Food Science & Safety

SUNY Cobleskill CAHT 104

Curriculum Map

School Year: 2023-2024 School: Southern Cayuga Jr./Sr. High School Program: Agricultural Sciences Teacher: Ms. Wasson

Course Rationale:

Food Science and Safety (FSS) is a specialization course in the agricultural sciences program. Students complete hands-on activities, projects, and problems that simulate actual concepts and situations in the food science and safety industry, allowing students to build content knowledge and technical skills. Students investigate areas of food science, including food safety, food chemistry, food processing, food product development, and marketing. The lessons in Food Science and Safety include the following: Introduction to Food Science, Food Chemistry, Safety of Our Food, Processing and Preservation, Health and Security, Consumers, and Food Product Development.

Course Outline:

| Title or Topics / Essential Questions | Content Skills (Activities to cover Essential Questions) | Major Assessments | Vocabulary | Time Frame |
|---|--|---|--|---------------|
| Unit 1: Introduction to Food Science 1.1 Exploring Food Science What is food science? What topics are part of a food science curriculum? What are the five senses? How do scientists use the five senses in food science? What is mouthfeel? What is a consumer? How does a consumer evaluate food preference using the senses? | 1.1.1 Food and Your Senses Determine how consumers perceive food quality using their five senses. Evaluate food using sensory evaluation. 1.1.2 Food Science Notebooks, Laboratory Notebook Evaluation Rubric Prepare an Agriscience Notebook to record and store information. Start a Laboratory Notebook to record observations and protocols. 1.1.3 History of Food Science | 1.1.2 Laboratory Notebook Evaluation Rubric 1.1.1 Evaluation Rubric | Aroma, Circumvallate papillae, Consumer, Consumer preference, Fermentation, Filiform papillae, Flavor, Foliate papillae, Food adulteration, Food and Drug Administration (FDA), Food preservation, Food processing, Food production, Food Safety and Inspection Service (FSIS), Food science, | 2 weeks |

| Why are accurate laboratory notebooks important to food scientists? What are the essential components of laboratory notebooks? What food processing or preservation techniques have impacted current food products? Why does the food industry develop products using the metric system? | Research the date and significance of a food science discovery, scientist, organization, or event. Organize key events in food science history into a timeline. 1.1.4 How Much Flour? Measure foods using imperial measurements and compare accuracy to the metric system. 1.1. Check for Understanding | 1.1.4 Laboratory Notebook Evaluation Rubric 1.1 Check for Understanding - Quiz | Food scientist, Fungiform papillae, Imperial, Metric, Mouthfeel, Olfactory bulb, Orthonasal olfaction, Palatability, Palatable, Palate, Papillae, Processed food, Regulatory agency, Retronasal olfaction, Savory, Sense, Sight, Smell, Taste, Texture, Umami, United States Department of Agriculture (USDA), Value-added, Volatile, Whole food, and Yeast leavening. | |
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| Unit 1: Introduction to Food Science 1.2 Food Handlers What are biological, chemical, and physical hazards in food safety? Why is safety important when processing and preparing food? Why is it important to wash your hands and workspace in the laboratory? What are the proper procedures for handwashing? | 1.2.1 Kitchen Investigators Identify biological, chemical, and physical hazards in a kitchen. 1.2.2 Safety in the Laboratory Diagram and describe the location of emergency equipment and safety hazards. 1.2.3 Personal Safety Protocols Publish and present a sign for display that outlines proper protocols for a personal hygiene topic. | ServSafe Food Handlers Certification: Module 1 Food Safety is Important ServSafe Food Handlers Certification: Module 2 Good Personal Hygiene 1.2.3 Evaluation Rubric | Accident, Antibacterial, Biological hazard, Chemical hazard, Cleaning, Current Good Manufacturing Practices (CGMPs), E. coli, Emergency, Inoculate, Mercer Rules tool, Mold, Personal protective equipment (PPE), Physical hazard, Protocol, Ready to eat (RTE), Safety, Sanitation Standard Operating | 2-3 weeks |

| What is the importance of soap and antibacterial cleaners in a food science laboratory? What guidelines am I expected to follow when working in the laboratory? How do food handlers practice knife safety? What conditions do pathogens need to grow? What is an example of a Standard Operating Procedure (SOP)? How do food manufacturers use Sanitation Standard Operating Procedures (SSOPs)? | 1.2.4 Knife Safety Demonstrate knife safety skills while cutting fruits and vegetables for salsa. 1.2.5 Controlling Pathogens Inoculate lettuce samples to observe cross-contamination of E. coli. (Activity 1.2.5) Inoculate foods exposed to the food danger zone to observe yeast and mold activity. 1.2.6 Operating Procedures Compose Standard Operating Procedures (SOPs) and Sanitation Standard Operating Procedures (SSOPs) for milling wheat into flour. 1.2 Check for Understanding | ServSafe Food Handlers Certification: Module 3 Controlling Time and Temperature ServSafe Food Handlers Certification: Module 4 Preventing Cross Contamination ServSafe Food Handlers Certification: Module 5 Cleaning and Sanitizing ServSafe Food Handlers Certification: Online Assessment 1.2 Check for Understanding - Quiz | Procedure (SSOP), Sanitize, Standard Operating Procedure (SOP), Sterilize, Wash, and Yeast | |
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| Unit 2: Food Chemistry | | | | 1-2 weeks |
| 2.1 Scientific Processes What are the six essential nutrients? What role do nutrients play in human health? What are the functions of nutrients in foods? What is qualitative data? What is quantitative data? | 2.1.1 Nutrient Analysis Research the function of nutrients in foods and human health Use indicators to determine the presence of food nutrients. 2.1.2 Polarizing Sugars Use a polarimeter to identify beverage sweeteners. 2.1.3 Nutrient Investigation | 2.1.3 Lab Report Evaluation | Aspartame, Carbohydrate, Complex carbohydrate, Conclusion, Control, Experiment, Fat, Fructose, Hypothesis, Illumination, Indicator, Infer, Lipid, Micronutrient, Mineral, Negative control, | |
| | 2.1.3 Nutrient Investigation | KUDFIC | , , , , , , , , , , , , , , , , , , , | |

| What is a control? What is a variable? What are the steps of the scientific method? How does a food scientist infer? How does a food scientist use the scientific method? | Use the scientific method to investigate the presence of nutrients in unknown food sources. 2.1 Check for Understanding | 2.1. Check for Understanding - Quiz | Nutrient, Optical rotation, Polarimeter, Polarized light, Procedure, Protein, Qualitative data, Quantitative data, Scientific method, Specific rotation, Starch, Sucrose, Sugar, Suspension, Variable, Vitamin, and Vitamin C. | |
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| Unit 2: Food Chemistry 2.2 Food Nutrients What is the function of starches in food? How do starches thicken foods? What is the difference between amylose and amylopectin? What is free water? What is free water? How does the amount of water influence the sensory characteristics of foods? What is a lipid? What are the main functions of lipids in a food product? What are the main functions of proteins in food? | 2.2.1 Sticky Starches Inspect amylose and amylopectin in starches under a microscope. 2.2.2 Starch Properties Observe the viscosity, retrogradation, syneresis, texture, stability, and opacity of starches. 2.2.3 Monitoring Meat Fat Compare how saturated and unsaturated fat content affects sensory characteristics. 2.2.4 Bonding with Water Model how water binds to food starches. 2.2.5 Water Weight Dehydrate meats to determine the percentage of water in each food product. | | Amino acid, Amylopectin, Amylose, Bound water, Chemical bond, Covalent bond, Dehydration, Double bond, Elasticity, Emulsion, Free water, Gel, Gliadin, Gluten, Gluten development, Glutenin, Gravy, Hydrogen bond, Insoluble, Molecular polarity, Opacity, Opaque, Phase separation, Plasticity, Polymer, Render, Retrogradation, Roux, Saturated fat, Solution, Solvent, Stability, Surface tension, Syneresis, Translucency, | 2-3 weeks |

| • What is gluten? | 2.2.6 Emulsify Emulsify a food using egg protein. 2.2.7 Protein Predicament Compare protein elasticity in different flours and its effect on sensory characteristics. 2.2 Check for Understanding | 2.2. Check for Understanding - Quiz | Unsaturated fat, Viscosity, Water-soluble, and Xantham gum | |
|--|---|--|---|-----------|
| Unit 2: Food Chemistry 2.3 Factors of Change What is the difference between a physical and chemical change? What is a suspension? What is foam? How does crystallization change food products? What are some examples of an ingredient's functional properties? How do ingredient substitutions change a food product? What physical changes occur during baking? What are Maillard's browning reactions? | 2.3.1 Let's Get Physical Demonstrate common physical changes in food. 2.3.2 Functional properties Research functional properties of ingredients in a cake recipe 2.3.3 Ingredient Swap Substitute ingredients in a recipe and evaluate physical changes. 2.3.4 Enzymes in Action Evaluate the effects of storing food products. Quantify nutrition loss from enzymatic browning. 2.3.5 Maillard's French Fries Demonstrate Maillard's browning reactions in French fries. | 2.3.1 Project Evaluation Rubric 2.3.3 Lab Evaluation Rubric | Activation energy, Asparagine, Atom, Binding, Catalyst, Chemical change, Colloidal dispersion, Condensation reaction, Crystallization, Electron charge, Environmental conditions, Enzyme, Foam, Functional property, Glycosylamine, Ketosamine, Leavening, Negative control, Maillard's browning reaction, Melanin, Melanoidin, Mixture, Organic, Phase change, Physical change, Polymerization, Positive control, Products, Reactant, Rearrangement | 2-3 weeks |

| What causes food to change chemically? | 2.3.6 Modeling Reactions Evaluate the effects of storing food products. Model chemical changes in Maillard's browning reactions 2.3 Check for Understanding | 2.3 Check for Understanding - Quiz | reaction, Reducing sugar, Reduction, Solute, and Suspension | |
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| 2.4 pH of Foods | 2.4.1 pH of the Pantry | | Acid, Acid-base reaction, | 1 week |
| What is pH? What is the pH of common food items? What is calibration? How do food scientists use sensors? Why do food scientists calibrate sensors? How does the pH of food ingredients influence the final product? How does pH influence chemical reactions in food substances? How does pH affect the characteristics of food? How are chemical reactions used in making bread? | Determine the pH of common pantry ingredients and the functions of those ingredients in foods. Calibrate a sensor using two known values. 2.4.2 pH Transformations Conduct a reference test of low acid orange juice and regular orange juice. Measure the amount of CO2 gas produced in a chemical reaction with varying pH levels. 2.4.3 Agents for Change Prepare a soda bread and observe how the ingredients chemically and physically react. 2.4 Check for Understanding | 2.4 Check for Understanding - Quiz | Base, Buffer, Calibration, Fermentation, Leavening agent, Logarithmic scale, pH, pH scale, Sensor, and Two-step calibration | |
| Unit 3: The Safety of Our Food | | | | |

| 3.1 Safe Practices What is a food inspection? How do food inspectors use Current Good Manufacturing Practices (CGMP)? How do Current Good Manufacturing Practices (CGMP) promote safe food handling? What is a Current Good Manufacturing Practices (CGMP) violation? What is an allergen? How can Current Good Manufacturing Practices (CGMP) prevent contamination? How can the food industry monitor allergens? What procedures reduce the potential for cross-contamination? What is a Good Agricultural Practice (GAPs)? How can fresh fruits carry biological contaminants from the farm to the consumer? | 3.1.1 Can I Spy? Inspect photographs of food science situations to identify what CGMPs compliance and violations. 3.1.2 Allergen Monitoring Verify cleaning producers using allergen monitoring tests. 3.1.3 Good Agricultural Practices Analyze a strawberry operation and create a food safety plan. 3.1 Check for Understanding | 3.1.3 Operating Procedures Evaluation Rubric 3.1 Check for Understanding - Quiz | Allergen, Allergen monitoring, Allergic reaction, Big 9, Cross-contamination, Food allergy, Foodborne illness, Food safety, Food Safety and Inspection Service (FSIS), Food Safety Modernization Act (FSMA), FSMA Inspection, GAP Audit, Good Agricultural Practices (GAP), Pathogen, Personal hygiene, Potable water, Spoilage, Third-party, Validate, and Verify | 1 week |
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| onit 5. The Salety of Our Food | 3.2.1 HACCP by the Numbers | 3.2.1 Evaluation Rubric | | 1-2 weeks |

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| 3.2 HACCP What is Hazard Analysis and Critical Control Points (HACCP)? What are the seven basic HACCP principles? What is a process flow diagram? What are prerequisite food safety programs? What is the difference between critical control points and critical limits? What is the purpose of verification procedures? How is a food safety plan monitored? What are corrective actions? | Design a poster and presentation detailing a HACCP principle. 3.2.2 It's the Principle Match HACCP principles to portions of a HACCP plan. 3.2.3 HACCP Team Assemble Summarize the processing of turkey and cheese sandwiches in a process flow diagram. 3.2.4 Hazard Analysis Develop control methods for biological, chemical, and physical safety hazards. 3.2.5 Limit and Monitor Assign critical control points and critical limits for significant safety hazards. Design monitoring methods for critical limits in a HACCP plan | 3.2.3 HACCP Plan Evaluation Rubric | Control point, Corrective action, Critical control point (CCP), Critical limit, Hazard analysis, Hazard Analysis and Critical Control Points (HACCP), Hazard Analysis and Risk-based Preventive Controls (HARCP), Monitor, and Preventive controls | |
| | 3.2 Check for Understanding | 3.2 Check for Understanding - Ouiz | | |
| Unit 3: The Safety of Our Food 3.3 Pathogen Pathways What are microbiological organisms? How can microbes be detrimental to foods? | 3.3.1 Mighty Microbes Research and examine bacteria, mold, and yeast. 3.3.2 Manipulating Microbes | 3.3.2 Research Proposal Evaluation Rubric | Bacteria, Centers for Disease Control and Prevention (CDC), Epidemiologic data, Food intoxication, Food spoilage, Incubation period, Infection (food), | 2 weeks |

| How do food scientists use | • Design and conduct a research project | | Microbe, Microbial | |
|--|--|--|--|---------|
| microbes to develop food products? What conditions are ideal for microbial growth? What factors deter the growth of microorganisms? What is a foodborne pathogen? What causes foodborne pathogens? How do pathogens cause foodborne illnesses? How can you prevent foodborne pathogens? What is an outbreak? How do food scientists investigate foodborne illness outbreaks? | examining the microbial growth of yeast. 3.3.3 Foodborne Illnesses Research foodborne pathogens and identify prevention methods to control pathogens. Create a comic strip depicting an assigned pathogen. 3.3.4 Outbreak Investigation Collaborate with peers to determine possible pathogens that caused sickness in a role-play activity. 3.3 Check for Understanding | 3.3.3 Lab Report Evaluation Rubric 3.3 Check for Understanding - Quiz | growth, Microorganism, Mold, Outbreak, Parasite, Recall, Toxin, Toxin-mediated infection, Virus, and Yeast | |
| Unit 4: Processing and Preservation 4.1 Processing What is food processing? What are the methods of food processing? How does food processing change the chemical properties of food? | 4.1.1 Chemical Changes Evaluate changes to the chemical properties of processed strawberries. 4.1.2 Physical Changes Identify changes to the physical characteristics of a raw commodity during food processing. 4.1.3 Processing Commodities | | Brine, Brix refractometer, Chemical property, Commodity, Degree Brix (°Bx), Disintegrating, Drying, Evaporation, Food processing, Forming, Heat exchange, Hulling, Kneading, Mixing, | 2 weeks |

| How does food processing change the physical characteristics of food? What are unit operations? How are commodities separated into components? How do food manufacturers use components of a food commodity? How does food processing make food more convenient for consumers? | Process foods and identify unit operations. 4.1.4 Poultry Processing Process a chicken into multiple food products. 4.1 Check for Understanding | 4.1 Check for Understanding - Quiz | Packaging, Pectin, Physical characteristic, Preservative, Pumping, Refractive index, Refractometer, Separating, Shelf life, Shelf-stable, and Unit operations | |
|--|---|---------------------------------------|--|-----------|
| Unit 4: Processing and Preservation 4.2 Preservation How does food preservation extend the food shelf life? Why is moisture removal necessary to preserve food products? What is the difference between dehydration and concentration? How does freezing help in food preservation? How do food scientists use heat to preserve food? How do food products benefit from pasteurization? | 4.2.1 Fruit to Leather Study the effects of water on microbes by removing water from fruit. 4.2.2 Below Zero Observe the deterioration rate of food products at room temperature, refrigeration, and freezing. 4.2.3 Pasteurization Preservation Compare microbial growth of non-heat-treated and heat-treated buttermilk. 4.2.4 pH for Preservation Change pH levels of apples to inactivate enzymatic reactions and extend shelf life. | | Acidification, Acidity control, Aromatic ring, Concentration, Heat treatment, Hydroxyl group, Oxidation, Pasteurization, Phenolic, Preservation, Puree, and Water activity (aw) | 1-2 weeks |

| What pH levels inactivate spoilage microbes? How do food scientists control the acidity of a food product? How is the quality of food reduced during preservation? How does preservation change a food product's usability? | 4.2.5 Processing Dilemmas Evaluate differences between minimally and highly processed food products. 4.2 Check for Understanding | 4.2 Check for Understanding - Quiz | | |
|--|--|---------------------------------------|--|-----------|
| Unit 4: Processing and Preservation 4.3 Quality and Safety What does USDA regulate? What are the roles of the FDA involving food safety and quality? How does the EPA regulate the food industry? What are quality grading standards? How are foods graded for quality? What foods have quality grading standards? What is a standard of identity? | 4.3.1 Regulating Food Products Research regulatory agencies and the laws that they regulate. Determine which agency is responsible for regulating specific food products. 4.3.2 Making the Grade Grade maple syrup by following quality grading standards. 4.3.3 Autonomous Grading Build an artificial intelligence model to predict U.S. quality grades of egg breakouts. 4.3.4 Identify Standards Evaluate milk samples to determine if the product has been adulterated. | 4.3.4 Lab Report Evaluation Rubric | Adulteration, Albumen, Artificial intelligence, Broken outs, Color grade, Colorimeter, Environmental Protection Agency (EPA), Fair Packaging and Labeling Act, Food Drug and Cosmetic Act, Grade, Grading standard, Lactometer, Light transmittance (%T), Machine learning, Marbling, Meat Inspection Act, Niter, Nutrition Labeling and Education Act (NLEA), Pure Food and Drug Act, Specific gravity, | 1-2 weeks |

| How do food products meet standards of identity? | | 4.3 Check for Understanding - Quiz | Standard of Identity (SOI), and Yolk | |
|---|--|---------------------------------------|--|-----------|
| Unit 5: Health and Security 5.1 Nutrition and Labeling What are the components of a food label? What claims do food manufacturers make on food labels? How are claims approved for a food label? What is traceability? What information is on a nutrition label? How are calories calculated? What are percent daily values? What is a recommended dietary allowance (RDA)? Why are recommended dietary allowances based on age, activity, and muscle mass? | 5.1.1 Label Your Food Locate required claims, required information, consumer warnings on food labels. 5.1.2 Calculating Labels Calculate the caloric content of foods based upon nutritional content. Identify the nutrient contents of each ingredient for a food product and prepare a nutrition panel. 5.1.3 Meal Planning Mission Develop a menu containing the necessary nutrients for a healthy diet. Recommend alternative foods for individuals with dietary restrictions. 5.1 Check for Understanding | 5.1 Check for Understanding - Quiz | Calorie, Food label, Health claims, Information panel, Lean, Nutrient content claims, Nutrition label, Nutritionist, Principal display panel (PDP), Recommended dietary allowance (RDA), Structure-function claims, and Traceability. | 1-2 weeks |
| Unit 5: Health and Security5.2 Security and DefenseWhat is food security? | 5.2.1 Food for ThoughtAnalyze local food insecurity statistics. | | Department of Homeland, Security (DHS), Food defense, | 1-2 weeks |

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| What factors affect food | Develop solutions to possible situations | | Food insecurity, Food | |
| security? | of food insecurity in their community. | | security, Food terrorism, | |
| How does food insecurity | | | Hunger, Obesity, | |
| impact human health? | 5.2.2 Defend Your Hamburger | 5.2.2 Project Evaluation Rubric | Poverty, Supplemental | |
| • What is food defense? | Evaluate vulnorabilities toward | | Program (SNAP) and | |
| How does the United States | intentional adulteration of a packing | | Vulnerability | |
| protect the food supply from | plant. | | | |
| intentional adulteration? | Develop a food defense plan. | | | |
| • How can food be intentionally | | | | |
| adulterated by terrorists? | | | | |
| • What is a food defense plan? | | 5.2 Check for Understanding | | |
| • How is the Department of | 5.2 Check for Understanding | S.2 Check for Understanding - | | |
| Homeland Security involved | | | | |
| in food defense? | | | | |
| Unit 6: Consumers | | | | |
| 6.1 Consumer Preferences | 6.1.1 Consumer Choices | | Accontance test Rias | 1 week |
| | Evaluate a menu and consider choices | | Consumer behavior. | |
| What factors affect consumer | based on nutrition, price, acceptance, | | Descriptive analysis, | |
| choice of food products? | convenience, and culture. | | Discrimination test, | |
| How does convenience | | | Duo-trio test, Paired | |
| impact the consumers' food | 6.1.2 Evaluation Execution | | comparison, | |
| product purchases? | | | Psychological bias, and | |
| • What are biases? | Participate in sensory evaluation | | indigie test | |
| How can biases affect sensory | modeling factors to identify blases. | | | |
| evaluations? | manipulate the perception of panelists | | | |
| How do you reduce biases in | | | | |
| sensory evaluations? | | 6.1.3 Lab Report Evaluation | | |
| How do food scientists | 6.1.3 Sensory Science | Rubric | | |
| determine consumer | | | | |
| preference? | | | | |
| | | | | |

| What is a preference test? What is a discrimination test? | Construct and conduct a sensory evaluation and analyze the outcome. 6.1 Check for Understanding | 6.1 Check for Understanding - Quiz | | |
|--|--|--|---|-----------|
| Unit 6: Consumers 6.2 To Protect and Sell What are the Four Ps of marketing? What is a promotion? What is the purpose of food packaging? How does packaging protect food? How does a food package attract customers? | 6.2.1 Marketing to Consumers Compare different advertisements and determine how the marketer addresses the Four Ps. 6.2.2 Snack Pack Design a food package to protect a peanut butter and jelly sandwich and attract consumers. 6.2.3 Test the Jelly | 6.2.2 Project Evaluation Rubric | Advertisement, Benefit, End cap, Feature, Intangible, Marketing, Placement, Planogram, Price, Product, Profit margin, Promotion, Target market, and Tangible | 1-2 weeks |
| How do retailers position food? What is a planogram? | Evaluate a food package using a crush, drop, and water test. 6.2.4 Retail Reconnaissance Evaluate a food retailer and evaluate product placement. 6.2 Check for Understanding | 6.2 Check for Understanding - Quiz | | |
| Unit 7: Food Product Development 7.1 Innovative Foods | 7.1.1 Product Innovation | 7.1.1 Laboratory Notebook Evaluation Rubric | Commercialization, Feasibility analysis, Food product development, | 5-7 weeks |

| • | What are the four steps in the food product development process? How do food scientists determine the need for a new food product? | Start the food product development process by choosing a food to innovate. 7.1.2 Food Patents Collect and summarize research about similar products with patented solutions. | 7.1.3 Project Evaluation Rubric | Food trend, Food trial, Formulation, Innovation, Intellectual property, Interstate commerce, Market gap, Need, Niche, Patent, Screening, Test marketing, and Want. |
|---|---|--|---------------------------------------|---|
| • | What is a food trial? How does a food scientist develop a formulation? Why is consumer testing necessary when developing a new food product? | 7.1.3 Feasibility Analysis Collect and summarize research about similar products with patented solutions. 7.1.4 Prepare for Market | 7.1.4 Project Evaluation Rubric | |
| • | What is new food product validation? | Test market a food product. Prepare a food product for commercialization. | 7.1.5 Project Evaluation Rubric | |
| | | 7.1.5 Introducing Innovation Justify that a developed product meets consumer needs. Develop a display to highlight new food products. | 7.1 Check for Understanding - Quiz | |
| | | 7.1 Check for Understanding | | |

Standards:

• FSS Common Career and Technical Core Content Standards

- Next Generation Science Standards
- <u>Common Core Standards for High School Mathematics</u>
- <u>Common Core Standards for English Language Arts</u>

References (APA Format):

Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards. (2015). Retrieved from <u>https://thecouncil.ffa.org/afnr/</u>

Curriculum for Agricultural Science and Education. (2023). Retrieved from <u>https://www.case4learning.org/</u>