

Arkansas Department of Career Education Model Framework

Course Title: Plant Science II

Career Cluster: Agriculture, Food & Natural Resources

Secondary – Agriculture Science and Technology	
Course Number	491210
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 growth, plant diseases and insects, plant genetics, plant propagation, 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**

Standard 1.0 Plant Growth

- 1.1 Determine the influence of environmental factors on plant growth
- 1.2 Evaluate growing media for use in plant systems
- 1.3 Develop and implement a fertilization plan for specific plants or crops

Standard 2.0 Plant Diseases and Insects

- 2.1 Develop and implement a plan for integrated pest management
- 2.2 Develop and implement a plan for pest management

Standard 3.0 Plant Genetics

- 3.1 Analyze Genetic Inheritance
- 3.2 Apply Genetic Inheritance to modern plant production

Standard 4.0 Plant Propagation

- 4.1 *Analyze plant propagation techniques*
- 4.2 *Analyze plant propagation*

Standard 1.0 Plant Growth			
Performance Indicator 1.1 Determine the influence of environmental factors on plant growth	Recommended Application/Activity	CCSS Standards	CCTC Standards
1.1.1 Describe plant responses to light. (long day, short day, day neutral, phototropism, photoperiodism) (PS.02.01.01.b)	<ul style="list-style-type: none"> Research phototropism using the website www.plantsinmotion.bio.indiana.edu Design and conduct an Agriscience research project on tropism or daylength response. Classify plants according to daylength. 	SL 9-10.1a SL 11-12.1a SL 9-10.2 SL 11-12.2	AG-PL 2 CRP 6
1.1.2 Differentiate the effects air, temperature and water have on plant metabolism and growth. (hardiness zones, humidity) (PS.02.01.02.a)	<ul style="list-style-type: none"> Draw a map of the US and/or Arkansas indicating hardiness zones and/or heat zones. Compare US and/or Arkansas heat and hardiness zones. Research first and last frost dates in your area. Grow plants using recommended environmental conditions. Design and conduct an Agriscience research project on the effects of air, temperature and/or water on plant metabolism and growth, 	SL 9-10.2 SL 11-12.2 SL 9-10.4 SL 11-12.4 R 9-10.1 R11-12.1	AG-PL 3 CRP 4
Performance Indicator 1.2 Evaluate growing media for use in plant systems	Recommended Application/Activity	CCSS Standards	CCTC Standards
1.2.1 Evaluate growing medias as to the major components of soil . (mineral matter, organic matter, air, water) (PS.02.02.01.a)	<ul style="list-style-type: none"> Develop a pie chart to identify typical percentages of major soil components. Dehydrate a soil sample to determine water content. Demonstrate pore space concepts using pinto beans, sand, and water in a glass jar. Conduct a procedure to remove organic matter from a soil sample to calculate percent mineral matter and organic matter. 	W 9-10.3 W 11-12.3 R 9-10.1 R 11-12.1	AG-PL 3 CRP 6

1.2.2. Analyze types of soilless growing media . (peat, vermiculite, perlite) (PS.02.02.01.a)	<ul style="list-style-type: none"> Identify samples of soilless growing media. Design and conduct an Agriscience experiment on water holding or drainage capabilities of soilless growing media. Develop a soilless medium for a specific plant crop. 	SL 9-10.1a SL 11-12.1a SL 9-10.2 SL 11-12.2	AG-PL 2 AG-PL 3 CRP 6 CRP 2
1.2.3 Differentiate soil texture. (sand, silt, clay) (PS.02.02.01.b)	<ul style="list-style-type: none"> Design a model of soil particles. (ex. Basketball, softball, pingpong ball) Measure and compare pore space of soil particles using the model you created and water. Analyze the soil textural triangle. Perform soil ribbon test. Perform a silt test. 	W 9-10.3 W 11-12.3	AG-PL 2 AG-PL 3 CRP 6
1.2.4 Asses the categories of soil water. (capillary, gravitational, hydroscopic) (PS.02.02.02.a)	<ul style="list-style-type: none"> Discuss how soil drainage and water-holding capacity can be improved. (PS.02.02.02.b) Design and conduct an Agriscience experiment on water holding or drainage capabilities of soil or soilless growing media. 	SL 9-10.1a SL 11-12.1a SL 9-10.2 SL 11-12.2	AG-PL 2 AG-PL 3 CRP 6 CRP 2
Performance Indicator 1.3 Develop and implement a fertilization plan for specific plants or crops	Recommended Application/Activity	CCSS Standards	CCTC Standards
1.3.1 Analyze the three major nutrients for plant growth and development and their major functions. (Nitrogen, Phosphorus, Potassium) (PS.02.03.01.a)	<ul style="list-style-type: none"> Draw a representation of a plant that has proper nutrition, and plants that are deficient in each of the major nutrients. Design and conduct an Agriscience experiment to compare a plant's response to one or more of the major nutrients. Identify deficiency symptoms in plants. Describe nutrient deficiency symptoms. (PS.02.03.02.a) Prepare a multimedia presentation of nutrient-deficient 	SL 9-10.2 SL 11-12.2 SL 9-10.4 SL 11-12.4 R 9-10.1 R11-12.1	AG-PL 3 CRP 4

	plants.		
1.3.2 Evaluate pH as it relates to plant growth. (alkalinity, acidic) (PS.02.03.02.a)	<ul style="list-style-type: none"> • Draw and label a pH scale. • Perform a pH test and record findings on the pH scale. • Classify soils as alkaline, acidic, or neutral. • Design and conduct an Agriscience experiment using hydrangeas to demonstrate soil pH effect on flower color. • 	W 9-10.3 W 11-12.3	AG-PL 2 AG-PL 3 CRP 6 CRP 2
1.3.3 Assess fertilizer sources of essential plant nutrients (organic, inorganic), (PS.02.03.04.a)	<ul style="list-style-type: none"> • Categorize nutrient sources as organic or inorganic. • Calculate the cost of nutrients in organic and inorganic forms of fertilizers, and determine which is the most cost effective for a given scenario. 	R 9-10.1 R 11-12.1 W 9-10.1E W 11-12.1E	AG-PL 1 AG-PL 2 CRP 2 CRP 6
1.3.4 Analyze different types of fertilizers. (granular, time released, water soluble) (PS.02.03.04.a)	<p>Research common types of fertilizers.</p> <ul style="list-style-type: none"> • Describe different methods of fertilizer application. • Apply fertilizers using prescribed methods for that fertilizer. • Develop a fertilizer schedule and cost projection for a given crop scenario. 	W 9-10.2a W 11-12.2a R 9-10.7 R 11-12.7	AG-PL 1 AG-PL 2 CRP 2 CRP 6
1.3.5 Evaluate fertilizer analysis. (N-P-K) (PS.02.03.04.a)	<ul style="list-style-type: none"> • Analyze fertilizer bags to determine analysis. • Calculate the amount of a nutrient in fertilizer. • Develop a fertilizer program for a given crop using soil test results. • Conduct a soil nutrient analysis. 	R 9-10.7 R 11-12.7 R 9-10.6 R 11-12.6 W 9-10.1 b W 11-12.1b	AG-PL 1 AG-PL 2 AG-PL 4 CRP 2 CRP 6

Standard 2.0 Plant Diseases and Insects			
Performance Indicator 2.1 Develop and implement a plan for integrated pest management	Recommended Application/Activity	CCSS Standards	CCTC Standards
2.1.1 Design pest control strategies utilizing integrated pest management (IPM) . (biological pest control, mechanical pest control, cultural pest control, chemical pest control) (PS.03.03.03.a)	<ul style="list-style-type: none"> • Create a poster or collage of examples of IPM. • Research biological control methods of a specific pest and present your findings. • Use appropriate IPM in a crop-growing situation. • Design a plan for IPM for a given scenario. 	W 9-10.7 W 11-12.7 R 9-10.7 R 11-12.7	AG-PL 2 CRP 2 CRP 6
2.1.2 Differentiate methods of chemical pest controls. (insecticide, herbicide, miticide, rodenticide, fungicide, molluscicide) (PS.03.03.03.b)	<ul style="list-style-type: none"> • Draw a representation of a chemical pest control method and how it functions. • Match pests with the correct chemical control. • Design a game in which students match plant pests with the appropriate chemical controls and/or symptoms. (ex. Images on index cards) • Generate a report on an effective chemical control for a given pest. 	W 9-10.7 W 11-12.7 R 9-10.7 R 11-12.7	AG-PL 2 CRP 2 CRP 6
Performance Indicator 2.2 Develop and implement a plan for pest management	Recommended Application/Activity	CCSS Standards	CCTC Standards
2.2.1 Assess types of plant pests (insects, wildlife, weeds) (PS.03.03.01.a)	<ul style="list-style-type: none"> • Prepare a multimedia presentation of plant pests. • Evaluate plant pests from images or actual examples. • Describe damage caused by plant pests. (PS.03.03.02.a) 	W 9-10.7 W 11-12.7 R 9-10.7 R 11-12.7	AG-PL 2 CRP 2 CRP 6
2.2.2 Assess types of diseases. (fungus)	<ul style="list-style-type: none"> • Prepare a multimedia presentation of plant diseases. 	W 9-10.7 W 11-12.7	AG-PL 2 CRP 2

	<ul style="list-style-type: none"> Evaluate plant diseases from images or actual examples. Describe damage caused by plant diseases. (PS.03.03.02.a) 	<p>R 9-10.7 R 11-12.7</p>	<p>CRP 6</p>
<p>2.2.3 Assess types of disorders. (nutrient deficiency)</p>	<ul style="list-style-type: none"> Prepare a multimedia presentation of plant disorders. Evaluate plant disorders from images or actual examples. Describe damage caused by plant disorders. (PS.03.03.02.a) 	<p>W 9-10.7 W 11-12.7 R 9-10.7 R 11-12.7</p>	<p>AG-PL 2 CRP 2 CRP 6</p>

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Standard 3.0 Plant Genetics			
Performance Indicator 3.1 Analyze Genetic Inheritance	Recommended Application/Activity	CCSS Standards	CCTC Standards
3.1.1 Explain genetic inheritance in plants in terms of genes, chromosomes and DNA .	<ul style="list-style-type: none"> • Create a model of plant DNA using craft materials. • Extract DNA from a tissue sample. 	W9-10.2a W11-12.2a R9-10.3 R11-12.3	CRP2 CRP4 AG-PL 2 AG-PL 3
3.1.2 Assess and analyze dominant and recessive traits in terms of alleles, genotype, phenotype, homozygous, heterozygous and hybrid vigor .	<ul style="list-style-type: none"> • Design and conduct an Agriscience experiment to replicate one of Mendel's plant experiments. • Differentiate between genotypic and phenotypic traits. • Define and understand the terms; dominant, recessive, genotype, phenotype, homozygous, heterozygous, and hybrid vigor. 	R9-10.3 R11-12.3 L9-10.4c L11-12.4c L9-10.4 L11-12.4	CRP 2 CRP 4 AG-PL 2 AG-PL 4
Performance Indicator 3.2 Apply Genetic Inheritance to modern plant production	Recommended Application/Activity	CCSS Standards	CCTC Standards
3.2.1 Predict possible offspring of matings by using the Punnett Square .	<ul style="list-style-type: none"> • Devise a game in which students have predetermined "genes" and cross them with those of another student. • Complete Punnett Squares and record the predicted ratios and percentages of each type of offspring. • Use candies to create and complete models of Punnett Squares. 	SL 9-10.1 SL 11-12.1 SL 9-10.4 SL 11-12.4	CRP 2 CRP4 AG-PL 2 AG-PL 4
3.2.2 Explain how genetic principles are used to improve agricultural production.	<ul style="list-style-type: none"> • Plan a breeding program to produce plants with the desired qualities. • Research genetic advances in plant production. 	SL 9-10.2 SL11-12.2 W 9-10.7 W11-12.7	CRP 2 CRP 4 AG-PL 2
3.2.3 Analyze the benefits and concerns associated with genetically modified organisms (GMO) .	<ul style="list-style-type: none"> • Conduct a panel discussion using the Ag.Issues format concerning the benefits and concerns associated with genetically modified organisms (GMO). 	W 9-10.7 W 11-12.7	CRP 2 CRP 4 AG-PL 2

(PS.03.01.05.b)			
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Standard 4.0 Plant Physiology			
Performance Indicator 4.1 Analyze plant fertilization processes	Recommended Application/Activity	CCSS Standards	CCTC Standards
4.1.1 Diagram the process of plant fertilization . (PS.03.01.01.b)	<ul style="list-style-type: none"> • Diagram the process of plant fertilization. • Explain the process of plant fertilization. 	W9-10.2a W11-12.2a SL9-10.1a SL11-12.1a L9-10.6 L11-12.6	CRP 2 CRP 6 CRP 4 AG-PL 2
4.1.2 Synthesize the conditions needed for seed germination . (temperature, moisture, light, oxygen) (PS.03.01.02.a)	<ul style="list-style-type: none"> • Manipulate environmental conditions and predict the results on germination of seeds. • Research optimal conditions for germination of a given plant's seed. • Calculate seed germination percentages using a packet of seeds, and compare results to the expected germination rates. • Design and conduct an Agriscience experiment on the effect of temperature, moisture, light or oxygen on germination rates. 	W9-10.1 W11-12.1 W9-10.7 W11-12.7 W9-10.4 W11-12.4	CRP 2 CRP 7 AG-PL 1 AG-PL 3
Performance Indicator 4.2 Analyze plant propagation	Recommended Application/Activity	CCSS Standards	CCTC Standards
4.2.1 Investigate asexual propagation methods (cuttings, division, separation, grafting, micropropagation and layering) (PS.03.01.03.a) (PS.03.01.04.a)	<ul style="list-style-type: none"> • Demonstrate techniques used to propagate plants. • Compare asexual propagation methods utilizing different growing media • Evaluate the rooting/growth of different plants when asexual propagation methods are utilized. 	SL9-10.4 SL 11-12.4	CRP 4 AG-PL 3
4.2.2 Explain cross-pollination and self-pollination of flowering plants. (PS.03.01.01.a)	<ul style="list-style-type: none"> • Create a model or diagram of the pollination process. • Discuss methods of pollen transfer. (wind, animals, insects, mechanical) • 	W 9-10.2a W11-12.2a SL9-10.1a SL11-12.1a R9-10.3	CRP 2 CRP 6 CRP 4 AG-PL 2 AG-PL 3

		R11-12.3	
4.2.3 Differentiate pollination techniques in annuals and perennials	<ul style="list-style-type: none">• Perform pollination or cross-pollination using common plants.		

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Glossary

Standard 1.0 Plant Growth

1. Acidic – pH of below 7
2. Alkalinity – pH of above 7
3. Capillary water – available water held within pore spaces
4. Clay – the smallest soil particle
5. Day neutral plant – plants that flower regardless of day length
6. Granular fertilizer – fertilizer that comes in a dry pellet form
7. Gravitational water – available water that moves downward through the soil as a result of gravity
8. Hardiness zone – a geographically defined area in which a specific category of plant life is capable of growing.
9. Humidity – amount of water vapor in the air
10. Hygroscopic water – water that is usually unavailable that clings tightly to soil particles
11. Inorganic fertilizer – plant nutrients derived from a non-living source
12. Long day plant – a plant that flowers when the days get longer.
13. Mineral matter – the basic components of soil; sand, silt, clay
14. Nitrogen – major plant nutrient that encourages growth and dark green color
15. Organic fertilizer – plant nutrients derived from plant and animal sources
16. Organic matter – decayed remains of plants and animals
17. Peat – partially decayed vegetation commonly consisting of sphagnum moss
18. Perlite – heat treated lava rock that is white, light weight with low moisture and nutrient holding capacity
19. pH – the index of the acidity or alkalinity of a substance.
20. Phosphorus – an element that is a major plant nutrient needed by the plant for flower and fruit production.
21. Photoperiodism – a plant's response to light duration.
22. Phototropism – a plant's response to light resulting to a directional change towards the light.
23. Potassium – an element that is a major plant nutrient that promotes overall plant health and root growth.
24. Sand – the largest soil particle.
25. Short-day plant – a plant that blooms as the days get shorter.
26. Silt – fine particles of soil smaller than sand and larger than clay.

27. Soil – layer of the earth’s surface favorable to plant growth.
28. Soilless growing medium – non-soil materials that are used to grow plants; vermiculite, perlite, peat, bark
29. Time released fertilizer – fertilizer encased in a semi-permeable coating that releases nutrients over a period of time.
30. Vermiculite – heated treated mica that is lightweight with nutrient and moisture-holding capacity.
31. Water soluble fertilizer – plant nutrients that dissolve easily in water.

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Standard 2.0 Plant Diseases and Insects

1. Biological pest control – the use of living organisms to reduce pest populations
2. Chemical pest control – the use of chemicals to reduce pest populations
3. Cultural pest control – the use of agricultural practices to reduce pest populations
4. Fungicide – an agent that is used to kill fungus
5. Herbicide – a material that is used to kill undesirable plants
6. Insecticide – a material that is used to kill insects
7. Integrated pest management – using a variety of control methods to reduce pest populations
8. Mechanical pest control – methods that physically remove or exclude pests
9. Miticide – a material used to kill mites
10. Molluscicide – a material used to kill snails and slugs
11. Nutrient deficiency – when a nutrient is not in sufficient quantity to meet the needs of a growing plant
12. Pests – unwanted organisms that may damage crops
13. Rodenticide – a material used to kill rodents

Standard 3.0 Plant Genetics

1. Genetically modified organism – an organism whose genetic material has been altered using genetic engineering techniques; GMO
2. Punnett square – a diagram used to predict the outcome of a particular genetic cross

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Standard 4.0 Plant Propagation

1. Cross pollination – the transfer of pollen from the anther of one plant to the stigma of another.
2. Cuttings – vegetative plant parts that regenerates roots and forms new plants.
3. Division – asexual propagation involving separation of plant into two or more pieces, each containing a portion of the roots.
4. Grafting – implanting a branch or bud from one plant onto another.
5. Layering – asexual propagation method in which roots form on the stem while it is still attached to the parent plant.
6. Micropropagation – plant reproduction using very small actively growing plant parts under sterile conditions and medium; tissue culture
7. Plant fertilization – the fusing or joining of sperm with an egg.
8. Pollination – the transfer of pollen from the anther to the stigma of the flower.
9. Seed germination – the process by which a seed embryo begins to grow; sprouting.
10. Self pollination – transfer of pollen from the anther to the stigma of the same flower.

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**

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**