction	7.3.1 Label the parts of a flower on a line drawing	Foundation	Science	Acquires and processes scientific data [1.4.1]	
	7.3.2 Dissect a flower to determine major parts (Note: follow all safety procedures)		Writing	Applies/Uses technical words and concepts [1.6.4]	
	7.3.3 Distinguish between complete and incomplete flowers				
	7.3.4 Explain pollination and relate its role in sexual reproduction				
7.4 Discuss the meaning and importance of seed viability	7.4.1 Calculate germination percentages of seed samples using the rag doll or other method	Foundation	Speaking	Communicates a thought, idea, or fact in spoken form [1.5.5]	
	7.4.2 Store and otherwise handle seed to maintain viability	Interpersonal	Teamwork	Contributes to group with ideas, suggestions, and effort [2.6.2]	
	7.4.3 Determine proper seeding depth and rate for efficient germination and economical plant production				
7.5 Discuss the common methods of asexual plant propagation	7.5.1 Identify plant species most readily asexually propagated	Foundation	Listening	Listens to follow directions [1.2.6]	
	7.5.2 Explain how cuttings are used in propagation and demonstrate the procedure for taking and placing cuttings		Science	Applies knowledge to complete a practical task [1.4.3]	

7.5.3	Demonstrate the steps involved in budding	Personal	Integrity/Honesty/ Work Ethic	Follows established rules, regulations, and policies [3.2.5]
7.5.4	Demonstrate the steps involved in grafting	Thinking	Problem Solving	Draws conclusions from observations, evaluates conditions, and gives possible solutions [4.4.5]
7.5.5	Demonstrate other methods of asexual plant propagation including air layering and dividing			

Unit 8: Hydroponics Systems 8 Hours

Terminology: hydroponics, nutrient solution

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
8.1 Define terms	8.1.1	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
8.2 Discuss the meaning and use of hydroponics	8.2.1 Explain how plants are produced using hydroponics	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
	8.2.2 List advantages and disadvantages of hydroponics			Applies information to new situation [1.3.5]
	8.2.3 Create a plan for a hydroponics growing area			Interprets drawings to obtain factual information [1.3.17]
	8.2.4 Identify plants most often produced using hydroponics	Interpersonal	Teamwork	Recognizes effects of positive/negative attitudes on co-workers [2.6.4] Works effectively with others to reach a common goal [2.6.6]
8.3 Identify the various types of hydroponics systems	8.3.1 Write a paper comparing and contrasting ebb and flow, nutrient film technique/NGT, media-based system, and aeroponic types of hydroponics systems	Foundation	Reading Writing	Applies information and concepts derived from printed materials [1.3.3] Organizes information into an appropriate format [1.6.10]
8.4 Explain the need/importance of using hydroponics	8.4.1 Make an oral presentation on the uses of hydroponics products	Foundation	Listening	Comprehends ideas and concepts related to hydroponics [1.2.1]
	8.4.2 Tend plants being produced in a hydroponics system in the school greenhouse or local community		Speaking	Communicates a thought, idea, or fact in spoken form [1.5.5]

Unit 9: Plant Tissue Culture

10 Hours

Terminology: agar, asepsis, callus, explant, laminar flow hood/transfer cabinet, media, micropropagation, petri dish, sterile technique

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do			ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description	
9.1 Define terms	9.1.1	Foundation	Reading	Applies/Understands technical words that pertain to subject [1.2.6]	
9.2 Explain the meaning and techniques used in tissue culture	9.2.1 List plant species most commonly propagated using tissue culture	Foundation	Listening	Comprehends ideas and concepts related to tissue culture [1.2.1]	
	9.2.2 Use tissue culture to propagate a plant		Science	Applies scientific principles related to tissue culture [1.4.1]	
	9.2.3 Assess the role of asepsis in tissue culture				
9.3 Identify the advantages and disadvantages of tissue culture	9.3.1 Prepare a poster that lists advantages and disadvantages of tissue culture	Foundation	Listening	Comprehends ideas and concepts related to tissue culture [1.2.1]	
			Science	Applies scientific principles related to tissue culture [1.4.1]	
			Writing	Writes appropriate entries [1.6.22]	
9.4 Discuss the sterile technique	9.4.1 Establish a work environment that promotes asepsis	Foundation	Science	Applies knowledge to complete a practical task [1.4.3]	
				Applies scientific principles related to sterilization [1.4.4]	
				Follows safety guidelines [1.4.15]	
				Uses equipment and techniques related to sterilization [1.4.23]	
9.5 Describe processes used in tissue culturing	9.5.1 List the steps in tissue culture on a poster	Foundation	Mathematics	Applies mathematical formula to solve a problem [1.1.3]	
	9.5.2 Demonstrate the process of tissue culture using a plant species that is commonly propagated using tissue culture			Computes, using a formula [1.1.14]	
	9.5.3 Care for tissue cultures to assure liveability and productivity			Demonstrates mathematical calculation [1.1.19]	
	9.5.4 Calculate the number of explants potentially produced for a given period of time		Science	Monitors variables in experiment [1.4.17]	

9.5.5	Determine the number of explants needed to reach a desired production level			
-------	---	--	--	--

Unit 10: Biological Engineering 7 Hours

Terminology: biological engineering, biotechnology, E. coli, gene splicing, genetic engineering, genetically modified organism (GMO), particle gun, transgenic plant

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
10.1 Define terms	10.1.1	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
10.2 Discuss the meaning and process of genetic engineering	10.2.1 Explain the basic method of gene transfer	Foundation	Listening	Comprehends ideas and concepts related to biological engineering [1.2.1]
	10.2.2 Observe gene transfer used in science applications, including the particle gun and bacterial insertion		Reading	Applies information and concepts derived from printed materials [1.3.3]
	10.2.3 Identify the advantages and disadvantages of genetic engineering			
	10.2.4 Debate the advantage or disadvantage of most consequence			
10.3 Identify and investigate issues associated with genetic engineering	10.3.1 Make a survey of students to determine their opinions about genetic engineering	Foundation	Listening	Comprehends ideas and concepts related to biological engineering [1.2.1]
	10.3.2 Debate the issues associated with genetic engineering		Reading	Applies information and concepts derived from printed materials [1.3.3]

Unit 11: Plants and Chemicals

8 Hours

Terminology: defoliant, growth regulator, herbicide, insecticide, integrated pest management (IPM), pest, pesticide

CAREER AND TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
11.1 Define terms	11.1.1	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
11.2 Explain the use and meaning of integrated pest management (IPM)	11.2.1 Research and prepare an oral report on integrated pest management	Foundation	Reading	Comprehends written information for main ideas [1.3.7]
	11.2.2 Identify pest management alternatives using IPM			
	11.2.3 Investigate the role of IPM in reducing the release of chemical substances into the environment			
11.3 Discuss the role and importance of chemical products in the biological plant sciences	11.3.1 List chemical products used in plant production, including insecticide, herbicide, fungicide, and growth regulator including defoliant	Foundation	Listening	Comprehends ideas and concepts related to pesticides [1.2.1]
	11.3.2 Explain the reasons chemical products are used in plant production			
	11.3.3 Identify a pest, and select the appropriate pest management approach			
11.4 Explain various modes of action for pesticides	11.4.1 Observe the effect of different herbicides on plants	Foundation	Science	Constructs hypothesis [1.4.11] Monitors variables in experiment [1.4.18]
		Thinking	Reasoning	Extracts rules or principles from written information [4.5.4] Sees relationship between two or more ideas [4.5.5]

Glossary

Unit 1: Biological Science in Our Lives

1. agronomy—the theory and practice of field crop production, including soils
2. biological plant science—the biological approach to studying plant science
3. botany—the study of plants
4. entomology—the study of insects
5. forestry—the science, art, and business practices associated with the production of trees and their products
6. horticulture—the area encompassing the production of fruits, vegetables, flowers, turf, nuts, and shrubs and other ornamental plants
7. soil science—the study of soil

Unit 2: Safety in the Biological Plant Sciences

1. hazard—a danger or potential danger
2. laboratory accidents—accidents occurring in a laboratory
3. occupational safety—safety in the work place
4. personal protective equipment (PPE)—equipment worn to protect from injury including goggles, ear plugs, face shields, gloves, boots, and respirators
5. personal safety—promoting the protection of individuals from injury
6. plant allergy—human susceptibility to substances produced by plants, such as poison ivy and pollen; may afflict animals
7. safety—preventing loss or injury

Unit 3: Conducting Experiments and Research

1. average—the value arrived at by adding the quantities in a series and dividing the total by their number
2. control—to hold constant
3. data—factual information that is often in numerical form
4. dependent variable—a variable that is measured to determine the effects of the independent variable
5. experimental method—a process of scientific inquiry where all factors, except the variable under investigation, are controlled or held constant
6. hypothesis—a tentatively accepted theory that explains the relationship between two variables
7. independent variable—the variable in an experiment that is manipulated
8. mean—midway between two extreme numbers; the average
9. research—investigation or experimentation aimed at the discovery and interpretation of facts
10. scientific method—a carefully controlled, systematic process for discovering the unknown
11. treatment—the manipulation of an independent variable

Unit 4: Summarizing and Reporting Research

1. abstract—a summary or short version of a piece of writing
2. background—information that reveals key knowledge about an item or theory that can be used to support ideas or give guidance for further investigation
3. bibliography—a list of references presented in a manner that the sources can be found again for verification or further studies
4. conclusion—specific statements about the relationships between variables
5. finding—actual data generated from an experiment
6. procedure—method of carrying out an experiment so it can be replicated again by other individuals
7. recommendation—a suggestion on how results should be used or for further experimentation
8. style—the way a paper is presented, including headings, citations, tables, graphs, bibliography, table of contents, and title page

Unit 5: Plant Genetics and Heritability

1. allele—matching genes on homologous chromosomes
2. chromosome—that part of a cell that contains information about genetic makeup and transmits that information to offspring; made up of proteins and nucleic acids; consists of DNA
3. deoxyribonucleic acid (DNA)—a genetic protein-like nucleic acid in plant and animal genes and chromosomes that controls inheritance
4. dominant gene—causes a certain characteristic to be expressed; present in offspring
5. F1 hybrid—an offspring of two parents in which the offspring is sterile
6. gene—the specific determiner of heredity
7. genotype—the genetic makeup
8. heritability—the portion of the differences in animals that is transmitted from parent to offspring
9. heterozygous—having different alleles for a single trait and therefore producing two or more different kinds of gametes
10. homozygous—having identical alleles at one or more loci and therefore producing identical gametes
11. hormone—a chemical messenger substance produced in one location of an organism and carried to another where it has a specific effect(s)
12. hybrid vigor (heterosis)—the act of the offspring outperforming the parents due to gene combination
13. incomplete dominance—when either gene is dominant, both genes are expressed (example: red and white cattle produce a roan colored calf)
14. mutation—an accident of heredity in which an offspring has different characteristics than the genetic code intended
15. phenotype—the physical appearance of an organism
16. Punnett Square—a common method predicting the genotypes and phenotypes of offspring using a matrix
17. recessive gene—the character will be masked if either parent has a dominant gene; will only be expressed if the alleles from both parents are the same (and not dominant)

Unit 6: Plant Growth Processes

1. gravitropism—plant growth in response to gravity
2. legume—a plant that has the ability to convert atmospheric nitrogen (N₂) to a form that can be used by plant root systems
3. nitrogen fixation—the biochemical process of converting atmospheric nitrogen (N₂) to a form that can be used with plants
4. photosynthesis—process by which green plants produce carbohydrates
5. phototropism—plant growth in response to light
6. respiration—chemical processes in cells to release energy and waste products; also sometimes known as oxidation
7. thigmotropism—plant growth in response to touch
8. translocation—movement of materials in plants and cells
9. transpiration—process of water vapor being released by plants into the atmosphere
10. tropism—growth reaction of plants to external stimuli, such as sunlight or gravity

Unit 7: Plant Reproduction

1. asexual reproduction—reproduction without fertilization
2. budding—a form of plant asexual reproduction that involves transferring a bud from a parent plant to a stock (new plant)
3. cutting—a form of plant asexual reproduction using a section of plant that can regenerate itself
4. fertilization—in plant reproduction, union of pollen sperm with ovule to produce seeds
5. germination—sprouting of a seed to produce a new plant
6. grafting—asexual plant reproduction involving the insertion or moving of a scion (piece of a plant) onto another plant (stock) so that a new plant is created
7. hybrid—a plant resulting from selected crossing of parents that are unlike
8. layering—asexual plant reproduction involving promoting the growth of roots on stems or branches while still attached to the parent plant
9. ovary—the portion of the pistil of a flower that contains one or more ovules, female reproductive organ
10. ovule—the egg-containing part of an ovary that develops into a seed
11. pollen—the male element or spore of a flower borne by the anthers and forms sperm cells needed for fertilization of the ovules in the ovary of a flower
12. pollination—the transfer of pollen from the anther to the stigma of a flower in the fertilization process
13. propagation—the reproduction of plants by sexual or asexual means
14. scarification—to scratch or crack the coating of a seed to promote germination
15. seed—the structure that contains the embryo of a plant
16. sexual propagation—reproducing plants from seeds
17. stigma—the female organ of a flower that receives pollen
18. stratification—the rest period some seeds need before they will germinate

Unit 8: Hydroponics Systems

1. hydroponics—a method of growing plants in which the nutrients needed by the plant are supplied by a nutrient solution
2. nutrient solution—water with dissolved nutrient salts

Unit 9: Plant Tissue Culture

1. agar—a nutrient-rich medium used to culture living organisms
2. asepsis—a condition of freedom from microbes
3. callus—an undifferentiated mass of plant cells that grow from an explant when placed on an artificial medium under sterile conditions
4. explant—small pieces of plant tissue
5. laminar flow hood/transfer cabinet—scientific equipment that provides a positive air flow and prevents any foreign material from contaminating a culture
6. media—soil or soil-like materials in which plants may be grown (singular form: medium)
7. micropropagation—the creation of plant tissue on a small or microscopic scale
8. petri dish—circular container with a top used for culturing various organisms
9. sterile technique—using procedures that assure asepsis in the work environment, such as in a laminar flow hood, and instruments and materials that are aseptic

Unit 10: Biological Engineering

1. biological engineering—an advanced form of biotechnology; techniques involve gene splicing, replication, and transfer of genes to other organisms
2. biotechnology—the management of biological systems for the benefit of humanity
3. E. coli—bacteria that are commonly used to deliver new or altered genetic material in an organism
4. gene splicing—the process of adding new genetic material within the DNA sequence of an organism
5. genetic engineering—artificially altering the genetic makeup of an organism
6. genetically modified organism (GMO)—an organism that has been genetically engineered to achieve a desired trait
7. particle gun—a device used to insert new genetic material into an organism
8. transgenic plant—a plant that has been genetically altered by artificial means

Unit 11: Plants and Chemicals

1. defoliant—a chemical substance applied to plants which causes the foliage to fall off; a growth regulator
2. growth regulator—compounds applied to plants to promote, inhibit, or modify plant growth processes
3. herbicide—a chemical used to kill plants
4. insecticide—a chemical used to kill insects
5. integrated pest management (IPM)—an approach that manages pest populations while minimizing environmental damage and reducing economic damage; uses a variety of chemical, mechanical, and biological techniques with pests
6. pest—anything that is unwanted
7. pesticide—anything that is used to control, manage, or eliminate pests; includes insecticides, herbicides, and others