

2012 – 2013

**Arkansas Department of Career Education
Model Framework**

Course Title: Plant Science I

Career Cluster: Agriculture, Food & Natural Resources

Secondary – Agriculture Science and Technology	
Course Number	491340
CIP Number	01.11
Grade Level	9-12
Prerequisite	Survey of Agricultural Systems
Course Type	Core
Teacher Certification	010 Agriculture 218 Agricultural Sciences & Technology 604 Horticulture 605 Forestry
CTSO	FFA
Facility Requirements	http://arkansasfacilities.arkansas.gov/SchoolFacManual.aspx
Industry Certifications	Arkansas Certified Green Industry Associate (ACGIA) certification is categorized as ACGIA Level I or ACGIA Level II. http://www.argia.org/displaycommon.cfm?an=1&subarticlenbr=13

Course Description

This course covers the relationship between plants and people, plant morphology and physiology, plant production, the environment, soil, careers in plant science, and other related areas.

Program Purpose/Structure

This course allows for an in-depth look at Plant Science while providing Hands on Laboratories, and opportunities to participate in FFA and Supervised Agriculture Experiences.

**Arkansas Department of Career Education
Plant Science 1 Student Performance Standards**

At the completion of this course, the student will be able to:

1.0 Plant Science Industry

- 1.1 Discuss the Plant Industry in the U.S.
- 1.2 Explore the plant industry as it relates to agriculture.
- 1.3 Classify agricultural plants according to taxonomy systems.

2.0 Safety in the Plant Science Industry

- 2.1 Apply Safety Concepts in the Plant Science Industry

3.0 Plant Anatomy

- 3.1 Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
- 3.2 Apply knowledge of plant physiology and energy conversion to plant systems.

Standard 1.0 Plant Science Industry			
Performance Indicator 1.1 The Plant Industry in the U.S.	Recommended Application/Activity	CCSS Standards	CCTC Standards
1.1.1 Examine the importance of plants in our daily lives. (Food, fiber , shelter, medicine, aesthetics)	<ul style="list-style-type: none"> • Prepare and deliver a short oral presentation on an important plant species. • Compile a log of products from plants that are used in daily living, including those for food, clothing, shelter, medicine and aesthetics. 	SL 9-10.4 SL 11-12.4 SL9-10.2 SL11-12.2	CRP 4 AG-PL 2
1.1.2 Examine the major areas of the plant science industry in the U.S. (Horticulture, Agronomy, Forestry, Nursery/Landscape, Floriculture)	<ul style="list-style-type: none"> • Create a color coded map of the U.S. and or Arkansas indicating major production areas of each division of plant science. • Identify at least two major species of plants grown in each division of the plant science industry. 	SL 9-10.2 SL 11-12.2 SL 9-10.4 SL11-12.4	AG=PL 2 CRP 6
1.1.3 Research/Investigate careers in plant science.	<ul style="list-style-type: none"> • Research a career in plant science using an online career database such as ffa.org to determine educational requirements, working conditions and salary. • Give an oral report in class on the career that has been researched. • Invite a guest speaker from the plant science industry to speak to the class. • Have students interview a person that works in the plant science industry. 	SL 9-10.4 SL 11-12.4 SL 9-10.2 SL11-12.2 SL 11-12.1	AG 5 CRP 7
1.1.4 Discuss FFA and SAE opportunities available to students in plant science.	<ul style="list-style-type: none"> • Demonstrate knowledge by participating in Career Development Events related to plant science (agronomy, floriculture, nursery/landscape, land, forestry) • Research other FFA opportunities/awards related to plant science. (Proficiencies, SAE Grants, Agriscience Fair) • Maintain records on an SAE project and complete an appropriate FFA award application. 	R9-10.1 R 11-12.1 R 9-10.5 R 11-12.5 W 9-10.3 W 11-12.3	AG=PL 1 CRP 7 CRP 8

	<ul style="list-style-type: none"> Conduct an agriscience research project related to plant science. 		
Performance Indicator 1.2 Explore the plant industry as it relates to agriculture.	Recommended Application/Activity	CCSS Standards	CCTC Standards
1.2.1 Illustrate the life cycle of an agricultural plant crop. (propagation, growth, harvesting, storage)	<ul style="list-style-type: none"> Diagram the life cycle of a plant. Follow a crop from propagation to plate and present your results. 	SL 9-10.2 SL 11-12.2	AG-PL 3 CRP 5
Performance Indicator 1.3 Classify agricultural plants according to taxonomy systems.	Recommended Application/Activity	CCSS Standards	CCTC Standards
1.3.1 Explain systems used to classify plants. (binomial nomenclature, genus, species, cultivar/variety) (PS.01.01.01.a)	<ul style="list-style-type: none"> Determine the common and scientific names of five plants that grow in the local area. 	SL 9-10.4 SL 11-12.4	CRP 2 AG-PL 2
1.3.2 Classify agricultural plants according to the life cycles. (annual, biennial, perennial) (PS.01.01.01.c)	<ul style="list-style-type: none"> Diagram the life cycle of a plant. 	SL 9-10.2 SL 11-12.2	AG-PL 3 CRP 5
1.3.3 Classify agricultural plants as deciduous or evergreen . (PS.01.01.01.c)	<ul style="list-style-type: none"> Prepare a leaf collection of 5 evergreen and 5 deciduous plants. 	L11-12.6 L 9-10.6	AG-PL 3 CRP 6
1.3.4 Compare and contrast morphology of monocotyledons and dicotyledons . (PS.01.01.01.c)	<ul style="list-style-type: none"> Dissect monocot and dicot seeds and label the structures. Observe monocot and dicot stems under a microscope. Classify plants or plant photos as monocots and dicots. 	R 9-10.5 R 9-10.3 R 11-12.3	AG-PL 2 CRP 2

<p>1.3.5 Classify agricultural plants by growth habit. (trees, shrubs, grasses, vines) (PS.01.01.01.c)</p>	<ul style="list-style-type: none"> • Create a “plant monster” from available materials and classify it by growth habit, type, and life cycle. • Classify local plants into groups by growth habit. 	<p>W 9-10.8 W 9-10.4 W 11-12.4 R 9-10.3 R 11-12.3</p>	<p>CRP 6 AG=PL 2 AG-PL 3 AG-PL 4</p>
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Standard 2.0 Safety in the Plant Science Industry			
Performance Indicator 2.1 Apply Safety Concepts in the Plant Science Industry	Recommended Application/Activity	CCSS Standards	CCTC Standards
2.1.1 Discuss the meaning and importance of safety and safe work with plant science. (OSHA)	<ul style="list-style-type: none"> Relate examples of safety hazards in plant science, including equipment used in plant production and the inputs applied to plants such as pesticides and fertilizers. Have students name examples of accidents that have occurred locally in plant agriculture, horticulture or forestry. Identify health issues that are transmissible from plants to humans and the precautions to follow to minimize such transmission. 	SL 9-10.5 SL 11-12.5 R 9-10.9 R 11-12.9	AG-PL 4 CRP 9
2.1.2 Identify and classify hazards in plant science. (chemical hazards, mechanical hazards, biological hazards)	<ul style="list-style-type: none"> Survey hazardous situations in local agriculture or horticulture facilities and prescribe the appropriate safety measures to be taken and propose ways of eliminating or reducing the risk of these hazards. Classify hazards as chemical, biological, or mechanical. Develop a list of practices to reduce risk when working with plants. 	SL 9-10.2 SL 11-12.2 W 9-10.1a W 11-12.1a	AG-PL 4 CRP 5
2.1.3 Describe the importance of personal safety in plant science, and demonstrate proficiency in safety. (PPE)	<ul style="list-style-type: none"> Identify and properly use appropriate Personal Protective Equipment (PPE) with plant science. Calculate the cost of PPE for an individual involved with plant science. Work together with others to promote safety in plant science. Take a test on plant science safety before beginning work with plants. 	W9-10.2e W 11-12.2e R 11-12.3 R 9-10.3	CRP 12 AG-PL 1
2.1.4 Explain procedures for the safe handling, use and storage of pesticides. (MSDS) (PS.03.03.04.b)	<ul style="list-style-type: none"> Read and interpret pesticide labels. Convey the meaning of the 4 signal words. Research pesticide safety, storage, and disposal procedures at www.uaex.edu/other_areas/publications/pdf/fsa-9522.pdf 	R 9-10.2 R 11-12.2 SL 9-10.2 SL 11-12.2	AG-PL 1 CRP 3

Standard 3.0 Plant Anatomy			
Performance Indicator 3.1 <i>Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.</i>	Recommended Application/Activity	CCSS Standards	CCTC Standards
3.1.1 Label a typical plant cell and identify plant cell organelles and their functions. (cell wall, chloroplasts, nucleus, mitochondria, cytoplasm, cell membrane, vacuole)(PS.01.02.01.a)	<ul style="list-style-type: none"> • Create a model of a plant cell and the organelles using food products. • Compare the plant cell to a workout facility • View plant cells under a microscope and identify cell organelles. 	SL 9-10.2 SL 11-12.2 R 9-10.4 R 11-12.4	AG-PL 2 CRP 6 CRP 11
3.1.2 Identify the types and the functions of plant roots. (fibrous, tap, legume, nitrogen fixation) (PS.01.02.02.a)	<ul style="list-style-type: none"> • Construct a root zone viewing box from plexiglass and observe fibrous and tap roots. • Dig plants from the yard and label root types. • List root crops used for human and animal foods. 	R 9-10.3 R 11-12.3 W 9-10.4 W 11-12.4	AG-PL 2 AG-PL 3 CRP 6 CRP 2
3.1.3 Identify the types and the functions of plant stems. (herbaceous, woody) (PS.01.02.03.a)	<ul style="list-style-type: none"> • Research and bring examples of modified stems to class. • List foods and animal feeds derived from stems. • Analyze the weekly lunch menu and list plant foods and the part of the plant used. • Plant an Herb garden using both woody and herbaceous plants. 	SL 9-10.1 SL 11-12.1 SL 9-10.2 SL 11-12.2	AG-PL 2 AG-PL 3 CRP 6 CRP 3

<p>3.1.4 Describe and illustrate the processes of translocation. (xylem, phloem, cambium) (PS.01.02.03.b)</p>	<ul style="list-style-type: none"> Place a celery stalk in food coloring and record translocation data. Dye a carnation using the process of translocation. Prepare a tree cookie to view cambium. 	<p>W 9-10.2 W 11-12.2 R 9-10.3 R 11-12.3</p>	<p>AG-PL 2 CRP 6 CRP 2</p>
<p>3.1.5 Discuss the functions of leaves. (PS.01.02.04.a) (PS.01.02.04.b)</p>	<ul style="list-style-type: none"> Diagram the underside of a leaf, showing guard cells and stoma. 	<p>W 9-10.2a W 11-12.2a</p>	<p>AG-PL 2 CRP 2 CRP 6</p>
<p>3.1.6 Identify the components of a flower and their functions of a flower. (pistil, stamen, petal, sepal, pollination, stigma, style, ovary, anther, filament) (PS.01.02.05.a)</p>	<ul style="list-style-type: none"> Create a model of a flower using craft materials. Draw a flower and label the parts. Dissect a flower and mount the labeled parts on a poster. 	<p>SL 9-10.1a SL 11-12.1a SL 9-10.2 SL 11-12.2 W 9-10.2a W 11-12.2a</p>	<p>AG-PL 2 CRP 6</p>
<p>3.1.7 Compare and contrast the different types of flowers. (complete, incomplete, perfect, imperfect). (PS.01.02.05.b)</p>	<ul style="list-style-type: none"> Create a model of a flower using craft materials. Draw a flower and label the parts. Dissect a flower and mount the labeled parts on a poster. Compare and contrast complete and incomplete flowers, and perfect and imperfect. 	<p>SL 9-10.1a SL 11-12.1a SL 9-10.2 SL 11-12.2 W 9-10.2a W 11-12.2a</p>	<p>AG-PL 2 CRP 6</p>
<p>3.1.8 Compare and contrast the components of a seed and their functions. (embryo, endosperm, seed coat) (PS.01.02.06.a)</p>	<ul style="list-style-type: none"> Create a model of a seed using craft materials. Draw a seed and label the parts. Dissect seeds and mount the labeled parts on a poster. Compare and contrast monocot and dicot seeds. 	<p>SL 9-10.1a SL 11-12.1a SL 9-10.2 SL 11-12.2 W 9-10.2a W 11-12.2a</p>	<p>AG-PL 2 CRP 6</p>

Performance Indicator 3.2 Apply knowledge of plant physiology and energy conversion to plant systems	Recommended Application/Activity	CCSS Standards	CCTC Standards
3.2.1 Explain and illustrate the basic process of photosynthesis and its importance to life on Earth. (PS.01.03.01.a)	<ul style="list-style-type: none"> • Diagram the chemical equation for photosynthesis. • Create a model of the photosynthetic process using craft materials. • Create a skit or song to explain the process of photosynthesis. 	W 9-10.2 W 11-12.2 R 9-10.1 R 11-12.1	AG-PL 2 CRP 6 CRP2 CRP 4
3.2.2 Explain and illustrate cellular respiration and its importance to plant life. (PS.01.03.02.a)	<ul style="list-style-type: none"> • Explain factors that affect cellular respiration and identify the products and byproducts of cellular respiration. <ul style="list-style-type: none"> • Diagram the chemical equation for respiration. • Create a model of the photosynthetic process using craft materials. • Create a skit or song to explain the process of photosynthesis. 	W 9-10.2 W 11-12.2 R 9-10.1 R 11-12.1	AG-PL 2 CRP 6 CRP2 CRP 4
3.2.3 Explain and illustrate transpiration and its importance to plant life.	<ul style="list-style-type: none"> • Draw a representation of the process of transpiration. • Compare the amount of water lost through transpiration as a function of leaf area, temperature, light, or air movement. • 	SL 9-10.4 SL 11-12.4 W 9-10.2a W 11-12.2a	AG-PL 2 CRP 6 CRP2 CRP 4
3.2.4 Define primary growth and the role of the apical meristem . (PS.01.03.03.a)	<ul style="list-style-type: none"> • Formulate a hypothesis on the growth history of a tree with fencing wire embedded in the trunk. • Label the meristematic tissue of a plant. 	SL 9-10.2 SL 11-12.2	AG-PL 2 CRP 6 CRP2 CRP 4

Glossary

Standard 1.0 Plant Science Industry

- 1. Annual – a plant that completes its life cycle in one growing season.**
- 2. Biennial – a plant that completes its life cycle in two growing seasons. The first season is vegetative growth and the second season is reproductive.**
- 3. Binominal nomenclature – the two-name naming system to identify organisms using Genus and species.**
- 4. Cultivar/variety –Cultivated plants within a species that are unique and different from other plants within a species; written in single quotation marks.**
- 5. Deciduous – plant that shed their leaves in the fall.**
- 6. Dicotyledons – plants with two cotyledons, vascular tissue arranged in rings around a cambium layer, and flower parts in multiples of four or five.**
- 7. Evergreen –a plant that retains its foliage year round.**
- 8. Genus – a category including closely related species**
- 9. Grasses – a monocot plant commonly used for groundcover or forage.**
- 10. Growth – a stage in the life cycle of a plant characterized by increase in size and mass.**
- 11. Harvesting – the process of gathering desired products from plants.**
- 12. Monocotyledons – plants with one cotyledon, vascular bundles scattered in the stem, flower parts usually in multiples of three, and leaf venation is usually parallel.**
- 13. Morphology – the branch of biology that deals with the forms or shapes of organisms.**
- 14. Perennial – a plant that lives for more than three years or growing seasons.**
- 15. Propagation – process of reproducing plants by sexual or asexual methods.**
- 16. Shrubs –multi-stem, woody plants that do not exceed twenty feet in height.**
- 17. Species – a classification of organisms that can freely interbreed; second term in a scientific name; exhibit more similarities than members of a Genus.**
- 18. Trees – a single-stem, woody, perennial plant reaching the height of twelve feet or more.**
- 19. Vines – any woody or herbaceous plants that trails, climbs, or creeps**

Standard 2.0 Safety in the Plant Science Industry

- 1. Biological hazards – living organisms that may cause damage or injury to humans or other organisms.**
- 2. Chemical hazards – chemical agents that may cause damage or injury to humans or other organisms.**
- 3. Mechanical hazards – hazards that are the result of working with machinery or equipment.**
- 4. MSDS – a sheet containing information about the safe use of a chemical and the steps to take in case of an accident; Material Safety Data Sheet.**
- 5. OSHA – the federal agency that regulates safety in the workplace; Occupational Safety and Health Administration.**
- 6. PPE – protective clothing, helmets, goggles, or other equipment designed to protect the worker’s body; Personal Protective Equipment.**

Standard 3.0 Plant Anatomy

1. **Anther** – a sac-like structure at the top of the stamen that contains pollen.
2. **Apical meristem** – the areas of primary growth in a plant.
3. **Cambium** – layer of actively dividing cells that gives rise to new xylem and phloem.
4. **Cell membrane** – thin semi-permeable membrane that surrounds the cytoplasm of the cell.
5. **Cell wall** – rigid, impermeable membrane made of cellulose and found in plant cells; supports and gives shape to the plant.
6. **Cellular respiration** – the process by which plants utilize stored food; uses oxygen and releases carbon dioxide.
7. **Chloroplasts** – the specialized organelle in green plants in which photosynthesis takes place.
8. **Complete flower** – a flower that has sepals, petals, pistils and stamens.
9. **Cytoplasm** – jelly-like substance found within the plant cell that cushions and supports plant organelles.
10. **Embryo** – seed structure that develops into the new plant.
11. **Endosperm** – starchy tissue that provides nutrition for the growing embryo
12. **Fibrous root** – consists of several main roots that each branch and develop many lateral roots.
13. **Filament** – a stalk-like structure that supports the anther.
14. **Herbaceous** – a plant that has stems with little or no woody tissue; a soft-stemmed plant
15. **Imperfect flower** – flower that is lacking either stamens or pistils; flower is either male or female.
16. **Incomplete flower** – Flower that is lacking one or more of the following parts—sepals, petals, pistils and stamens.
17. **Legume** – a plant that has the ability to convert atmospheric nitrogen to a form that can be utilized by plant root systems; nitrogen fixation
18. **Mitochondria** – organelles that are the site of respiration in a plant cell; powerhouse of the cell
19. **Nitrogen fixation** – the biochemical process of converting atmospheric nitrogen to a form that can be used within plants; legumes
20. **Nucleus** – the membrane-bound organelle that contains the chromosomes
21. **Ovary** – the lower part of the pistil that contains ovules
22. **Perfect flower** – flowers that contain both stamens and pistils.
23. **Petal** – the part of the flower inside the sepals that are often colorful or fragrant to attract pollinators
24. **Phloem** – vascular tissue that carries food from the photosynthetic tissue to the roots

- 25. Photosynthesis – manufacture of food by green plants in which carbon dioxide and water are combined in the presence of light and chlorophyll to form sugar and oxygen.**
- 26. Pistil – female reproductive part of a plant; stigma, style and ovary**
- 27. Pollination – transfer of pollen from the anther to the stigma.**
- 28. Seed coat – protective outer layer of a seed.**
- 29. Sepal – green leaf-like structures on the exterior of a flower.**
- 30. Stamen – the male reproductive structures of a flower; anther and filament**
- 31. Stigma – the sticky structure at the top of the pistil to which receives pollen.**
- 32. Style – the central part of the pistil through which pollen travels to the ova or egg.**
- 33. Tap root – a large main root with small lateral roots.**
- 34. Translocation – the movement of water and nutrients throughout the plant.**
- 35. Transpiration – the water loss from plant tissues**
- 36. Vacuole – a cavity that may contain water, food or waste.**
- 37. Woody – a plant that produces wood and has buds above the ground that survive winter.**
- 38. Xylem – vascular tissue that carries water and nutrients from the roots to other parts of the plant**

Common Core State Standards Grades 9-12

ELA Speaking and Listening Standards Grades 9-10

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively. **SL9-10.1**
 - a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. **SL9-10.1a**
 - b. Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed. **SL9-10.1b**
 - c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. **SL9-10.1c**
 - d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented. **SL9-10.1d**
2. Integrate multiple sources of information presented in diverse media or format (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source. **SL9-10.2**
3. Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence. **SL9-10.3**
4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task. **SL9-10.4**
5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **SL9-10.5**

ELA Speaking and Listening Standards Grades 11-12

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively. **SL11-12.1**
 - a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. **SL11-12.1a**

- b. Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed. **SL11-12.1b**
 - c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives. **SL11-12.1c**
 - d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task. **SL11-12.1d**
2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. **SL11-12.2**
 3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used. **SL11-12.3**
 4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. **SL11-12.4**
 5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **SL11-12.5**

ELA Language Grades 9-10

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies. **L9-10.4**
 - a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase. **L9-10.4a**
 - b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy). **L9-10.4b**
 - c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology. **L9-10.4c**
 - d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary). **L9-10.4d**
6. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. **L9-10.6**

ELA Language Grades 11-12

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies. **L11-12.4**
 - a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase. **L11-12.4a**
 - b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable). **L11-12.4b**
 - c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage. **L11-12.4c**
 - d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary) **L11-12.4d**
6. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. **L11-12.6**

Reading Standards for Literacy in Science and Technical Subjects Grades 9-10

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. **R9-10.1**
2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. **R9-10.2**
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. **R9-10.3**
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. **R9-10.4**
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **R9-10.5**
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. **R9-10.6**
7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. **R9-10.7**
8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. **R9-10.8**
9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. **R9-10.9**
10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **R9-10.10**

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Reading Standards for Literacy in Science and Technical Subjects Grades 11-12

1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **R11-12.1**
2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. **R11-12.2**
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. **R11-12.3**
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics. **R11-12.4**
5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. **R11-12.5**
6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. **R11-12.6**
7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **R11-12.7**
8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **R11-12.8**
9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. **R11-12.9**
10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently. **R11-12.10**

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects Grades 9-10

1. Write arguments focused on discipline-specific content. **W9-10.1**
 - a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. **W9-10.1a**
 - b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience’s knowledge level and concerns. **W9-10.1b**
 - c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. **W9-10.1c**
 - d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. **W9-10.1d**
 - e. Provide a concluding statement or section that follows from or supports the argument presented. **W9-10.1e**
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **W9-10.2**

- a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. **W9-10.2a**
 - b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. **W9-10.2b**
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. **W9-10.2c**
 - d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. **W9-10.2d**
 - e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. **W9-10.2e**
 - f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). **W9-10.2f**
3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. **W9-10.3**
 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **W9-10.4**
 5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. **W9-10.5**
 6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. **W9-10.6**
 7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **W9-10.7**
 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. **W9-10.8**
 9. Draw evidence from informational texts to support analysis, reflection, and research. **W9-10.9**
 10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. **W9-10.10**

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects Grades 11-12

1. Write arguments focused on discipline-specific content. **W11-12.1**

- a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. **W11-12.1a**
 - b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. **W11-12.1b**
 - c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. **W11-12.1c**
 - d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. **W11-12.1d**
 - e. Provide a concluding statement or section that follows from or supports the argument presented. **W11-12.1e**
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **W11-12.2**
 - a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. **W11-12.2a**
 - b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. **W11-12.2b**
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. **W11-12.2c**
 - d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. **W11-12.2d**
 - e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). **W11-12.2e**
 3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. **W11-12.3**
 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **W11-12.4**
 5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. **W11-12.5**
 6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. **W11-12.6**

7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **W11-12.7**
8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **W11-12.8**
9. Draw evidence from informational texts to support analysis, reflection, and research. **W11-12.9**
10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. **W11-12.10**

Common Career and Technical Core Standards

Agriculture, Food, and Natural Resources Cluster

Agriculture, Food, & Natural Resources Career Cluster Standards (AG)

1. Analyze how issues, trends, technologies, and public policies impact systems in the Agriculture, Food, & Natural Resources (AFNR) Career Cluster. **AG1**
2. Evaluate the nature and scope of the AFNR cluster and the role AFNR plays in society and the economy. **AG2**
3. Examine and summarize importance of health, safety, and environmental management systems in AFNR organizations. **AG3**
4. Demonstrate stewardship of natural resources in AFNR activities. **AG4**
5. Describe career opportunities and means to achieve those opportunities in each of the AFNR career pathways. **AG5**
6. Analyze the interaction among ANFR systems in the production, processing and management of food, fiber, and fuel and sustainable use of natural resources. **AG6**

Agribusiness Systems Career Pathway (AG-BIZ)

1. Apply management planning principles in AFNR business enterprises. **AG-BIZ1**
2. Use record keeping to accomplish AFNR business objectives, manage budgets, and comply with laws and regulations. **AG-BIZ2**
3. Manage cash budgets, credit budgets, and credit for an AFNR business using generally accepted accounting principles. **AG-BIZ3**
4. Develop a business plan for an AFNR enterprise or business unit. **AG-BIZ4**
5. Use sales and marketing principles common to agribusiness systems to accomplish AFNR business objectives. **AG-BIZ5**

Animal Systems Career Pathway (AG-ANI)

1. Analyze historic and current trends impacting the animal systems industry. **AG-ANI1**

2. Utilize best practice protocols for husbandry and welfare based upon animal behaviors. **AG-ANI2**
3. Design and provide proper animal nutrition given desired outcomes for performance, development, reproduction, and/or economic production. **AG-ANI3**
4. Apply principles of animal reproduction given desired outcomes for performance, development, and/or economic production. **AG-ANI4**
5. Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health. **AG-ANI5**
6. Classify, evaluate and select animals based on anatomical and physiological characteristics. **AG-ANI6**
7. Apply principles of effective animal health care. **AG-ANI7**

Environmental Service Systems Career Pathway (AG-ENV)

1. Use analytical procedures and instruments to manage environmental service systems. **AG-ENV1**
2. Evaluate the impact of public policies and regulations on environmental service system operations. **AG-ENV2**
3. Develop proposed solutions to environmental issues, problems, and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology. **AG-ENV3**
4. Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management, and energy conservation). **AG-ENV4**
5. Use tools, equipment, machinery, and technology common to tasks in environmental service systems. **AG-ENV5**

Food Products and Processing Systems Career Pathway (AG-FD)

1. Develop and implement procedures to ensure safety, sanitation, and quality in the food product and processing facilities. **AG-FD1**
2. Apply principles of nutrition, biology, microbiology, chemistry, and human behavior to development of food products. **AG-FD2**
3. Select and process food products for storage, distribution, and consumption. **AG-FD3**
4. Explain the scope of the food industry and the historical and current developments of food products and processing. **AG-FD4**

Natural Resources Systems Career Pathway (AG-NR)

1. Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals. **AG-NR1**
2. Analyze the interrelationships between natural resources and humans. **AG-NR2**
3. Develop plans to ensure responsible and sustainable production and processing of natural resources. **AG-NR3**
4. Demonstrate responsible control and management procedures and techniques to protect or maintain natural resources. **AG-NR4**

Plant Systems Career Pathway (AG-PL)

1. Develop and implement a crop management plan for a given production goal that accounts for environmental factors. **AG-PL1**
2. Apply the principles of classification, plant anatomy, and plant physiology to plant production and management. **AG-PL2**
3. Propagate, culture, and harvest plants and plant products based on current industry standards. **AG-PL3**
4. Apply principles of design in plant systems to enhance an environment (e.g., floral, forest, landscape, and farm). **AG-PL4**

Power, Structural and Technical Systems Career Pathway (AG-PST)

1. Apply physical science principles and engineering applications related to mechanical equipment, structures, and biological systems to solve problems and improve performance in AFNR power, structural, and technical systems. **AG-PST1**
2. Operate and maintain AFNR mechanical equipment and power systems. **AG-PST2**
3. Service and repair AFNR mechanical equipment and power systems. **AG-PST3**
4. Plan, build, and maintain AFNR structures. **AG-PST4**
5. Use control, monitoring, geospatial, and other technologies in AFNR power, structural, and technical systems. **AG-PST5**

Common Career and Technical Core Career Ready Practices (CCTC CRP)

1. Act as a responsible and contributing citizen and employee. **CRP1**
2. Apply appropriate academic and technical skills. **CRP2**
3. Attend to personal health and financial well-being. **CRP3**
4. Communicate clearly, effectively, and with reason. **CRP4**
5. Consider the environmental, social and economic impacts of decisions. **CRP5**
6. Demonstrate creativity and innovation. **CRP6**
7. Employ valid and reliable research strategies. **CRP7**
8. Utilize critical thinking to make sense of problems and persevere in solving them. **CRP8**
9. Model integrity, ethical leadership, and effective management. **CRP9**
10. Plan education and career path aligned to personal goals. **CRP10**
11. Use technology to enhance productivity. **CRP11**
12. Work productively in teams while using cultural/global competence. **CRP12**