

# Beef Science

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**Arkansas Department of Career Education  
 Model Framework**

**Course Title: Beef Science**

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

<b>Secondary – Agriculture Science and Technology</b>	
Course Number	491430
CIP Number	01.0999
Grade Level	11 - 12
Course Type	Elective
Teacher Certification	010 Agriculture 218 Agricultural Sciences & Technology
CTSO	FFA
Facility Requirements	<a href="http://arkansasfacilities.arkansas.gov/SchoolFacManual.aspx">http://arkansasfacilities.arkansas.gov/SchoolFacManual.aspx</a>
Prerequisite Courses	Animal Science I & Animal Science II
Industry Certifications	

**Course Title: Beef Science**

**Course Number: 491430**

**Course Credit: .5**

**Course Description:** This course allows for an in-depth look at the Beef Science Industry while providing Hands on Laboratories, and opportunities to participate in FFA and Supervised Agriculture Experiences.

**Arkansas Department of Career Education  
Student Performance Standards**

**Program Purpose/Structure**

***1.0 Introduction to the Beef Cattle Industry and Animal Selection***

- 1.1 Research Beef production systems
- 1.2 Analyze factors in animal selection

***2.0 Nutrition and Feeding of Beef Cattle***

- 2.1 Examine Cow/calf nutritional requirements
- 2.2 Assess herd bull nutritional requirements
- 2.3 Evaluate nutritional requirements for stocker, feeder, and finishing cattle

***3.0 Pasture and Forage Management***

- 3.1 Design a Forage Production Plan
- 3.2 Analyze beef cattle grazing systems and soil fertility

***4.0 Herd Health and Reproduction***

- 4.1 Assess common beef cattle diseases and parasites
- 4.2 Research Herd Health care
- 4.3 Assess Beef Cattle Reproduction

***5.0 Facilities and Equipment***

- 5.1 Analyze Cattle Handling Facilities
- 5.2 Investigate Environmental Concerns

***6.0 Marketing and Promoting Beef***

- 6.1 Assess the Marketing of Beef Cattle
- 6.2 Analyze the current Beef Promotions

<b>Standard 1.0 Introduction to the Beef Cattle Industry and Animal Selection</b>			
<b>Performance Indicator 1.1 Research Beef production systems</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
1.1.1 List the three main types of beef production systems (Cow/calf, Stocker/back grounding, Feedlot)	<ul style="list-style-type: none"> <li>Actual or virtual tour of beef production systems.</li> </ul>	SL11-12.1, SL11-12.2	AG-ANI1 CRP1
1.1.2. Differentiate and describe the three main beef production systems.	<ul style="list-style-type: none"> <li>Compare the two types of cow/calf systems. (Commercial, Seedstock)</li> </ul>	R11-12.5	AG-ANI2 CRP8
<b>Performance Indicator 1.2 Analyze factors in animal selection</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
1.2.1 Identify physical qualities needed in replacement females and males. (structural correctness, frame score, conformation)	<ul style="list-style-type: none"> <li>Judge a class of beef heifers and a class of beef bulls.</li> <li>Prepare and deliver a set of reasons supporting your placing of these classes.</li> </ul>	SL11-12.4, R11-12.1	AG-ANI6 CRP2
1.2.2 Evaluate the importance and uses of EPD's (expected progeny difference)	<ul style="list-style-type: none"> <li>Judge a class of beef animals using EPD's based on a given scenario.</li> </ul>	SL11-12.4	AG-ANI6 CRP2
1.2.3 Discuss & grade feeder and market animal selection and grading. (Frame-small, medium, large; muscling-1, 2, 3)	<ul style="list-style-type: none"> <li>Grade feeder cattle by assessing photographs, videos, or live animals.</li> <li>Differentiate beef cattle breeds by the feeder cattle grades they tend to represent.</li> </ul>	SL11-12.1	AG-ANI6 CRP2
1.2.4 Analyze & apply USDA slaughter cattle grading. (prime, choice, select)	<ul style="list-style-type: none"> <li>Grade slaughter cattle by assessing photographs, videos, or live animals.</li> </ul>	SL11-12.5	AG-ANI6 CRP2

<b>Standard 2.0 Nutrition and Feeding of Beef Cattle</b>			
<b>Performance Indicator 2.1 Examine Cow/calf nutritional requirements</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
2.1.1 Explain & formulate nutritional requirements and options of a cow/calf herd in Fall and Winter	<ul style="list-style-type: none"> <li>Formulate a ration/feeding plan for a cow/calf herd in winter.</li> </ul>	SL11-12.1, SL11-12.4, W11-12.2a	AG-ANI3 CRP2
2.1.2 Explain & formulate nutritional requirements and options of a cow/calf herd in Spring and Summer	<ul style="list-style-type: none"> <li>Formulate a ration/feeding plan for a cow/calf herd in summer.</li> </ul>	SL11-12.1, SL11-12.4, W11-12.2a	AG-ANI3 CRP5
<b>Performance Indicator 2.2 Asses herd bull nutritional requirements</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
2.2.1 Explain & formulate nutritional requirements and options for herd bulls in Fall and Winter	<ul style="list-style-type: none"> <li>Formulate a ration/feeding plan for herd bulls in winter.</li> </ul>	SL11-12.1, SL11-12.4, W11-12.2a	AG-ANI3 CRP5
2.2.2 Explain & formulate nutritional requirements and options for herd bulls in Spring and Summer	<ul style="list-style-type: none"> <li>Formulate a ration/feeding plan for herd bulls in summer.</li> </ul>	SL11-12.1, SL11-12.4, W11-12.2a	AG-ANI3 CRP5
<b>Performance Indicator 2.3 Evaluate nutritional requirements for stocker, feeder, and finishing cattle</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
2.3.1 Evaluate nutritional requirements and options for stocker cattle	<ul style="list-style-type: none"> <li>Appraise the decision to carry calves over as stockers instead of selling at weaning.</li> <li>Formulate a ration/feeding plan for stocker cattle in winter.</li> </ul>	SL11-12.1, SL11-12.4, W11-12.2a, R11-12.1	AG-ANI3 CRP5

2.3.2 Evaluate nutritional requirements and options for feeder cattle	<ul style="list-style-type: none"> <li>Appraise the decision to retain ownership of claves through the feeder phase.</li> <li>Formulate a ration/feeding plan for feeder cattle.</li> </ul>	SL11-12.1, SL11-12.4, W11-12.2a, R11-12.1	AG-ANI3 CRP5
2.3.3 Evaluate nutritional requirements and options for finishing cattle	<ul style="list-style-type: none"> <li>Appraise the decision to retain ownership of claves through the finishing phase.</li> <li>Formulate a ration/feeding plan for finishing cattle.</li> </ul>	SL11-12.1, SL11-12.4, W11-12.2a, R11-12.1	AG-ANI3 CRP8
<b>Standard 3.0 Create a Pasture and Forage Management Plan</b>			
<b>Performance Indicator 3.1 Design a Forage Production Plan</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
3.1.1 Evaluate forage production in Arkansas	<ul style="list-style-type: none"> <li>Develop a year-round forage plan for beef cattle production.</li> <li>Research available forages in your area.</li> </ul>	SL11-12.1, SL11-12.1a,	AG-ANI3 CRP5
3.1.2 Compare and contrast the uses of cool and warm season grasses. (cool-wheat, ryegrass; warm-bermuda grass, bahia grass)	<ul style="list-style-type: none"> <li>Compare and contrast purchase vs. production of forages.</li> </ul>	SL11-12.1c, SL11-12.1d	AG-ANI3 CRP8
3.1.3 Compare and contrast options in obtaining and storing harvested forages and other feedstuffs. (hay, silage/baleage/haylage, commodity and by-products)	<ul style="list-style-type: none"> <li>Compare and contrast different methods of storing harvested forages.</li> <li>Identify locally available commodity and by-product feedstuffs.</li> </ul>	SL11-12.1c, SL11-12.1d	AG-ANI3 CRP8
<b>Performance Indicator 3.2 Analyze beef cattle grazing systems and soil fertility</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
3.2.1 Assess cattle grazing systems. (continuous grazing,	<ul style="list-style-type: none"> <li>Calculate savings in hay cost achieved by stock piling grass based on a given scenario.</li> <li>Use Animal Units and Animal Unit Months to assess</li> </ul>	SL11-12.2, R11-12.3	AG-ANI3 CRP2

rotational grazing, management intensive grazing)	maximum stocking rate for a grazing scenario.		
3.2.2 Analyze soil fertility and conservation. (soil testing, fertilizers, limestone, erosion control)	<ul style="list-style-type: none"> <li>Demonstrate the proper method to obtain a soil sample.</li> <li>Research soil fertility and its effects on forage production for pasture and hay production then make a presentation of your findings.</li> <li>Create a conservation plan for your operation</li> </ul>	SL11-12.2, R11-12.3	AG-ANI3 CRP2
3.2.3 Analyze soil fertility for forage production.	<ul style="list-style-type: none"> <li>Interpret a soil analysis and synthesize a fertilization plan for a forage crop.</li> </ul>	SL 11-12.2, R11-12.3	AG-ANI3 CRP8
<b>Standard 4.0 Herd Health and Reproduction</b>			
<b>Performance Indicator 4.1 Assess common beef cattle diseases and parasites</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
4.1.1 Analyze common beef cattle diseases.	<ul style="list-style-type: none"> <li>Design a chart of common bovine diseases, their symptoms, and their treatments. (Black Leg, Leptospirosis, Bovine Viral Diarrhea)</li> </ul>	SL11-12.1, R11-12.7	AG-ANI7 CRP2
4.1.2 Assess common beef cattle parasites	<ul style="list-style-type: none"> <li>Design a chart of common parasites that affect beef cattle. (Lice, flies, horse flies, brown stomach worm, lung worm, tape worms, flukes, coccidia)</li> </ul>	SL11-12.1, R11-12.7	AG-ANI7 CRP2
<b>Performance Indicator 4.2 Research Herd Health care</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
4.2.1 Create a herd health plan for beef cattle. (vaccinations, sanitation)	<ul style="list-style-type: none"> <li>Develop a vaccination program for beef cattle in your local area.</li> <li>Observe and perform common management practices on beef cattle. (Identification, dehorning, castration)</li> <li>Relate Beef Quality Assurance to the proper administration of medications, vaccines, other treatments.</li> </ul>	SL11-12.1, SL11-12.1a, R11-12.3	AG-ANI7 CRP2

4.2.2 Compare and contrast internal and external parasites and their control. (Flies and Lice, roundworm, coccidia)	<ul style="list-style-type: none"> <li>• Compare and contrast the different methods of applying parasite control measures.</li> <li>• Explain the need for rotating different anthelmintics to avoid parasite resistance.</li> </ul>	SL11-12.1c	AG-ANI7 CRP8
<b>Performance Indicator 4.3 Assess Beef Cattle Reproduction</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
4.3.1 Evaluate options and considerations for a beef cattle breeding schedule. (seasonal temperatures, calving conditions, forage availability, market dynamics)	<ul style="list-style-type: none"> <li>• Design and justify a beef cattle breeding plan based on your local area and economy.</li> <li>• Explain length of breeding season and how it affects uniform calf crop, concentration of labor, and culling parameters.</li> </ul>	SL11-12.1, SL11-12.4	AG-ANI4 CRP8
4.3.2 Differentiate the signs of estrus in beef cattle. (standing when mounted or mounting another animal, swelling of the vulva, mucus discharge from the vulva)	<ul style="list-style-type: none"> <li>• Detect estrus in live animals.</li> <li>• Establish breeding time for artificial insemination.</li> <li>• Discuss synchronization protocols and products.</li> </ul>	R11-12.7	AG-ANI4 CRP9
4.3.3 Assess methods of pregnancy determination. (rectal palpation, ultrasound, blood test)	<ul style="list-style-type: none"> <li>• Palpate a group of cows</li> <li>• Ultrasound a group of bred cows/heifers</li> <li>• Critique other methods of pregnancy determination. (bumping, milk test)</li> </ul>	SL11-12.d	AG-ANI4 CRP1
4.3.4 Identify patterns of approaching parturition. (fullness of the udder, restlessness and separation from herd, elevated tail head and significant swelling of vulva area)	<ul style="list-style-type: none"> <li>• Observe and perform proper care of the female and newborn before, during, and immediately following parturition.</li> </ul>	R11-12.3	AG-ANI4. CRP9

<b>Standard 5.0 Facilities and Equipment</b>			
<b>Performance Indicator 5.1 Analyze Cattle Handling Facilities</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
5.1.1 Investigate facilities and equipment needed for safe and effective handling of beef cattle. (gathering pen, squeeze chute, crowding pen, loading chute)	<ul style="list-style-type: none"> <li>• Research modern beef cattle handling equipment.</li> <li>• Design a safe and effective beef cattle handling facility.</li> </ul>	SL11-12.1, SL11-12.1a, SL11-12.5	AG-ANI2 CRP8
5.1.2 Discuss facilities and equipment as related to animal and human safety.	<ul style="list-style-type: none"> <li>• Relate Beef Quality Assurance to safe and humane handling of beef cattle.</li> </ul>	SL11-12.1, SL11-12.1a	AG-ANI2 CRP3
<b>Performance Indicator 5.2 Investigate Environmental Concerns</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
5.2.1 Research environmental concerns and equipment needed to handle waste in a beef cattle operation (Manure spreader, front end loader, compost shed, etc..)	<ul style="list-style-type: none"> <li>• Research possible environmental concerns that may affect a beef cattle operation.</li> <li>• Identify equipment needed to handle waste and other environmental concerns.</li> </ul>	SL11-12.4, R11-12.3	AG-ANI5 CRP2
5.2.2 Research and report environmental concerns for a beef cattle operation and relate to EPA and state regulations. (water quality, noise, odors, dust, chemicals)	<ul style="list-style-type: none"> <li>• Research and report your findings on local, state, and federal environmental requirements for a beef cattle operation.</li> <li>• Design a beef cattle waste handling system to comply with regulations.</li> </ul>	SL11-12.4, R11-12.3	AG-ANI5 CRP2

<b>Standard 6.0 Marketing and Promoting Beef</b>			
<b>Performance Indicator 6.1 Assess the Marketing of Beef Cattle</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
6.1.1 Research marketing methods for beef cattle. (local, regional, and video auctions)	<ul style="list-style-type: none"> <li>Investigate other methods of marketing beef cattle. (private treaty, forward contracting, cooperative marketing)</li> </ul>	SL11-12.1, SL11-12.1a, SL11-12.1c, SL11-12.1d	AG-ANI3 CRP7
6.1.2 Interpret beef cattle market reports.	<ul style="list-style-type: none"> <li>Create and graph a chart of a beef cattle market for a specific time period.</li> </ul>	R11-12.7	AG-ANI3 CRP11
<b>Performance Indicator 6.2 Analyze the current Beef Promotions</b>	<b>Recommended Application/Activity</b>	<b>CCSS Standards</b>	<b>CCTC Standards</b>
6.2.1 Describe the source and impact of the beef check off.	<ul style="list-style-type: none"> <li>Examine beef promotional materials from NCBA and the Arkansas Beef Council.</li> <li>Distribute beef promotional materials in the community.</li> </ul>	W11-12.5, W11-12.6	AG-ANI3 CRP4
6.2.2 Examine the influence of consumer preferences on beef production.	<ul style="list-style-type: none"> <li>Differentiate beef products through a blind taste at school; interpret result to identify taste preferences and best value.</li> <li>Research how demand for beef influences the live cattle markets.</li> <li>Research the demand of different beef cuts and quality grades.</li> </ul>	W11-12.2, W11-12.2a	AG-ANI3 CRP1

### Glossary

1. **Cow-calf System**- a system of beef production that involves keeping a heard of beef cows that are bred each year to produce calves, which are sold to cattle feeders
2. **Backgrounding**- the growing and feeding of calves from weaning until they are ready to enter the feedlot
3. **Feedlot**- a facility where animals are contained and fed high-energy rations to produce market-ready carcasses
4. **Anthelmintic**- a chemical compound used for treating internal worms in animals
5. **Artificial Insemination**- the placing of sperm in the female reproductive tract by other than natural means

6. **Body Condition Score(BCS)**- a system of estimating body energy (relative body fat) in animals using a numerical score
7. **By-product**- a product of significantly less value than the major product
8. **Castration**- the removal of the testicles of a male animal
9. **Conception Rate**- the percentage of a group of animals that becomes a pregnant when bred
10. **Conformation**- the type, form, and shape of a live animal, usually with reference to some performance characteristic
11. **Culling**- removing animals from a herd that are not as productive or desirable as the others in the herd
12. **Estrus**- the time during which the female will accept the male for copulation; also referred to as being “in heat”
13. **Expected Progeny Difference (EPD)**- an estimate of the genetic value of an animal in passing genetic traits to its offspring
14. **Feed Efficiency**- the ratio of units of feed needed per one unit of production, also called feed conversion
15. **Feeder Calf**- a weaned calf that is under 1 year of age and is sold to be fed for more growth
16. **Finishing**- the heavy feeding of a beef animal to achieve a suitable condition for slaughter
17. **Frame Score**- in cattle, a score based on subjective evaluation of height or actual measurement of hip height to estimate mature size
18. **Baleage/Haylage**- low-moisture grass silage
19. **Marbling**- the presence and distribution of fat and lean in a cut of meat
20. **Rectal Palpating**- a method of pregnancy determination in cattle in which the arm is inserted into the cow’s rectum and the reproductive tract is felt for pregnancy indications
21. **Rotation Grazing**- grazing forage plants on well-managed pastures in such a manner as to allow for a definite recovery period following each grazing period; this includes alternate use of two or more pastures at regular intervals or the use of temporary fences within pastures to prevent overgrazing
22. **Roughage**- a feed containing more than 18 percent crude fiber when dry; examples: hay, silage, and pasture
23. **Sanitizing**- making a surface sanitary by using a sanitizing agent such as chlorine or quaternary ammonium compound
24. **Shrinkage**- the weight lost by an animal while it is being shipped to market
25. **Structural Correctness**- the correct physical condition of the skeletal structure (especially the feet and legs of an animal)
26. **Synchronization of Estrus**- the use of various compounds (usually hormones) to cause all of the females in a herd to come into heat within a short period of time
27. **Withdrawal Period**- the length of time required for a feed additive or drug to exit the body prior to slaughter
28. **Yardage**- the fee charged for the use of stockyard facilities
29. **Yearling**- an animal between 1 and 2 years of age

30. **Yield Grade-** a numerical score (with 1 being the highest yielding and 5 being the lowest yielding) given to beef carcasses; this score is based on the estimated carcass weight in boneless, closely trimmed retail cuts from the round, loin, rib, and chuck
31. **Quality Grade-** grade given a beef carcass; closely related to marbling, age of the animal, and color of the lean. The most common quality grades are prime, choice, and select.
32. **Wheat-** a winter annual used for grain production that may also be used for grazing
33. **Ryegrass-** a winter annual used for grazing
34. **pH-** a numerical measure of acidity of soil; with 7.0 being neutral, all values below are considered acidic and above alkaline
35. **Bermuda Grass-** a warm season perennial which provides excellent forage and hay production
36. **Bahia Grass-** a fast-growing warm season perennial which provides forage, hay production, and erosion control
37. **Hay-** any leafy plant material that has been cut and dried principally for livestock feeding
38. **Soil Testing-** a test of soil to determine available nutrients and pH
39. **Fertilizer-** any organic or inorganic material added to soil to provide plant nutrients and to increase the growth, yield, quantity, or nutritive value of the plants grown therein
40. **Limestone-** a compound used as an amendment chiefly for acid soils
41. **Erosion Control-** steps taken to limit or eliminate soil loss
42. **Continuous Grazing-** grazing for the entire grazing season; synonymous with set stocking
43. **Blackleg-** a highly infectious, rapidly fatal disease of cattle and sheep caused by the anaerobic bacillus *Clostridium chauvaei*
44. **Leptospirosis-** a disease of animals and occasionally humans caused by species of the genus *Leptospira*; in cattle, characterized by loss of appetite, fever, jaundice, abortion, and sometimes death
45. **Bovine Viral Diarrhea (BVD)-** an infectious viral disease of cattle, manifested clinically by an acute erosive stomatitis, gastroenteritis, and diarrhea
46. **Vaccination-** injecting controlled amounts of a vaccine (antigen) into an animal in an effort to prevent that animal from contracting a disease caused by that particular organism
47. **Roundworm-** a parasite found in animals commonly found in the intestines; severe infestations can spread to the blood stream, lungs, windpipe, liver, kidneys, etc.
48. **Coccidiosis-** a disease of the digestive tract which causes diarrhea caused by one or more different kinds of protozoans belonging to the order Coccidia
49. **Squeeze Chute-** a narrow stall with a hinged side and a head-catch chute that is used for restraining animal movements

## 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**