Poultry Science

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8/1/2014

2014 – 2015

Arkansas Department of Career Education
Model Framework

Course Title: **Poultry Science**

Career Cluster: **Agriculture, Food & Natural Resources**

Secondary – Agriculture Science and Technology	
Course Number	491440
CIP Number	01.0907
Grade Level	10-12
Prerequisite	Survey of Agriculture Systems
Course Type	Elective
Teacher Certification	010 Agriculture 218 Agricultural Sciences & Technology
CTSO	FFA
Facility Requirements	http://arkansasfacilities.arkansas.gov/SchoolFacManual.aspx
Industry Certifications	Contact the University of Arkansas Poultry Department, Gary D. Davis gddavis@uark.edu about students receiving college credit for this course.

Course Description

Poultry Science focuses on the production and management of poultry and the production and handling of poultry products.

Program Purpose/Structure

This course allows for an in-depth look at the Poultry Industry while providing hands-on laboratories with opportunities to participate in FFA and Supervised Agriculture Experiences.

Arkansas Department of Career Education
Poultry Science Student Performance Standards

Standard 1.0 Assess the Economics of the Poultry Industry

1.1 Investigate the poultry industry in the U.S.
1.2 Assess the impact and viability of the Arkansas poultry industry.

Standard 2.0 Evaluate Poultry Genetics

2.1 Cite historical evidence of genetic changes in poultry.
2.2 Evaluate the effect of breeding programs on heritability.
2.3 Analyze the structure of primary breeder programs.

Standard 3.0 Investigate the Reproductive Anatomy and Embryology of Poultry

3.1 Evaluate the reproductive anatomy of poultry.
3.2 Investigate the anatomy and developmental process of the egg.
3.3 Assess environmental conditions necessary for hatching.

Standard 4.0 Assess the Environmental Physiology and Health of Poultry

4.1 Evaluate the importance of environmental conditions to poultry health.
4.2 Investigate disease transmission and prevention in poultry.

Standard 5.0 Assess the Nutritional Needs of Poultry

5.1 Investigate the avian digestive system.
5.2 Analyze the feeding of commercial poultry, connecting nutritional requirements and health.
5.3 Analyze nutrient cost associated with poultry production

Standard 1.0 Assess the economics of the poultry industry			
Performance Indicator 1.1 Investigate the poultry industry in the US.	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
1.1.1 Explain how environmental conditions and consumer demands have driven changes in the poultry industry.	• Create a timeline of major shifts in the poultry industry in from the 1900's to the present, including types of birds raised. • Create a timeline of methods of marketing dressed birds from the 1900's to the present. o New York dressed bird (not sure what this means—as opposed to what type?)	3T	

1.1.2 Formulate a ranking of the top 5 states in each major area of poultry production, citing reasons for migration to those states.	• Research poultry production in the U.S.: www.nass.usda.gov/Charts_and_Maps/poultry
	• Create a map of the United States indicating the top 5 states for each major poultry product:
	  o Broilers
	  o Table eggs
	  o Turkeys		

1.1.3 Compare the value of current market trends in broiler processing.	• Research www.ers.usda.gov/
	• Visit a local grocery store to compare the price per pound for different poultry products:
	  o Whole bird
	  o Parts and cut-up
	  o Value-added products		

1.1.4 Identify the divisions of a vertically integrated poultry company.	• Create a visual representation of the divisions of a vertically integrated poultry company, including:
	  o Feed mill
	  o Hatchery
	  o Veterinary/Technical service
	  o Transportation
	  o Processing plant
	  o Further processing (this doesn't make sense to me)
	• Interview an employee of a local poultry company. (To		

	determine??) • Tour a poultry facility. (For?—maybe expand on this a bit)		
Performance Indicator 1.2 Assess the impact and viability of the Arkansas poultry industry.	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
1.2.1 Calculate the economic output of the Arkansas poultry industry	• Using multiple resources, research a poultry company operating in Arkansas to discover the economic impact of individual companies. Present findings to a group using chosen media (powerpoint, Prezi, etc.) • Research economic impact and employment data in the poultry industry in Arkansas, creating a visual representation of future employment opportunities. • Summarize a newspaper article from an Arkansas newspaper concerning the poultry industry. • Create an Arkansas map to identify the counties with the highest economic impact from broilers and turkeys.		
1.2.2 Assess the costs associated with poultry farming	• Estimate the start-up costs of setting up a poultry operation. • Compare the long-range return on investment of a poultry operation as compared with another farming opportunity.		
1.2.3 Critique the benefits of commercial poultry farming as compared with family farming	• Research contractual obligations required by a poultry integrator. • Evaluate the costs and benefits associated with a "tournament system" for paying poultry producers		
1.2.4 Examine the role of the government in the poultry industry	• Research laws impacting poultry operations, such as the Packer's Act, EPA air quality standards, OSHA requirements, etc.		
Standard 2.0 Evaluate Poultry Genetics			

Performance Indicator 2.1 Cite historical evidence of genetic changes in poultry	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
2.1.1 Defend the purpose for the poultry industry moving from a dual purpose bird to broilers and table egg layers.	• Research dual purpose breeds used by early poultry producers. (Plymouth Rock) • Describe two natural attributes that were critical in the success of poultry breeding programs. • Examine the negative correlation between meat and egg production.		
2.1.2 Identify the breeds used to develop today's broiler and layer strains.	• Teams prepare a multimedia presentation outlining the breeds used to develop today's broilers or layers: o Plymouth Rock o Cornish o Rhode Island Red • Create a multimedia presentation illustrating changes in percentage of breast meat in broilers over several decades. • Enrichment activity - Teams use the American Standard of Perfection to research classes of chickens, comb types, breed varieties or show standards.		
2.1.3 Connect the contributions of modern innovations to the success of early breeding programs.	• Using multiple web and print resources, determine the effectiveness of breeding programs in reducing broodiness. • Design and perform a comparison trial on broodiness of various breeds of poultry. • Research the use and value of trap nests and artificial incubators in the poultry industry.		
2.1.4 Analyze important genetic changes that occurred from the 1940s through the 1990s.	• Create a timeline reflective of the genetic changes discussed in this unit.		
Performance Indicator 2.2 Evaluate the effect of breeding programs on heritability	• **Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**

2.2.1 Connect selection pressure with genetic progress.	• Examine the reasons poultry geneticists have focused on breast meat as a trait for improvement. • Using valid research, develop graphs depicting levels of selection pressure. • Use a variety of resources to either prove or disprove: High heritability = Rapid progress Low heritability = Slow progress		
2.2.2 Compare the traits emphasized for male genetic lines and female genetic lines.	• Draw an example of an ideal male and female bird for a male line. • Draw an example of an ideal male and female bird for a female line. • Evaluate live male and female birds for their suitability as male or female line breeders, including: o Males: meat yield, weight for age, days to market, feed efficiency, body conformation, and fat content. o Females: fertility rate, hatchability, age at sexual onset, rate of egg production.		
2.2.3 Explain the science of sex-linked traits and how the commercial egg industry uses this in their breeding programs.	• Diagram a pairing of chickens to produce offspring that are sex-linked (can be sexed at hatch by chick down color) • Pair chickens to produce offspring with color that is sex-linked and hatch the chicks.		
Performance Indicator 2.3 Analyze the structure of primary breeder programs.	**Recommend Application / Activity**	**CCSS Standards**	**CCTC Standards**
2.3.1 Assess the benefits of the pyramidal structure of primary breeder programs	• Diagram the pyramidal structure of the primary breeder program, including: o Pedigree level o Great grandparent level o Grandparent level o Parent level o Commercial broiler (?) does this belong here? • Name and describe the purpose and origin of the types of birds contained within the pyramid structure of a		

	primary breeder company.		
2.3.2 Evaluate the argument for crossing pedigree lines to develop the modern commercial broiler.	• Diagram the multiplication of broiler stock within the primary breeder company including: o Heterosis o Hybrid vigor o Blending male and female traits o Protection from theft of genetics		
2.3.3 Investigate how the value of broiler stock changes within the pyramid structure.	• Calculate the value of birds at each level of the pyramid structure. • Research a poultry company's policies on the selling of breeder stock at different levels on the pyramid structure.		
Standard 3.0 Investigate the Reproductive Anatomy and Embryology of Poultry			
Performance Indicator 3.1 Evaluate the Reproductive Anatomy of Poultry.	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
3.1.1 Examine how estrogen contributes to sexual maturation of the hen.	• Draw a pullet and a mature hen and label the secondary sexual characteristics.		
3.1.2 Research the parts and functions of the oviduct, assessing the time eggs spend in each segment.	• Dissect an avian oviduct , label and describe the functions of the parts: o Ovary o Follicle o Infundibulum o Uterus o Magnum o Isthmus o Cloaca o Vent o Vagina • Diagram an avian ovary and label the types of follicles. • Create a timeline following the developing egg through the oviduct.		

3.1.3 Investigate the parts and functions of the male avian anatomy.	• Dissect a rooster's reproductive tract, labeling the structures and describing the functions: o Testicle o Cloaca o Vas deferens		
3.1.4 Analyze changes that occur in the brain and body of both male and female poultry in response to increased photoperiod.	• Create a flow chart diagramming the hormonal activity and physical changes in the hen or rooster in response to photoperiod. • Choose a breed of chicken or other poultry and illustrate the mature male, labeling the secondary sexual characteristics, including: o Sexual maturation o Estrogen o Pituitary gland o FSH o LH ovulation o Progesterone		
3.1.5 Evaluate pigment in a hen to predict productivity.	• Compare the productivity of hens with varying degrees of pigment loss. • Examine a number of hens to evaluate levels of pigments loss, predicting productivity based on examination. • Examine a hen to determine areas of possible pigment loss and the order in which loss occurs and returns.		
3.1.6 Analyze the calcium metabolism of an egg-producing hen.	• Diagram the calcium metabolism of an egg-producing hen.		
3.1.7 Compare clutch lengths in a variety of poultry.	• Research clutch length in various types of poultry, including o Turkey hens o Jungle fowl hens o Leghorn hens o Broiler breeder hens o Quail hens		
Performance Indicator 3.2 Investigate the	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**

anatomy and developmental process of the egg			
3.2.1 Investigate the major anatomical features of the egg, differentiating structures according to the function of each.	• Dissect an egg; label and describe the functions of each structure: o Stigma o Albumen o Shell o Chalazae o Germinal disc o Yolk membrane o Yolk • Grade broken–out eggs using USDA standards. • Weigh and classify eggs according to USDA sizing standards. • Grade exterior eggs according to USDA standards.		
3.2.2 Examine the steps involved in egg shell formation beginning with raw materials in the blood.	• Diagram the steps involved in egg shell formation beginning with raw materials in the blood. • Use common chemicals to decalcify an eggshell and record findings.		
3.2.3 Connect embryonic development (two phases) and structures in hatching eggs(maybe reword?)	• Candle incubated white eggs in various stages of embryo development, identifying the visibly-occurring process and its relationship to embryonic development.		
3.2.4 Compare the developmental processes in early-, mid-, and late-incubation periods	• Incubate a set of eggs adding one each day until hatching occurs. Dissect each embryo and label the structures.		
Performance Indicator 3.3 Assess environmental conditions necessary for hatching.	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
3.3.1 Investigate the responsibilities of breeder	• Interview a breeder farm employee about egg handling procedures.		

farms in hatching and egg preparation.	• Visit a breeder farm to see egg collection, storage, and handling procedures, assessing the need for packing eggs onto carts correctly. • Grade eggs according to USDA standards.		
3.3.2 Investigate the major responsibilities and concerns of a hatchery.	• Tour a hatchery to identify concerns and responsibilities, including: o Hatchability o Fertility o Hatch of fertile		
3.3.3 Assess the need for temperature and humidity controls in the hatchery.	• Explain why the relative humidity needs to be higher in a hatcher than in a setter. • Explain why the amount of supplemental heat provided in a setter changes during incubation. • Evaluate the implications of not maintaining proper temperature and humidity in the hatchery. • Create a visual presentation indicating the defects caused by improper temperature and humidity. • Conduct an experiment with hatching eggs to compare differing temperature and humidity levels on embryonic development.		
3.3.4 Investigate the length of time chicken and turkey eggs are held in the setter and hatcher.	• Incubate chicken and turkey eggs, following correct environmental conditions and procedures in the setter and hatcher. Record hatching times. • Calculate the effect that size and storage has on hatching time using a standard formula.		
3.3.5 Cite evidence supporting the need for egg rotation in the setter, but not in the hatcher.	• Conduct an experiment comparing developing eggs that are rotated correctly and those that are not. • (For the objective, there is no activity comparing the need for rotation in the setter vs. hatcher.)		
3.3.6 Research how hatchability, fertility, and hatch of fertile are used to evaluate reproductive performance.	• Calculate hatchability, fertility, and hatch of fertile • Explain which area of production is most responsible for the success of hatchabiity, fertility, and hatch of fertile		
	Standard 4.0 Assess the Environmental Physiology		

	and Health of Poultry		
Performance Indicator 4.1 Evaluate the Importance of environmental conditions to poultry health	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
4.1.1 Contrast methods of heat exchange, analyzing methods of head loss.	• Create a multimedia presentation with visual representation of the methods of heat exchange: o Convection o Conduction o Radiation • Contrast sensible vs. insensible heat loss • Investigate the concepts of homeostatis and homeothermic.		
4.1.2 Investigate how heat flow is impacted by vasoconstriction and vasodilation.	• Prepare a visual of a bird, illustrating how vasoconstriction and vasodialation differs depending upon changes in ambient temperature.		
4.1.3 Assess how total heat production and heat production per unit body weight changes as weight increases.	• Prepare a graph showing the relationship between heat production and body weight.		
4.1.4 Differentiate between active and passive thermoregulatory mechanisms.	• Create a display showing how active and passive thermoregulation interacts with vasoconstriction and vasodilation. • Create a visual representation of temperature zones which poultry may be exposed to and include the thermoregulatory mechanisms that may be involved.		
4.1.5 Connect how the range of temperatures in the thermoneutral zone changes as birds age.	• Create a graph or chart displaying the thermoneutral zone and how it differs by age of the bird.		
4.1.6 Evaluate how the	• Conduct an experiment with living birds, recording feed		

proportion of heat lost by insensible and sensible mechanisms is impacted by environmental temperature and humidity.	and water intake in response to varying temperature and humidity levels. Record findings and present information to peers. • After researching the effects of insensible and sensible heat loss, work in small groups to draw conclusions about how feed and water are affected.		
Performance Indicator 4.2 Investigate disease transmission and prevention in poultry.	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
4.2.1 Assess common methods of disease transmission, investigating effective prevention measures.	• Using multiple online and print resources (such as the IMS Poultry Science Manual), research methods of disease transmission, citing evidence to support effective prevention measures for a common poultry disease. Present findings to peers. • Research biosecurity methods used by a local poultry company. • Create a sign with biosecurity practices to be used at the county fair poultry barn • Draw an example of proper PPE for someone visiting your poultry barn. • Prepare a biosecurity plan for the school poultry barn, or your own poultry barn that addresses sanitation and protective clothing. • Watch a demonstration of blood testing and wing-banding of show birds.		
4.2.2 Assess common disease causing agents and factors that contribute to their proliferation.	• Diagram the life cycle of a pathogen. • Research the pathogens responsible for several common poultry diseases, identifying factors that contribute to onset and proliferation: o Bacteria o Virus o Fungus o Protozoa o Parasite		
4.2.3 Analyze the	• Diagram the lifecycle of an infectious disease including:		

differences between infectious and non-infectious disease, assessing mortality rates of each.	o Adherence o Penetration o Replication o Assimilation o Release • Using research, calculate mortality rates for both an infectious and non-infectious disease, addressing morbidity and pathogenicity. Based on research data, explain why infectious disease may be particularly damaging.		
4.2.4 Differentiate between active and passive immunity.	• Defend the need for poultry vaccines, explaining how passive immunity is received by chicks. • Research how active and passive immunity is obtained and the protection afforded by each.		
4.2.5 Compare commonly used vaccination methods for poultry, critiquing their use as a therapeutic treatment.	• Research vaccination methods used for several common poultry diseases, such as: o Aerosol o Subcutaneous o Wingweb o Oral • Vaccinate chicks or older birds.		
	Standard 5.0 Assess Nutritional Needs of Poultry		
Performance Indicator 5.1 Evaluate the avian digestive system.	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
5.1.1 Analyze the eating habits of chickens to determine efficient feeding processes and practices.	• Observe the eating habits of chickens or turkeys (for? to?) • Conduct an experiment manipulating feeding and watering methods for groups of chickens or turkeys and record findings. • Manipulate lighting conditions for poultry, evaluating the effects of lighting on feed consumption.		

5.1.2 Assess the monogastric digestive system of poultry, identifying the function of each segment of the digestive tract.	• Dissect the avian digestive tract, labeling a describing the function each of the parts, including: o Beak o Esophagus o Crop o Gizzard o Ventriculus o Small intestine o Ceca o Large intestine o Cloaca o Vent • Analyze changes in the appearance, texture, and pH of feed residue found in the various segments of the digestive tract. • Create a crossword puzzle of parts and functions of the digestive tract. • Compare and contrast the avian digestive tract to that of another agricultural monogastric animal.		
Performance Indicator 5.2 Analyze the feeding of commercial poultry, making the connection between nutritional requirements and health	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
5.2.1 Analyze classes of necessary nutrients, identifying sources of each.	• Prepare a table identifying the classes of nutrients and dietary sources of each, including: o Protein o Carbohydrates o Fats o Vitamins o Minerals o Water • Assess the role of triglycerides in the blood. • Identify feedstuffs and discuss nutrients contained in each.		

	• Use research to determine the specific limiting nutrients when given dietary levels and requirements. Based on this research, draw conclusions about the concept of limiting nutrients.		
5.2.2 Differentiate between essential and non-essential amino acids, describing factors that influence a bird's requirement for each.	• Research factors that influence a bird's requirement for essential amino acids: o Lysine o Methionine o Cysteine • Evaluate poultry feed formulations to determine the need for (?) amino acid supplementation.		
5.2.3 Analyze the vitamin and nutrient requirements of poultry, making the connection between nutrient requirements and feed sources.	• Compare avian vitamin requirements to those of another agricultural monogastric or ruminant species and report your findings. • Identify the fat- and water-soluble vitamins necessary in a poultry ration, making the connection between nutrients and their sources. • Compare the added-vitamin levels in various feeds. • Evaluate feed labels for different types of poultry, comparing the macro- and micro-mineral content of each. • Identify feedstuffs, evaluating the nutrients contained in each: o Cereal grains o Oilseed meals o Animal protein o Oils		
5.2.4 Investigate nutrient deficiencies in poultry, predicting conditions that result from deficiencies.	• Prepare a visual presentation showing clinical signs of nutrient deficiencies in poultry. • Conduct a feeding trial to create a nutrient deficiency in poultry.		
5.2.5 Assess the importance of the yolk residue in chick nutrition. (Meckel's diverticulum)	(Activity here?)		

Performance Indicator 5.3 Analyze nutrient costs associated with commercial poultry production	**Recommended Application/Activity**	**CCSS Standards**	**CCTC Standards**
5.3.1 Calculate the least-cost formulation for a poultry ration.	• Use a computer-based least cost formulation program to create a ration for poultry, identifying the information that must be used in the calculation. • Use a Pearson's Square to create a least-cost formulation for a poultry ration.		
5.3.2 Compare and contrast costs of the different forms of feed necessary at each stage of production.	• Identify forms of poultry feeds appropriate at each stage of production, noting the nutrition and cost of each.		

Glossary

1.

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**