THE COUNCIL
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AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR) CAREER CLUSTER

CONTENT FRAMEWORKS

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CONNECTICUT EDITION

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INTRODUCTION

PURPOSE

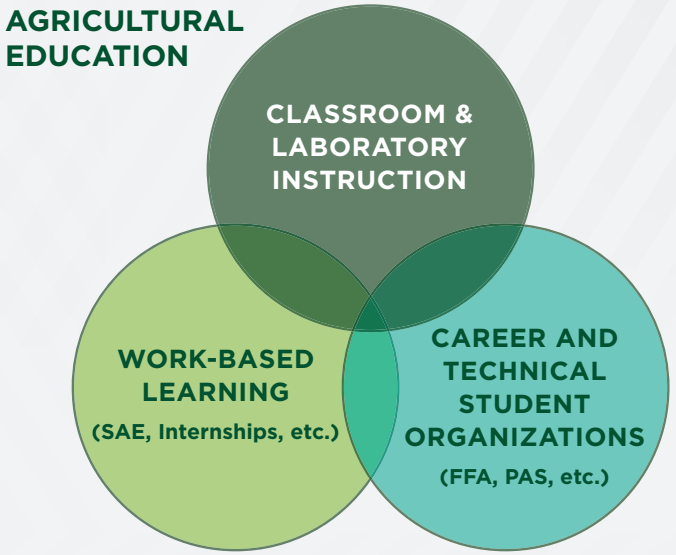
The agriculture, food and natural resources (AFNR) industry is a highly technical and ever-changing sector of the global economy upon which everyone is dependent. We will continue to meet national and global demand for a safe and abundant food, fiber and fuel supply if we invest in the growth and development of the human capital for the AFNR industry. Strong, relevant AFNR Career and Technical Edu-cation (CTE) programs that are informed by industry and education stakeholders are one way we can meet workforce needs now and in the future.

The AFNR Career Cluster Content Frameworks provide state agricultural education leaders and educators with a high-quality, rigorous set of frameworks to guide what students should know and be able to do after completing a program of study in each of the following AFNR career pathways:

1. Agribusiness Systems
2. Animal Systems
3. Biotechnology Systems
4. Environmental Service Systems
5. Food Products and Processing Systems
6. Natural Resource Systems
7. Plant Systems
8. Power, Structural and Technical Systems

State leaders and local educators are encouraged to use the frameworks as a guide for the development of well-planned curriculum and assessments for AFNR-related CTE programs. These frameworks are intended to help shape the design of all components of an agricultural education program including:

- Classroom and laboratory instruction.
- Career and Technical Student Organization (CTSO) experiences through organizations such as the National FFA Organization and the Post Secondary Agriculture Students Organization (PAS).
- Work-based learning experiences such as Supervised Agricultural Experience (SAE) Programs and internships.



Three circle model of agricultural education.

Just as agriculture varies throughout our nation and around the world, so will our agricultural education programs. Adoption and use of these frameworks is voluntary, states and local entities are encouraged to adapt the frameworks to meet local needs. States should use these frameworks in conjunction with state and local advisory committees to determine what is most relevant and appropriate for their students in providing that all-important link between the school and the business community.

NATIONAL BACKGROUND AND REVISION PROCESS

The National Council for Agricultural Education (The Council) strives to stimulate positive growth in agricultural education. Since its beginning in December 1983, The Council has provided leadership for stakeholders in agriculture, food, fiber and natural resources systems education. In 2012, The Council identified the review and revision of the AFNR Career Cluster Content Standards as a goal in its 2012-15 Strategic Plan.

The AFNR Career Cluster Content Frameworks were originally developed as part of the 2003 United States Department of Education (USDE) Career Clusters Project. In 2009, The Council first reviewed and revised the content frameworks. The 2015 revision focused on ensuring that the content frameworks:

- Reflect essential and up-to-date knowledge and skills that students need to be ready for early-career success in a variety of AFNR disciplines.
- Provide a sound basis upon which to design AFNR related Career and Technical Education (CTE) courses.
- Provide a sound basis for developing end of course/program assessments to measure students' attainment of essential disciplinary knowledge and skills

A revision governing committee was appointed by The Council to achieve these goals and ensure the integrity of the process. Vivayic, a learning solutions company, facilitated the process to revise the frameworks in partnership with The Council and the revision governing committee.

The multi-stage review and revision process began in 2014 and was informed by input and guidance from more than 270 secondary and post-secondary educators, business, industry and state leaders in career and technical education. A detailed overview of the process is included in Appendix A and a list of individuals who provided subject matter expert input is included in Appendix B.

A goal of the AFNR Career Cluster Content Frameworks revision project is to identify strategies for encouraging adoption and use of this body of work. In addition to the revisions to update the technical content and improvements to the clarity and consistency of the frameworks, several other steps were taken during the revision to work toward this goal. For example, the frameworks were aligned to the CCTC Standards for Career Ready Practices and the AFNR Career Cluster. They were also cross-walked to several other key frameworks including the Next Generation Science Standards, the Common Core Standards for English Language Arts and Mathematics, and the National Standards for Financial Literacy.

CONNECTICUT BACKGROUND AND REVISION PROCESS

Ongoing research in agricultural biotechnology, agricultural engineering, and marine science technology as well as other emerging agricultural industries have revolutionized the field of agriculture. Regional agricultural science and technology centers in Connecticut are meeting the challenge by providing educational programs in the field of agriculture and related occupations. To provide adequate training for those students planning a career in agriculture, Connecticut has designated regional agricultural science and technology centers in comprehensive high schools to serve students. The program prepares students for entry-level employment or higher education in the fields of agriculture, which include aquaculture and marine trades. Local or regional boards of education may be designated as regional agriculture centers if approved by the State Board of Education.

The multi-stage review and revision process began in 2016 and was informed by input and guidance from more than 60 secondary and post-secondary educators, business, industry and state leaders in agriculture and agricultural science and technology education. A detailed overview of the process is included in Appendix A and a list of individuals who provided subject matter expert input is included in Appendix B. Connecticut Agricultural Science and Technology Education Standards were developed originally in 2012. The 2012 standards were based on the 2009 National Agriculture, Food and Natural Resources Standards released by National Council for Agricultural Education. The Connecticut version of the document included standards for Aquaculture, Marine Trades and the CT AssessmentStandards. The 2017 revision focused on ensuring that the content frameworks:

- Reflect essential and up-to-date knowledge and skills that students need to be ready for college and career in a variety of agriculture, food andnatural resources fields.
- Provide a sound basis upon which to design Connecticut focused agriculture, food and natural resources related courses.
- Afford a wide-ranging source for creating meaningful formative and summative assessments to measure student's attainment of essential knowledge and skills.

A goal of the Connecticut AFNR Career Cluster Content Frameworks revision project is to identify strategies for encouraging adoption and use of this body of work. In addition to the revisions to update the technical content and improvements to the clarity and consistency of the frameworks, several other steps were taken during the revision to work toward this goal. For example, the frameworks were aligned to the CCTC Standards for Career Ready Practices and the AFNR Career Cluster. They were also cross-walked to several other key frameworks including the Next Generation Science Standards, the Common Core Standards for English Language Arts and Mathematics, and the National Standards for Financial Literacy.

Note: The Connecticut AFNR has been changed from standards to frameworks. In Connecticut standards are reserved for material that is required to be taught; framework is material that should be taught.

ORGANIZATION

This document outlines content Frameworks for the CCTC Career Ready Practices, the AFNR Cluster Skills and ten AFNR career pathways.

A complete program of study will include instruction on essential knowledge and skills that are required for success regardless of one's chosen career pathway in the AFNR industry. These essential concepts are outlined in the following content standards:

- ***CCTC Career Ready Practices (CRP)*** – encompasses fundamental skills and practices that all students should acquire to be career ready such as: responsibility, productivity, healthy choices, maintaining personal finances, communication, decision-making, creativity and innovation, critical-thinking, problem solving, integrity, ethical leadership, management, career planning, technology use and cultural/global competency.
  - ** NOTE: The Biotechnology Systems (BS) standards outlined in this document are set forth by the National Council for Agricultural Education. Please see the BS Content Standards for more information.*
- ***AFNR Cluster Skills (CS)*** – encompasses the study of fundamental knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health and environmental practices; stewardship of natural resources; and exploration of career opportunities.

Agriculture, Food and Natural Resource Content Frameworks consist of two foundations pieces and eight pathways

Beyond the foundational skills, the content frameworks are further organized into ten career pathways of study. The career pathway content frameworks cover technical content required for future success within each respective pathway.

***Agribusiness Systems (ABS)*:** encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application and management of agribusiness systems in AFNR settings.

***Aquaculture Systems (AQ)*:** encompasses the study of content areas such as life processes, health, nutrition, genetics, management and processing, of aquatic organisms service and repair of aquaculture vessels, machines and equipment. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of aquaculture facilities in AFNR settings.

Animal Systems (AS): encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, management, and processing, as applied to small animals, aquaculture, exotic animals, livestock, dairy, horses and/or poultry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of animal systems in AFNR settings.

Biotechnology Systems (BS): encompasses the study of using data and scientific techniques to solve problems concerning living organisms with an emphasis on applications to agriculture, food and natural resource systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of biotechnology in the context of AFNR.

***Environmental Service Systems (ESS)*:** encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of environmental service systems in AFNR settings.

Food Products and Processing Systems (FPP): encompasses the study of food safety and sanitation; nutrition, biology, microbiology, chemistry and human behavior in local and global food systems; food selection and processing for storage, distribution and consumption; and the historical and current development of the food industry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of food products and processing systems in AFNR settings.

***Marine Trades (MT)*:** encompasses the study of including content areas such as boat building, service and repair of aquaculture vessels, machines and equipment, seamanship, navigation, boat safety and operations. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of marine trades.

Natural Resource Systems (NRS): encompasses the study of the management, protection, enhancement and improvement of soil, water, wildlife, forests and air as natural resources. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of natural resource systems in AFNR settings.

The career pathway content frameworks, continued.

Plant Systems (PS): encompasses the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as wells as growth and cultural practices through the study of crops, turf grass, trees, shrubs and/or ornamental plants. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of plant systems in AFNR settings.

Power, Structural and Technical Systems (PST): encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in AFNR settings.

STRUCTURE

Within each pathway, the frameworks are organized as follows:

Common Career Technical Core (CCTC) Frameworks — These are the frameworks set forth for each of the respective content areas outlined above in the 2012 version of the Common Career and Technical Core Frameworks. These statements are owned by the National Association of State Directors of Career and Technical Education/ National Career Technical Education Foundation and are used here with permission. They define what students should know and be able to do after completing instruction in a program of study for this pathway.

** NOTE: The Biotechnology Systems (BS) frameworks outlined in this document are set forth by the National Council for Agricultural Education. Please see the BS Content Frameworks for more information.*

Performance Indicators — These statements distill each performance element into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related performance element at the conclusion of a program of study in this area.

Sample Measurements — The statements are sample measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c)*. This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

* Definition of the three levels of sample measurements of the AFNR frameworks:
Awareness (a) – initial instruction on the performance indicator. Student can demonstrate understanding of the concept at the basic level but does not have the ability to use the knowledge in an application sense.
Intermediate (b) - additional instruction has occurred and the student now has the understanding to place the performance indicator into a real world application and explain additional information dealing with that application.
Advanced (c) – Student has greater understanding of the performance indicator and can not only place it into an application in the real world but can also analyze or synthesize additional information around that application.

NATIONAL ACKNOWLEDGEMENTS

The revision process relied upon input from more than 270 volunteers representing educators at the secondary and post-secondary level, state leaders in CTE and agricultural education, as well as business and industry representatives. The input from these volunteers was fundamental to achieving the project goals. A listing of individuals providing input is included in Appendix B.

The members of the Revision Governing Committee are to be commended for their leadership, thoughtful inputs, and dedication to achieving the goals of this project. Members of the Revision Governing Committee appointed by the National Council for Agricultural Education included:

- Michael Womochil, Agricultural Education Program Director, Colorado - Chairperson and Plant Systems Pathway Leader
- Terry Hughes, Career Pathways Director, New York – Co-Chair and Power, Structural and Technical Systems Pathway Leader
- Dr. Randy Showerman, State Supervisor for Agricultural Education, Michigan – Animal Systems Pathway Leader
- John "Chip" Bridges, Agricultural Education Program Manager, Georgia – Natural Resource Systems Pathway Leader
- Dr. John Ewing, Associate Professor of Agricultural Education, Pennsylvania – Environmental Service Systems Pathway Leader
- Matthew Kreifels, Director of Agricultural Education, Nebraska – Food Products and Processing Systems Pathway Leader
- Harley Hepner, Principal Consultant (Agricultural Education), Illinois – Agribusiness Systems Pathway Leader
- Kurt Dillon, Agricultural Education Program Consultant, Kansas – Career Ready Practices and AFNR Cluster Skills Leader
- Jeff Hicken, Agriculture, Food and Natural Resources Consultant, Wisconsin – Biotechnology Systems Pathway Leader
- Michael Honeycutt, Managing Director, National Council for Agricultural Education – Project Director

The National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation (NASDCTEc/NCTEF) have provided permission to use the Common Career and Technical Core (CCTC) Standards in support of this project. Further, their insights and input regarding the revised standards has been very valuable in shaping the final product. NASDCTEc/NCTEF are the owners and developers of the Common Career and Technical Core (CCTC) Standards © Copyright 2012 and reserve all rights to the original material that is used here with permission.

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CONTENT FRAMEWORKS

CAREER READY PRACTICES

Agriculture, Food and Natural Resources Content Frameworks

Common Career Technical Core Career Ready Practices Content Frameworks

PURPOSE: The Common Career Technical Core (CCTC) Career Ready Practices (CRP) describe skills required for future success with ***all*** careers. The content frameworks outlined in this document are intended to provide state agricultural education leaders and educators with a guide for what students should know and be able to do related to each of the CCTC CRPs. State leaders and local educators are encouraged to use the frameworks as a basis for the development of opportunities to learn, practice and assess these skills through classroom instruction, Career and Technical Student Organization (CTSO) involvement (e.g., FFA, Post-secondary Agriculture Students Organization, etc.), and work-based/community learning experiences (e.g., Supervised Agriculture Experience Programs, internships, service, etc.). If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The CCTC CRPs encompass fundamental skills and practices that all students should acquire to be career ready such as: responsibility, productivity, healthy choices, maintaining personal finances, communication, decision-making, creativity and innovation, critical-thinking, problem solving, integrity, ethical leadership, management, career planning, technology use and cultural/global competency. Students completing a program of study in any AFNR career pathway will demonstrate the knowledge, skills and behaviors that are important to career ready through experiences in a variety of settings (e.g., classroom, CTSO, work-based learning, community etc.).

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for CRPs from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a CTE program of study.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:
For additional content frameworks on the topic of Careers, Career Planning and Career Exploration, see Cluster Skills CS.05.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee. Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.		
CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.01.01.01.a. Define personal responsibility and distinguish how it applies in workplace and community (e.g., make educated choices, listen and follow directions, ask for help when needed, meet expected standards, etc.).	**CRP.01.01.01.b.** Analyze and predict how personal responsibility impacts the workplace and community.	**CRP.01.01.01.c.** Evaluate past workplace and community situations and determine how personal responsibility positively or negatively impacted outcomes.
CRP.01.01.02.a. Distinguish personal levels of responsibility, which can be applied in the workplace and community.	**CRP.01.01.02.b.** Assess personal level of responsibility and examine opportunities for improvement.	**CRP.01.01.02.c.** Model personal responsibility in workplace and community situations.
CRP.01.02 Performance Indicator: Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before taking action.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.01.02.01.a. Classify the near- and long-term impacts of personal decisions on self and others (e.g., decisions involving health, relationships, money, perceptions, education, etc.).	**CRP.01.02.01.b.** Assess the pros and cons of personal decisions based on their anticipated impact on self and others.	**CRP.01.02.01.c.** Make and defend personal decisions after analyzing their near- and long-term impacts on self and others.
CRP.01.02.02.a. Classify professional decisions by their near- and long-term impact on employers and community (e.g., decisions involving: financials, business goals, processes, customer satisfaction, corporate image, etc.).	**CRP.01.02.02.b.** Analyze the pros and cons of professional decisions based upon impact on employers and community.	**CRP.01.02.02.c.** Make and defend professional decisions after evaluating their near- and long-term impacts on employers and community.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.01.03.01.a. Define and categorize opportunities for professional service at work and in the community (e.g., serve on committees, attend meetings, etc.).	**CRP.01.03.01.b.** Assess available professional service opportunities at workplaces and in community (e.g., trainings, organizing events, etc.).	**CRP.01.03.01.c.** Devise, implement, and evaluate strategies for involvement in professional service opportunities at work and in the community (e.g., coaching/mentorship, presentations at meetings, etc.).
CRP.01.03.02.a. Identify civic service opportunities in workplaces and the community (e.g., organizations, fundraising, etc.).	**CRP.01.03.02.b.** Assess available civic service opportunities at workplaces and in the community (e.g., community events, attend meetings, etc.).	**CRP.01.03.02.c.** Devise, implement, and evaluate strategies for personal involvement in civic service at work and in the community (e.g., volunteer at food pantry, community clean-up, join organizations or committees, etc.).
CRP.02. CCTC Standard: Apply appropriate academic and technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.		
CRP.02.01. Performance Indicator: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.02.01.01.a. Distinguish opportunities to apply academic learning to solve problems in the workplace (e.g., identify how to: increase productivity, reduce costs, lower inputs, etc.).	**CRP.02.01.01.b.** Assess workplace problems and identify the most appropriate academic knowledge and skills to apply.	**CRP.02.01.01.c.** Apply academic knowledge and skills to solve problems in the workplace and reflect upon the results achieved.
CRP.02.01.02.a. Distinguish opportunities to apply academic learning to solve problems in the community (e.g., identify how to: stop businesses from closing, increase access to emergency services, eliminate hunger, reduce unemployment, etc.).	**CRP.02.01.02.b.** Assess community problems and identify the most appropriate academic knowledge and skills to apply.	**CRP.02.01.02.c.** Apply academic knowledge and skills to solve problems in the community and reflect upon results achieved.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.02.02.01.a. Identify opportunities to apply technical concepts to solve problems in the workplace (e.g., identify how to: increase sales, better customer service, reduce inputs, reduce waste, ensure sustainability, etc.).	**CRP.02.02.01.b.** Assess workplace problems and distinguish the most appropriate technical concepts to apply.	**CRP.02.02.01.c.** Apply technical concepts to solve problems in the workplace and reflect upon the results achieved.
CRP.02.02.02.a. Identify opportunities to apply technical concepts to solve problems in the community (e.g., identify how to: ensure safe routes to schools, reduce vandalism, reduce air pollution, etc.).	**CRP.02.02.02.b.** Assess community problems and identify the most appropriate technical concepts to apply.	**CRP.02.02.02.c.** Apply technical concepts to solve problems in the community and reflect upon results achieved.
CRP.03. CCTC Standard: Attend to personal health and financial well-being. Career-ready individuals understand the relationship between personal health, workplace performance and personal well-being; they act on that understanding to regularly practice healthy diet, exercise and mental health activities. Career-ready individuals also take regular action to contribute to their personal financial well-being, understanding that personal financial security provides the peace of mind required to contribute more fully to their own career success.		
CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.03.01.01.a. Examine and summarize components in a personal wellness plan (e.g., healthy diet, exercise, mental health activities, etc.).	**CRP.03.01.01.b.** Assess the risks and benefits of implementing a personal wellness plan.	**CRP.01.01.c.** Create, implement and continually evaluate a personal wellness plan.
CRP.03.01.02.a. Research the impact of personal wellness plans in workplaces and/or communities.	**CRP.03.01.02.b.** Analyze the relationship between personal wellness and workplace performance.	**CRP.01.02.c.** Evaluate personal wellness plans in workplace and community organizations and the effectiveness of the plans.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.03.02.01.a. Research and examine components in a personal financial management plan (e.g., income, expense, budgeting, savings, credit, etc.).	**CRP.03.02.01.b.** Analyze management tools available for managing personal finances (e.g., software, calendars, banks, financial institutions, etc.).	**CRP.03.02.01.c.** Appraise and select management tools to include in a personal financial management plan.
CRP.03.02.02.a. Examine and categorize personal financial practices (e.g., earning, spending, use of management tools, credit, etc.).	**CRP.03.02.02.b.** Analyze the effectiveness of a personal financial management plan and explain how this practice may contribute to future financial independence.	**CRP.03.02.02.c.** Design, implement and evaluate a personal financial management plan
CRP.04. CCTC Standard: Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas and action plans with clarity, whether using written, verbal and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.		
CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.04.01.01.a. Identify and categorize strategies for ensuring clarity, logic, purpose and professionalism in verbal and non-verbal communication (e.g., vocal tone, organization of thoughts, eye contact, preparation, etc.).	**CRP.04.01.01.b.** Analyze use of verbal and non-verbal communication strategies in workplace situations.	**CRP.04.01.01.c.** Evaluate other's verbal and non-verbal communications (e.g., speeches, presentations, oral reports, etc.) and propose recommendations for improvement in clarity, logic, purpose and professionalism.
CRP.04.01.02.a. Examine and assess personal ability to speak with clarity, logic, purpose and professionalism in formal and informal settings (e.g., speeches, interviews, presentations, oral reports, etc.).	**CRP.04.01.02.b.** Apply strategies for speaking with clarity, logic, purpose and professionalism in a variety of situations in formal and informal settings.	**CRP.04.01.02.c.** Evaluate personal strengths and areas for growth with regard to speaking formally and informally with clarity, logic, purpose and professionalism, and identify ways to improve.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.04.02.01.a. Research and summarize the purpose of different forms of written and visual communication in formal and informal settings (e.g., letters, emails, reports, social media, graphics, diagrams, etc.).	**CRP.04.02.01.b.** Compare and contrast the structure of different forms of written and visual communication.	**CRP.04.02.01.c.** Evaluate the effectiveness of different forms of written and visual communication for achieving their intended purpose.
CRP.04.02.02.a. Identify and examine methods for producing clear, reasoned and coherent written and visual communication that are appropriate to the task, purpose and audience (e.g., audience analysis, objective development, etc.)	**CRP.04.02.02.b.** Apply techniques for ensuring clarity, logic and coherence to edit written and visual communications (e.g., emails, reports, presentations, technical documents, diagrams, etc.).	**CRP.04.02.02.c.** Compose clear and coherent written documents and visuals (e.g., agendas, audio-visuals, drafts, forms, etc.) that are adapted to the audience needs in both formal and informal settings.
CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.04.03.01.a. Research and summarize components of active listening (e.g., eye contact, have an open mind, restate, etc.).	**CRP.04.03.01.b.** Apply active listening strategies (e.g., be attentive, observe non-verbal cues, ask clarifying questions, etc.).	**CRP.04.03.01.c.** Evaluate personal effectiveness and devise a plan to improve active listening skills.
CRP.04.03.02.a. Observe and identify use of active listening strategies in formal (e.g., speeches, presentations, etc.) and informal (e.g., conversations, meetings, etc.) settings.	**CRP.04.03.02.b.** Apply and evaluate personal level of active listening strategies in formal and informal settings.	**CRP.04.03.02.c.** Model active listening strategies in formal and informal settings**.**

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions. Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organizations and the environment. They are aware of and utilize new technologies, understandings, procedures, materials and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.		
CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.05.01.01.a. Examine and describe the steps in the decision-making process used in the workplace and community.	**CRP.05.01.01.b.** Analyze how the process of decision making is used in workplace and community situations.	**CRP.05.01.01.c.** Evaluate workplace and community decision-making processes and devise strategies for improvement.
CRP.05.01.02.a. Examine and explain the relationship between information, resources and good decision making in workplace and community situations.	**CRP.05.01.02.b.** Analyze past workplace and community situations to determine if appropriate information and resources were used to make an effective decision.	**CRP.05.01.02.c.** Evaluate workplace and community situations and recommend the information and resources needed to support good decisions.
CRP.05.01.03.a. Classify the types of information (e.g., data, research, procedures, regulations, etc.) and resources (e.g., human, financial, technology, time, etc.) that may be used to make workplace and community decisions.	**CRP.05.01.03.b.** Analyze workplace and community decisions and assess the information and resources used to make those decisions.	**CRP.05.01.03.c.** Synthesize information and resources and apply to workplace and community situations to make positive decisions.
CRP.05.02. Performance Indicator: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.05.02.01.a. Examine areas in the workplace and community where decisions will make a positive impact.	**CRP.05.02.01.b.** Apply a structured decision-making process to improve workplace and community situations.	**CRP.05.02.01.c.** Evaluate and defend decisions applied in the workplace and community situations.
CRP.05.02.02.a. Examine information about environmental, social and economic impacts when making decisions in the workplace and community.	**CRP.05.02.02.b.** Assess past decisions made in workplace and community and analyze their effects on environmental, social and economic situations.	**CRP.05.02.02.c.** Evaluate workplace and community situations and propose decisions to be made based upon the positive impact made on environment, social and economic areas.

CRP.06. CCTC Standard: Demonstrate creativity and innovation. Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.		
CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.06.01.01.a. Identify and summarize steps for generating ideas used in the workplace and community.	**CRP.06.01.01.b.** Synthesize information, knowledge and experiences to generate ideas for workplace and community situations.	**CRP.06.01.01.c.** Evaluate workplace and community situations and devise strategies to apply original ideas.
CRP.06.01.02.a. Define "assumption" and identify different types and sources of assumptions that could impact effectiveness in workplace and community situations.	**CRP.06.01.02.b.** Analyze how assumptions can impact outcomes in a variety of workplace and community situations.	**CRP.06.01.02.c.** Devise and apply strategies (e.g., ask questions, brainstorm ideas, present facts and information etc.) to challenge common assumptions in workplace and community situations.
CRP.06.02. Performance Indicator: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.06.02.01.a. Identify and categorize the types of processes and procedures used in workplaces and the community (e.g., health and safety, email, compliance, etc.).	**CRP.06.02.01.b.** Analyze how processes and procedures are implemented in workplace and community situations (e.g., employee evaluations, vacation, leave time, etc.).	**CRP.06.02.01.c.** Evaluate past workplace and community situations and determine how processes and procedures impacted outcomes.
CRP.06.02.02.a. Identify and summarize methods used to increase efficiency and add value to workplace and community processes and procedures (e.g., individual input, scheduled reviews, etc.).	**CRP.06.02.02.b.** Predict and communicate potential gains in efficiency and value-added from implementing an improved process or procedure.	**CRP.06.02.02.c.** Construct and implement methods to improve workplace and community processes and procedures.

CRP.06.03. Performance Indicator: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.06.03.01.a. Examine workplace and community situations to identify opportunities for improvement through the introduction of new ideas and innovations.	**CRP.06.03.01.b.** Assess and communicate the risks and benefits of applying new ideas and innovations to the workplace and community.	**CRP.06.03.01.c.** Design a plan of action to introduce a new idea or innovation into the workplace and community.
CRP.06.03.02.a. Identify individuals and organizations (i.e., stakeholders) that need to provide input and feedback on new ideas or innovation prior to implementation in the workplace or community.	**CRP.06.03.02.b.** Elicit and assimilate input and feedback from individuals and organizations about new ideas or innovations for the workplace or community.	**CRP.06.03.02.c.** Evaluate and execute strategies for using stakeholder input and feedback to improve a plan of action for introducing a new idea or innovation into the workplace or community.
CRP.07. CCTC Standard: Employ valid and reliable research strategies. Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use a reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices. They use an informed process to test new ideas, information and practices in their workplace situation.		
CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.07.01.01.a. Identify and summarize reliable research processes and methods used to generate data for decision-making.	**CRP.07.01.01.b.** Analyze how different research methods are used to generate data in a variety of situations.	**CRP.07.01.01.c.** Evaluate business' and organizations' use of research methods and processes and propose recommendations for improvement.
CRP.07.01.02.a. Identify the data requirements for potential decisions in the workplace and community and determine possible research strategies to use to generate the necessary data.	**CRP.07.01.02.b.** Assess the positives and negatives of using different research strategies and methods to generate data for workplace and community decisions and use this information to select appropriate methods.	**CRP.07.01.02.c.** Design plans for use and implementation of reliable research methods to generate data for decision making in workplace and community situations.

CRP.07.02. Performance Indicator: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.07.02.01.a. Identify and summarize types of data sources available to research new technologies and practices for workplaces and community organizations (e.g., blog, research, news, etc.).	**CRP.07.02.01.b.** Assess data sources for reliability and validity.	**CRP.07.02.01.c.** Propose valid and reliable data sources to use when considering the adoption of new technologies, practices and ideas.
CRP.07.02.02.a. Categorize potential technologies, practices and ideas that could be adopted by workplaces and community organizations.	**CRP.07.02.02.b.** Assimilate data to assist in making a decision about the adoption of a new technology, practice or idea by workplaces and community organizations.	**CRP.07.02.02.c.** Create and defend proposals for new technologies, practices and ideas using valid and reliable data sources.
CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem. They thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.		
CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.08.01.01.a. Identify and summarize steps to think critically (e.g., identify problem, gather information, brainstorm solutions, etc.).	**CRP.08.01.01.b.** Apply steps for critical thinking to a variety of workplace and community situations.	**CRP.08.01.01.c.** Evaluate how applying critical thinking skills can impact workplace and community situations.
CRP.08.01.02.a. Examine and identify opportunities to apply reason, logic and multiple perspectives to solve problems in workplace and community situations.	**CRP.08.01.02.b.** Assess solutions to workplace and community problems for evidence of reason, logic and consideration of multiple perspectives.	**CRP.08.01.02.c.** Devise and implement strategies to apply reason, logic and input from multiple perspectives to solve workplace and community problems.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.08.02.01.a. Investigate and summarize potential tools and resources used to solve problems in the workplace and community.	**CRP.08.02.01.b.** Assimilate and prioritize potential solutions to solve problems in the workplace and community.	**CRP.08.02.01.c.** Devise and implement strategies to evaluate the effectiveness of solutions for resolving workplace and community problems.
CRP.08.02.02.a. Identify and summarize steps in the decision-making process to solve workplace and community problems.	**CRP.08.02.02.b.** Apply decision-making processes to generate possible solutions to solve workplace and community problems.	**CRP.08.02.02.c.** Evaluate and select solutions with greatest potential for success to solve workplace and community problems.
CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.08.03.01.a. Identify different types of problem solving models and summarize their applicability to workplace and community situations.	**CRP.08.03.01.b.** Analyze and determine the best problem-solving model to apply to workplace and community problems.	**CRP.08.03.01.c.** Evaluate the effectiveness of different problem-solving models for reaching a solution to workplace and community issues.
CRP.08.03.02.a. Identify and analyze the elements of a plan for solving workplace and community problems (e.g., budget, timeline, etc.).	**CRP.08.03.02.b.** Create plans to solve workplace and community problems.	**CRP.08.03.02.c.** Implement and evaluate plans to solve workplace and community problems.
CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem. They thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.		
CRP.09.01. Performance Indicator: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.09.01.01.a. Identify and summarize the characteristics of ethical and effective leaders in workplace and community settings.	**CRP.09.01.01.b.** Analyze workplace and community leaders and determine what ethical and effective leadership characteristics they demonstrate.	**CRP.09.01.01.c.** Evaluate ethical and effective leadership characteristics demonstrated by others.

CRP.09.01.02.a. Reflect upon and summarize situations where ethical and effective leadership characteristics were needed and/or personally demonstrated (e.g., motivation, empathy, etc.).	**CRP.09.01.02.b.** Conduct a self-assessment of personal ethical and effective leadership characteristics (e.g., relates to others, focused, integrity, etc.) and reflect upon the results to identify opportunities for improvement.	**CRP.09.01.02.c.** Model characteristics and actions of ethical and effective leaders in workplace and community situations (e.g., integrity, self-awareness, etc.).
CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.09.02.01.a. Identify and summarize personal management skills necessary to function effectively in the workplace (e.g., time management, planning, prioritizing, etc.).	**CRP.09.02.01.b.** Analyze leaders' use of effective personal management skills and determine how they apply them in workplace and community situations.	**CRP.09.02.01.c.** Evaluate opportunities to apply personal management skills into daily tasks and responsibilities.
CRP.09.02.02.a. Examine and describe personal management skills (e.g., time management, prioritizing, setting goals, etc.) that are individually implemented and demonstrated in workplace and community situations.	**CRP.09.02.02.b.** Conduct a self-assessment of personal management skills used in daily workplace or community situations.	**CRP.09.02.02.c.** Model personal management skills and identify opportunities for continuous improvement.
CRP.09.03. Performance Indicator: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.09.03.01.a. Identify and summarize respectful and purposeful behaviors that contribute to positive morale and culture in workplace and community settings (e.g., positively influencing others, effectively communicating, etc.).	**CRP.09.03.01.b.** Analyze the relationship between demonstrating respectful and purposeful behaviors (e.g., collaborative, clear expectations, etc.) and increased influence in the workplace and community.	**CRP.09.03.01.c.** Evaluate workplace and community cultures and determine specific behaviors and actions that contribute to building the morale and culture.

CRP.09.03.02.a. Examine personal levels of respectful and purposeful behaviors and summarize how they are demonstrated (e.g., treat others with respect, model professionalism, etc.).	**CRP.09.03.02.b.** Devise, implement and evaluate strategies for continuation and improvement of respectful and purposeful behaviors that contribute to positive morale and culture in workplace and community (e.g., recognize others' skills, promote collaboration, etc.).	**CRP.09.03.02.c.** Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).
CRP.10. CCTC Standard: Plan education and career path aligned to personal goals. Career-ready individuals take personal ownership of their own educational and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the educational and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors and other experts to assist in the planning and execution of career and personal goals.		
CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.10.01.01.a. Determine personal interests, talents, goals and preferences for potential careers.	**CRP.10.01.01.b.** Assess and select areas for growth and improvement based upon analysis of personal interests for potential careers.	**CRP.10.01.01.c.** Plan a career path based on personal interests, goals, talents and preferences.
CRP.10.01.02.a. Examine career clusters and identify potential career opportunities based on personal interests, talents, goals and preferences.	**CRP.10.01.02.b.** Analyze skills needed for potential careers and compare and contrast skills needed with personal interests, talents, goals and preferences.	**CRP.10.01.02.c.** Match potential career opportunities in career clusters with personal interests, talents, goals and preferences.
CRP.10.02. Performance Indicator: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.10.02.01.a. Categorize career advancement requirements for potential careers (e.g., degrees, certification, training, etc.).	**CRP.10.02.01.b.** Analyze the steps to meet career advancement requirements for potential careers.	**CRP.10.02.01.c.** Devise and implement plans to complete the requirements for career advancement.
CRP.10.02.02.a. Identify methods for setting goals for personal improvement and continuous growth in a career area (e.g., SMART goals, training, professional development, etc.).	**CRP.10.02.02.b.** Create goals for personal improvement and continuous growth in a career area.	**CRP.10.02.02.c.** Evaluate actions taken and make appropriate modifications to continuous growth goals in career areas.

CRP.10.03. Performance Indicator: Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.10.03.01.a. Summarize ways that input and/or advice from career area experts could assist in planning personal career goals.	**CRP.10.03.01.b.** Assess career and personal goals and determine additional information career area experts could provide.	**CRP.10.03.01.c.** Devise strategies to gather answers and information from career area experts and use this information to plan and execute goals.
CRP.10.03.02.a. Identify trusted individuals to consult with on setting and achieving career and personal goals (e.g., counselors, teachers, mentors, coaches, community leaders, etc.).	**CRP.10.03.02.b.** Devise and implement strategies to gather input and advice for planning career and personal goals from trusted experts.	**CRP.10.03.02.c.** Assimilate input and advice from experts and formulate plans to implement into career and personal goals for chosen career areas.
CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.10.04.01.a. Identify and explain the purpose of fundamental tools used to pursue a career path (e.g., resume, cover letter, portfolio, etc.) as well as the common components of each (e.g., content in cover letter, categories in resume, etc.).	**CRP.10.04.01.b.** Organize personal information (e.g., goals, experiences, education, achievements, work examples, etc.) to prepare and continuously update a set of tools to aid in the pursuit of a career path.	**CRP.10.04.01.c.** Select and use appropriate tools to pursue career advancement opportunities and assimilate feedback from the process to identify improvements for the future.
CRP.10.04.02.a. Summarize common processes involved in pursuing a career (e.g., interviews, applications, networking, etc.) and the appropriate tools used for completing each.	**CRP.10.04.02.b.** Examine and practice the skills needed to complete common processes for pursuing a career (e.g., ability to communicate about past experiences, ability to articulate one's goals and career objectives, etc.).	**CRP.10.04.02.c.** Apply skills to complete common processes involved in pursuing a career and assimilate input and feedback from experts (e.g., mentors, teachers, business persons, etc.) to improve.

CRP.11. CCTC Standard: Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks – personal and organizational – of technology applications, and they take actions to prevent or mitigate these risks.		
CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.11.01.01.a. Identify and summarize new technologies, tools and applications to use in workplace and community situations.	**CRP.11.01.01.b.** Analyze advantages and disadvantages of new technologies, tools and applications to maximize productivity in the workplace and community.	**CRP.11.01.01.c.** Construct effective communications to explain the features, benefits and risks of new technologies, tools and applications in the workplace and community.
CRP.11.01.02.a. Examine and categorize opportunities in workplace and community settings to use new technologies, tools and applications to maximize productivity and efficiency.	**CRP.11.01.02.b.** Select, apply and use new technologies, tools and applications in workplace and community situations to maximize productivity.	**CRP.11.01.02.c.** Evaluate effectiveness and make recommendations for using new technologies, tools and applications in the workplace and community.
CRP.11.02. Performance Indicator: Evaluate personal and organizational risks of technology use and take actions to prevent or minimize risks in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.11.02.01.a. Identify and summarize potential personal and organizational risks of using technology in the workplace and community.	**CRP.11.02.01.b.** Assess the physical, financial and professional risks associated with using technology in the workplace and community and use this information to determine appropriate uses of technology.	**CRP.11.02.01.c.** Construct and implement methods to evaluate personal and organizational risks of technology in workplace and community settings.
CRP.11.02.02.a. Synthesize tools and processes to prevent or minimize risks of technology use in community and work settings (e.g., risk management tools, benefit risks, etc.).	**CRP.11.02.02.b.** Analyze the effectiveness of methods for preventing or minimizing the risks of technology use.	**CRP.11.02.02.c.** Design and implement strategies to prevent or minimize the risks of technology use in the workplace and community.

CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence. Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural differences to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.		
CRP.12.01. Performance Indicator: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.12.01.01.a. Differentiate the strengths and talents of all team members needed to complete projects in the workplace and community.	**CRP.12.01.01.b.** Formulate action plans to complete team-oriented projects in the workplace and community, including plans for personal contributions.	**CRP.12.01.01.c.** Evaluate the effectiveness of team-oriented projects at work and in the community and make recommendations for future improvements.
CRP.12.01.02.a. Identify and summarize techniques to build consensus in a team situation.	**CRP.12.01.02.b.** Apply consensus building techniques to accomplish results in team-oriented situations.	**CRP.12.01.02.c.** Devise and implement methods to obtain feedback from team members on their experiences after completing workplace and community projects.
CRP.12.01.03.a. Identify and categorize components of cultural and global competence (e.g., awareness, attitude, understanding cultural differences, etc.).	**CRP.12.01.03.b.** Assess the need and benefit for cultural and global competency and apply these competencies in team settings at work and in the community.	**CRP.12.01.03.c.** Evaluate personal level of cultural and global competence and implement plans for growth and improvement in workplace and community situations.
CRP.12.02. Performance Indicator: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.12.02.01.a. Identify and summarize effective strategies used to engage team members to accomplish goals.	**CRP.12.02.01.b.** Assess team dynamics and match strategies to increase team member engagement.	**CRP.12.02.01.c.** Create and implement novel strategies to engage team members based on the situation.
CRP.12.02.02.a. Examine and summarize workplace and community situations where it is important to engage team members to meet team and organizational goals (e.g., meetings, presentations, etc.).	**CRP.12.02.02.b.** Select strategies to engage team members and apply in a variety of situations.	**CRP.12.02.02.c.** Evaluate the effectiveness of strategies to engage team members in a variety of workplace and community situations.

CRP.13. CCTC Standard: Engage in concepts, strategies and tools which contribute to premier leadership, personal growth and career success through participation in FFA.		
CRP.13.01. Performance Indicator: Examine the history, organization, and opportunities through FFA.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CRP.13.01.01.a. Recite and explain the FFA mission, motto, creed and code of ethics.	**CPR.13.01.01.b.** Explain what FFA is through analysis of the FFA mission, motto, creed, and code of ethics.	**CPR.13.01.01.c.** Explore and participate in FFA opportunities.
CRP.13.01.02.a. Identify important dates in FFA history.	**CRP.13.01.02.b.** Discuss the impact of important dates on the history of the FFA.	**CRP.13.01.02.c.** Synthesize dates and create a timeline of historical dates in FFA history.
CRP.13.01.03.a. Identify the components of the FFA emblem and FFA jacket.	**CRP.13.01.03.b.** Discuss the symbolism of the FFA emblem and correct use of the jacket.	**CRP.13.01.03.c.** Demonstrate proper use of the FFA emblem and FFA jacket.
CRP.13.01.04.a. Identify the different FFA degrees.	**CRP.13.01.04.b.** Determine qualifications for each FFA Degree.	**CRP.13.01.04.c.** Devise a plan to earn an FFA Degree or Degrees.
CRP.13.01.05.a. Explain the components of a Program of Activities.	**CRP.13.01.05.b.** Identify the essentials of a successful FFA Chapter's Program of Activities.	**CRP.13.01.05.c.** Write and implement a new Program of Activities for the Chapter.
CRP.13.01.06.a. Identify the different FFA Officer positions and duties.	**CRP.13.01.06.b.** Compare and contrast FFA Officer Duties.	**CRP.13.01.06.c.** Demonstrate duties of any FFA Officer position.
CRP.13.01.07.a. List steps in organizing an FFA Chapter or committee meeting.	**CRP.13.01.07.b.** Prepare an FFA Chapter meeting or committee order of business.	**CRP.13.01.07.c.** Conduct an FFA Chapter or Committee meeting.
CRP.13.01.08.a. Describe FFA Awards and Recognition programs.	**CRP.13.01.08.b.** Compare and contrast leadership development events (LDE) and career development events (CDE).	**CRP.13.01.08.c.** Compete or participate in a practice of a leadership development event (LDE) or career development event (CDE).
CRP.13.01.09.a. List FFA Activities and organizations available to FFA members after graduating high school.	**CRP.13.01.09.b.** Compare and contrast opportunities for FFA involvement upon graduation.	**CRP.13.01.09.c.** Design a progression plan to join or be involved in one of the post-secondary FFA Organizations.
CRP.13.02. Performance Indicator: Utilize Robert's Rules of Order for conducting FFA Chapter business.		
CRP.13.02.01.a. Explain the purpose of using parliamentary procedure in FFA meetings.	**CRP.13.02.01.b.** Demonstrate knowledge of parliamentary procedures such as use of the gavel, making and amending main motions, debating, and voting.	**CRP.13.02.01.c.** Exhibit the skills needed to lead a meeting or activity that engages all participants in the process.
CRP.13.03. Performance Indicator: Plan and conduct a Supervised Agriculture Experience, (SAE).		
CRP.13.03.01.a. Explain the purpose and types of Supervised Agriculture Experience programs (SAE).	**CRP.13.03.01.b.** Develop a personal SAE program.	**CRP.13.03.01.c.** Apply for a chapter, state and national proficiency award that corresponds with an SAE program.

AFNR CLUSTER SKILLS

Agriculture, Food and Natural Resources Content Frameworks

Agriculture, Food, and Natural Resources Cluster Skill Content Frameworks

PURPOSE: The Cluster Skill Content Frameworks outline foundational technical knowledge and skills required for future success with *all* careers in the Agriculture, Food and Natural Resources (AFNR) Career Cluster®. The content frameworks are intended to provide state agricultural education leaders and educators with a guide for what students should know and be able to do after completing a program of study in any AFNR career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for AFNR-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The AFNR Cluster Skills (CS) encompasses the study of fundamental knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health and environmental practices; stewardship of natural resources; and exploration of career opportunities.

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for Agriculture, Food and Natural Resources Career Cluster® (AG) from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** –The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:
For additional content frameworks on the topic of Careers, Career Planning and Career Exploration, see Career Ready Practices CRP.10.

CS.01. CCTC Standard: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.		
CS.01.01. Performance Indicator: Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.01.01.01.a. Examine historical and current data to identify issues impacting AFNR systems.	**CS.01.01.01.b.** Analyze and summarize AFNR issues and their impact on local, state, national and global levels.	**CS.01.01.01.c.** Evaluate and explain AFNR issues and their impacts to audiences with limited AFNR knowledge.
CS.01.01.02.a. Research and summarize trends impacting AFNR systems.	**CS.01.01.02.b.** Analyze current trends in AFNR systems and predict their impact on local, state, national and global levels.	**CS.01.01.02.c.** Evaluate and explain emerging trends and the opportunities they may create within the AFNR systems.
CS.01.02. Performance Indicator: Examine technologies and analyze their impact on AFNR systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.01.02.01.a. Research technologies used in AFNR systems.	**CS.01.02.01.b.** Apply appropriate use of technologies in AFNR workplace scenarios.	**CS.01.02.01.c.** Solve problems in AFNR workplaces or scenarios using technology.
CS.01.02.02.a. Compare and contrast AFNR systems before and after the integration of technology.	**CS.01.02.02.b.** Analyze how technology is used in AFNR systems to maximize productivity.	**CS.01.02.02.c.** Evaluate the importance of technology use and how it impacts AFNR systems.
CS.01.03. Performance Indicator: Identify public policies and examine their impact on AFNR systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.01.03.01.a. Summarize public policies affecting AFNR systems.	**CS.01.03.01.b.** Analyze and assess at least two public policies that impact each AFNR system.	**CS.01.03.01.**c.Evaluate a public policy within AFNR systems and defend or challenge it.
CS.01.03.02.a. Identify influential historical and current public policies that impact AFNR systems.	**CS.01.03.02.b.** Create and propose a hypothetical policy that will impact current AFNR systems.	**CS.01.03.02.c.** Create a plan for implementing a new public policy that will positively impact AFNR systems.

CS.02. CCTC Standard: Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.		
CS.02.01. Performance Indicator: Research and use geographic and economic data to solve problems in AFNR systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.02.01.01.a. Research and describe different types of geographic data used in AFNR systems.	**CS.02.01.01.b.** Analyze and interpret AFNR related geographic data using a variety of systems and technologies (e.g., GIS, GPS, etc.).	**CS.02.01.01.c.** Evaluate geographic data and select necessary data sets to solve problems within AFNR systems.
CS.02.01.02.a. Identify and examine economic data related to AFNR systems (e.g., commodity markets, food marketing, food and nutritional assistance programs, etc.).	**CS.02.01.02.b.** Analyze and interpret a set of economic data and explain how it impacts an AFNR system.	**CS.02.01.02.c.** Devise a strategy to solve a problem in an AFNR system using a set of economic data.
CS.02.02. Performance Indicator: Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.02.02.01.a. Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).	**CS.02.02.01.b.** Assess components within AFNR systems and analyze relationships between systems.	**CS.02.02.01.c.** Devise and implement a strategy for explaining components of AFNR systems to audiences with limited knowledge.
CS.02.02.02.a. Define and summarize societies on local, state, national and global levels and describe how they relate to AFNR systems.	**CS.02.02.02.b.** Assess how people within societies on local, state, national and global levels interact with AFNR systems on daily, monthly or yearly basis.	**CS.02.02.02.c.** Evaluate how society traditions, customs or policies have resulted from practices with AFNR systems.
CS.02.02.03.a. Examine and summarize the components of the agricultural economy (e.g., environmental, crops, livestock, etc.).	**CS.02.02.03.b.** Assess the economic impact of an AFNR system on a local, state, national and global level.	**CS.02.02.03.c.** Evaluate how positive or negative changes in the local, state, national or global economy impacts AFNR systems.

CS.03. CCTC Standard: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.		
CS.03.01. Performance Indicator: Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.03.01.01.a. Research and explain the implications of regulatory, safety and health standards on AFNR systems (e.g., SDS, bioterrorism, etc.).	**CS.03.01.01.b.** Execute health, safety and environmental procedures to comply with regulatory and safety standards.	**CS.03.01.01.c.** Evaluate how AFNR organizations/businesses promote improved health, safety and environmental management and determine steps to maintain compliance with regulatory and safety standards in AFNR situations.
CS.03.01.02.a. Summarize the importance of safety, health and environmental management in the workplace.	**CS.03.01.02.b.** Analyze existing required regulations within an AFNR workplace.	**CS.03.01.02.c.** Construct and implement methods to evaluate compliance with required safety, health and environmental management regulations.
CS.03.02. Performance Indicator: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.03.02.01.a. Research and identify components required in health and safety performance plans.	**CS.03.02.01.b.** Analyze the effectiveness of health and safety performance plans of an AFNR workplace.	**CS.03.02.01.c.** Create and implement a plan to improve safety, health and environmental management regulations in an AFNR workplace.
CS.03.02.02.a. Examine and categorize examples of environmental compliance plans from AFNR workplace.	**CS.03.02.02.b.** Develop plans to improve environmental compliance and performance within an AFNR system.	**CS.03.02.02.c.** Devise and implement a strategy to educate employees on environmental compliance and performance in an AFNR workplace.
CS.03.03. Performance Indicator: Apply health and safety practices to AFNR workplaces.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.03.03.01.a. Research and summarize the purposes and objectives of health and safety policies and procedures relevant to AFNR careers.	**CS.03.03.01.b.** Analyze and evaluate the impact of current health and safety practices of AFNR workplaces.	**CS.03.03.01.c.** Create and implement a health and safety policy plan for AFNR workplaces.

CS.03.03.02.a. Identify emergency response procedures for health and safety issues at AFNR workplaces.	**CS.03.03.02.b.** Assess various emergency response plan requirements for an AFNR workplaces and/or facility.	**CS.03.03.02.c.** Create and implement a plan to communicate appropriate responses for health and safety situations within an AFNR workplace.
CS.03.03.03.a. Examine and categorize examples of how to avoid health or safety risks in AFNR workplaces.	**CS.03.03.03.b.** Assess and apply first aid knowledge and procedures relevant to AFNR workplaces.	**CS.03.03.03.c.** Conduct a survey and evaluate results of AFNR workplaces to identify structure of health and safety practices and number of employees certified in first aid training.
CS.03.03.04.a. Examine and categorize the risk level of contamination or injury as associated with AFNR tasks in the workplace.	**CS.03.03.04.b.** Assess the safety priorities and select appropriate responses for different levels of contamination or injury at an AFNR workplace.	**CS.03.03.04.c.** Create a plan to mitigate the level of contamination or injury identified as a risk in the workplace.
CS.03.04. Performance Indicator: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.03.04.01.a. Identify and differentiate the appropriate protective equipment for the safe use and operation of specific tools and equipment (e.g. PPE, etc.).	**CS.03.04.01.b.** Analyze and demonstrate adherence to protective equipment requirements when using various AFNR tools and equipment.	**C3.06.04.01.c.** Design and implement plans to ensure the use of appropriate protective equipment when using various AFNR tools and equipment.
CS.03.04.02.a. Identify standard tools, equipment and safety procedures related to AFNR tasks.	**CS.03.04.02.b.** Complete the set up and adjustment for tools and equipment related to AFNR tasks.	**C3.06.04.02.c.** Evaluate and select appropriate tools and equipment to complete AFNR tasks.
CS.03.04.03.a. Read and interpret operating instructions related to operation, storage and maintenance of tools and equipment related AFNR tasks.	**CS.03.04.03.b.** Assess and demonstrate appropriate operation, storage and maintenance techniques for AFNR tools and equipment.	**C3.06.04.03.c.** Devise and implement operation, storage and maintenance plans or schedules for AFNR tools and equipment.
CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.		
CS.04.01. Performance Indicator: Identify and implement practices to steward natural resources in different AFNR systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.04.01.01.a. Define stewardship of natural resources and distinguish how it connects to AFNR systems.	**CS.04.01.01.b.** Analyze available practices to steward natural resources in AFNR systems (e.g., wildlife and land conservation, soil and water practices, etc.).	**CS.04.01.01.c.** Devise strategies for stewarding natural resources at home and within community.

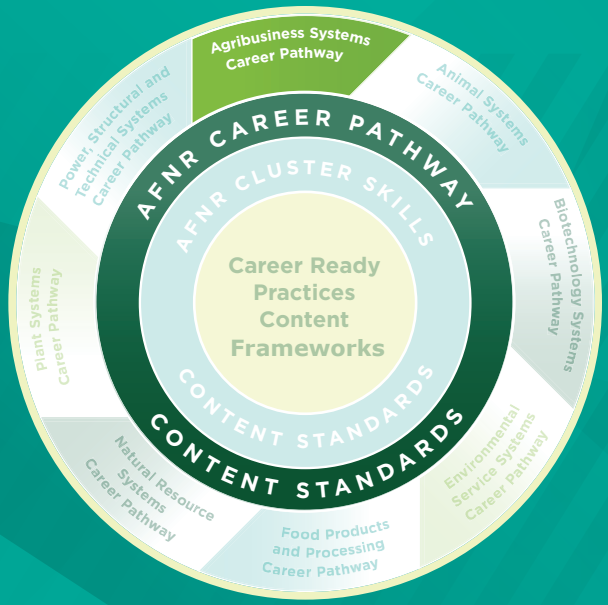
CS.04.01.02.a. Read and interpret the definition of sustainability and summarize how it relates to AFNR activities.	**CS.04.01.02.b.** Analyze and assess sustainability practices that can be applied in AFNR systems (e.g., energy efficiency, recycle/reuse/repurpose, green resources, etc.).	**CS.04.01.02.c.** Evaluate sustainability policies and plans and prepare summary of potential improvements for AFNR businesses or organizations.
CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.04.02.01.a. Research and examine historical and current natural resources trends and technologies.	**CS.04.02.01.b.** Analyze natural resources trends and technologies and explain how they impact AFNR systems (e.g., climate change, green technologies, water resources, etc.).	**CS.04.02.01.c.** Defend or challenge natural resources trends and technologies based upon an assessment of their impact on AFNR systems.
CS.04.02.02.a. Research and summarize influential historical and current natural resources policies that impact AFNR systems.	**CS.04.02.02.b.** Create and defend a hypothetical natural resources policy that will impact current AFNR systems (e.g., for water resources, land use, air quality, etc.).	**CS.04.02.02.c.** Design and implement strategies for implementing a new natural resources policy that will positively impact AFNR systems.
CS.05. CCTC Standard: Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.		
CS.05.01. Performance Indicator: Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.05.01.01.a. Identify and summarize the steps to pursue a career in an AFNR pathway (e.g., self-assessment, set goals, etc.).	**CS.05.01.01.b.** Create a personal plan outlining goals and steps to obtain a career in an AFNR pathway.	**CS.05.01.01.c.** Evaluate progress toward AFNR career goals and identify opportunities for improvement and necessary adjustments to one's plan of action.
CS.05.01.02.a. Examine the educational, training and experiential requirements to pursue a career in an AFNR pathway (e.g., degrees, certifications, training, internships, etc.).	**CS.05.01.02.b.** Analyze personal skillset and create a plan for obtaining the required education, training and experiences to obtain a career in an AFNR pathway.	**CS.05.01.02.c.** Implement one's personal plan of action for obtaining the required education, training and experiences and evaluate progress to identify opportunities for improvement and necessary adjustments.

CS.05.01.03.a. Research and summarize specific tools (e.g., resumes, portfolios, cover letters, etc.) and processes (e.g., interviews, applications, etc.) needed to pursue a career in an AFNR pathway.	**CS.05.01.03.b.** Assess personal goals, experiences, education and skillsets and organize them to produce the appropriate tools and develop the skills to effectively communicate about one's qualifications for an AFNR career.	**CS.05.01.03.c.** Evaluate, update and improve a set of personal tools to reflect current skills, experiences, education, goals, etc. and complete the processes needed to pursue and obtain a career in an AFNR pathway.
CS.05.02. Performance Indicator: Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.05.02.01.a. Examine and categorize careers in each of the AFNR pathways.	**CS.05.02.01.b.** Assess personal skills and align them with potential career opportunities in AFNR pathways.	**CS.05.02.01.c.** Interpret and evaluate the results of a personal career assessment and connect them to potential careers in AFNR pathways.
CS.05.02.02.a. Research and describe careers in each of the AFNR pathways and choose potential careers connecting to personal interests and skills.	**CS.05.02.02.b.** Assemble and analyze examples of careers and related statistics on a local, state, national and global level.	**CS.05.02.02.c.** Conduct interviews with career professionals within AFNR pathways and summarize the results.
CS.06. CCTC Standard: Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.		
CS.06.01. Performance Indicator: Examine and explain foundational cycles and systems of AFNR.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.06.01.01.a. Research and explain the foundational cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, etc.).	**CS.06.01.01.b.** Analyze and explain how foundational cycles affect production, processing and management of food, fiber and fuel.	**CS.06.01.01.c.** Teach others about the impact of foundational cycles within AFNR systems.
CS.06.01.02.a. Examine and describe examples of systems within AFNR (e.g., sustainability, gate-to-plate, etc.).	**CS.06.01.02.b.** Analyze AFNR systems and determine their impact on producing and processing food, fiber and fuel.	**CS.06.01.02.c.** Evaluate AFNR systems and predict how the systems may change or adapt in the future of food, fiber and fuel production based on current trends and data.

CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
CS.06.02.01.a. Summarize how AFNR systems connect and relate on a national and global level (e.g., soil, water, economic, etc.).	**CS.06.02.01.b.** Analyze differences between AFNR systems on a national and global scale.	**CS.06.02.01.c.** Evaluate how AFNR systems impact each other on a national and global level.
CS.06.02.02.a. Examine and summarize changes that happen in AFNR systems on a national and global level (e.g., using less irrigation water, reduction of inputs, etc.).	**CS.06.02.02.b.** Analyze the connections and relationships impacted when there is a change in an AFNR system on a national and global level.	**CS.06.02.02.c.** Evaluate how changes in one AFNR system can benefit cost components of other systems on a national and global level.

CAREER PATHWAY

CONTENT FRAMEWORKS



AGRIBUSINESS SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Agribusiness Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Agribusiness Systems (ABS) Career Pathway encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), and business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application and management of agribusiness systems in AFNR settings.

SAMPLE CAREERS: Banker/Loan Officer, Farm Investment Manager, Agricultural Commodity Broker, Agricultural Economist, Agricultural Chemical Dealer, Field Service Representative, Rural Appraiser, Insurance Adjuster

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for Agribusiness Systems (AG-ABS) from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Framework into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Framework at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of career awareness, see Cluster Skills CS.05.
For additional content frameworks on the topic of leadership, see Career Ready Practices CRP.09.
For additional content frameworks on the topic of ethics, see Career Ready Practices CRP.09.
For additional content frameworks on the topic of teamwork, see Career Ready Practices CRP.12.

ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.		
ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.01.01.01.a. Examine and provide examples of microeconomic principles related to decisions about AFNR business inputs and outputs (e.g., supply, demand and equilibrium, elasticity, diminishing returns, opportunity cost, etc.).	**ABS.01.01.01.b.** Apply microeconomic principles to calculate values associated with different inputs and outputs in AFNR businesses (e.g., price, point of equilibrium, opportunity costs, marginal costs, etc.).	**ABS.01.01.01.c.** Create strategies to maximize the efficiency of AFNR business inputs and outputs using microeconomic principles.
ABS.01.01.02.a. Examine and provide examples of macroeconomic principles related to AFNR businesses (e.g., Gross Domestic Product, inflation, capital accounts, unemployment rate, etc.).	**ABS.01.01.02.b.** Analyze and describe the relationship between AFNR business and industry outputs and domestic and global macroeconomic trends (e.g., Gross Domestic Product, national income, rate of growth, price levels, etc.).	**ABS.01.01.02.c.** Analyze the impact of the current macroeconomic environment on decisions related to AFNR businesses.
ABS.01.01.03.a. Define and research the nature of monetary policies in different global economic systems (e.g., traditional economic system, command economic system, market economic system, mixed economic system, etc.).	**ABS.01.01.03.b.** Assess the monetary policy in different countries and explain how it impacts AFNR businesses.	**ABS.01.01.03.c.** Create recommendations for change in monetary policy according to a scenario related to an AFNR business.
ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.01.02.01.a. Read and interpret statements of purpose (e.g., vision, mission statement, charter, etc.).	**ABS.01.02.01.b.** Assess different approaches for creating statements of purpose for AFNR businesses and choose an appropriate approach to meet organizational needs.	**ABS.01.02.01.c.** Create and disseminate statements of purpose for activities in AFNR businesses.
ABS.01.02.02.a. Identify the meaning and importance of goals and objectives in AFNR business enterprises.	**ABS.01.02.02.b.** Prepare short-term, intermediate and long-term goals and objectives that are consistent with the statements of purpose for an AFNR business.	**ABS.01.02.02.c.** Evaluate AFNR business goals and objectives, then make revisions based on data and observations.

ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.01.03.01.a. Define and provide examples of management skills used to organize an AFNR business (e.g., management types, organizational structures, time management techniques, conducting business agreements, etc.).	**ABS.01.03.01.b.** Analyze the effectiveness of different management skills used in an AFNR business.	**ABS.01.03.01.c.** Devise strategies to improve the operation of AFNR businesses using management skills.
ABS.01.03.02.a. Identify and interpret appropriate local, state, federal, international and industry regulations that impact the management and operation of AFNR businesses.	**ABS.01.03.02.b.** Assess and describe the positive and negative impact of local, state, federal, international and industry regulations on the management and operation of AFNR businesses.	**ABS.01.03.02.c.** Devise management or operational strategies to address and adhere to local, state, federal, international and industry regulations.
ABS.01.03.03.a. Identify and evaluate the presence or lack of ethical standards in planning and operating AFNR businesses.	**ABS.01.03.03.b.** Analyze the importance of using ethical standards and develop methods to communicate ethical standards within AFNR businesses.	**ABS.01.03.03.c.** Design methods for AFNR businesses to implement ethical standards in management skills (e.g., management types, organizational structures, time management techniques, conducting business agreements, etc.).
ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.01.04.01.a. Research and explain the meaning and functions of human resources in AFNR businesses (e.g., recruitment, evaluate employee performance, employee record management, compensation, etc.).	**ABS.01.04.01.b.** Create methods to describe specific positions and structures of an AFNR business to share with human resources (e.g., job descriptions, business information sheet, pamphlet, etc.).	**ABS.01.04.01.c.** Establish and maintain appropriate records and reports on human resources in AFNR businesses (e.g., personal records, absenteeism record, payroll data, employee requests, etc.).
ABS.01.04.02.a. Identify and explain programs used in AFNR businesses to recruit, train and retain employees and define their purpose (e.g., career development, training plans, recruitment plans, evaluation programs, etc.).	**ABS.01.04.02.b.** Analyze and evaluate programs used to recruit, train and retain employees based on their effectiveness.	**ABS.01.04.02.c.** Design guidelines and programs to recruit, train and retain employees in AFNR businesses.

ABS.01.04.03.a. Research and summarize purposes and objectives of benefit and compensation plans for AFNR businesses.	**ABS.01.04.03.b.** Generate compliant and competitive benefit and compensation plans for AFNR business employees.	**ABS.01.04.03.c.** Create recommendations for AFNR employers to improve current benefit and compensation plans (e.g., how to motivate employees, recognize productivity, equitably compensate, etc.).
ABS.02. CCTC Standard: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.		
ABS.02.01. Performance Indicator: Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.02.01.01.a. Examine and describe accounting systems and procedures used for record keeping in AFNR businesses (e.g., cash vs. accrual systems, identification of appropriate accounts, double-entry accounting, entry of debits and credits, etc.).	**ABS.02.01.01.b.** Evaluate the implementation and appropriateness of accounting systems and procedures used for record keeping in AFNR businesses.	**ABS.02.01.01.c.** Select appropriate accounting systems and develop accounting procedures to maintain records for AFNR businesses.
ABS.02.01.02.a. Research and summarize the features of different tools and services for recording, tracking and auditing AFNR business transactions (e.g., electronic tools, paper-based tools, consultative services, online services, banking services, etc.).	**ABS.02.01.02.b.** Compare and contrast the benefits and limitations of different tools and services for recording, tracking, and auditing AFNR business transactions (e.g., convenience, costs, data security, etc.).	**ABS.02.01.02.c.** Recommend and select tools and services to track, record and audit AFNR business transactions that meet business needs and priorities (e.g., electronic and paper based systems, etc.).
ABS.02.01.03.a. Research and examine the implications of applicable laws and regulations related to recording, tracking and auditing AFNR business transactions (e.g., Generally Accepted Accounting Principles, data security, etc.).	**ABS.02.01.03.b.** Predict and calculate the consequences of non-compliance with laws and regulations related to recording, tracking and auditing accounting information in AFNR businesses.	**ABS.02.01.03.c.** Assess the degree to which AFNR accounting practices comply with laws and regulations related to recording, tracking and auditing accounting information in AFNR businesses.

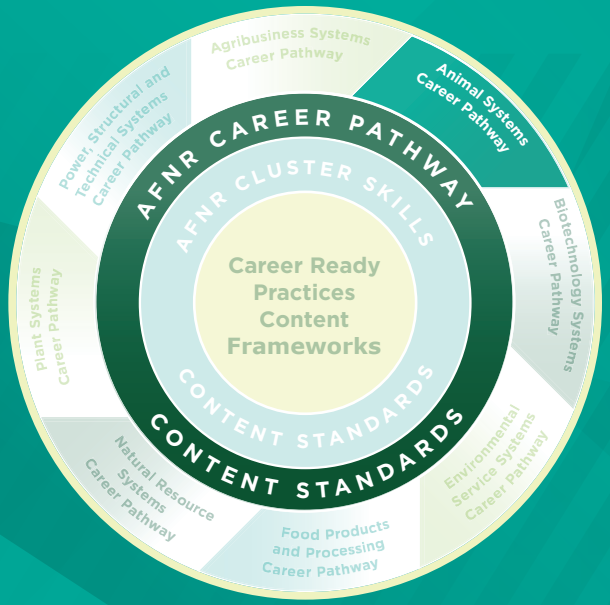
ABS.02.02. Performance Indicator: Assemble, interpret and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.02.02.01.a. Compare and contrast the different types of financial reports (e.g., income statements, cash flow statements, equity statements, etc.) and their frequency of use (e.g., daily, weekly, monthly, quarterly, annual) for monitoring AFNR business performance.	**ABS.02.02.01.b.** Prepare and interpret financial reports to describe the performance of AFNR businesses (e.g., efficiency, profitability, net worth, financial ratios, working capital ratio, leverage, etc.).	**ABS.02.02.01.c.** Recommend appropriate financial reports to assemble to support specific AFNR business decisions (e.g., evaluating efficiency, profitability, net worth, financial ratios, etc.).
ABS.02.02.02.a. Research and summarize strategies for tracking, reporting and managing inventory in AFNR businesses (e.g., spreadsheets, databases, word processing, networked systems and the Internet, etc.).	**ABS.02.02.02.b.** Use accounting information to prepare financial reports associated with inventory in AFNR businesses (e.g., cost of goods sold, margins on goods, etc.).	**ABS.02.02.02.c.** Create recommendations to improve management of inventory in AFNR businesses (e.g., maintaining optimal levels, calculating costs of carrying input and output inventory, supply chain management, etc.).
ABS.02.02.03.a. Define and classify different types of taxes that may be paid by AFNR businesses (e.g., income, property, sales, employment, estate, etc.).	**ABS.02.02.03.b.** Analyze and describe reporting requirements for different types of taxes paid by AFNR businesses (e.g., income, property, sales, employment, etc.).	**ABS.02.02.03.c.** Assemble financial information to prepare tax filings for AFNR businesses.
ABS.03. CCTC Standard: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.		
ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.03.01.01.a. Compare and contrast components of cash budgets (e.g., anticipated revenue, production costs, overhead costs, profit, etc.) and identify the appropriate components to include in a budget given the nature of the AFNR enterprise.	**ABS.03.01.01.b.** Examine and interpret cash budgets for AFNR businesses.	**ABS.03.01.01.c.** Develop cash budgets for AFNR businesses.

ABS.03.01.02.a. Research and summarize factors that impact management of cash budgets in AFNR businesses (e.g., changes in price of inputs/outputs, financial investment performance, capital purchases, human resources, etc.).	**ABS.03.01.02.b.** Examine and identify strategies to manage components of cash budgets to minimize liabilities and maximize profit in AFNR businesses (e.g., delayed payment of expenses, prepayment of expenses, etc.).	**ABS.03.01.02.c.** Predict the impact of management decisions on cash budgets in AFNR businesses.
ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.03.02.01.a. Research and summarize the characteristics of different types of credit instruments available to AFNR businesses (e.g., lines of credit, operating notes, alternative sources of capital, etc.).	**ABS.03.02.01.b.** Analyze AFNR business needs to determine the necessity of loans for business operation.	**ABS.03.02.01.c.** Analyze and assemble the information needed to obtain credit for AFNR businesses.
ABS.03.02.02.a. Examine and interpret the terms and conditions associated with credit instruments used in AFNR businesses (e.g., repayment terms, APR, grace periods, personal liability, interest rates, etc.).	**ABS.03.02.02.b.** Compare and contrast strategies to responsibly manage credit budgets in AFNR businesses.	**ABS.03.02.02.c.** Analyze AFNR business needs and recommend appropriate uses of available credit budgets to meet goals.
ABS.04. CCTC Standard: Develop a business plan for an AFNR business.		
ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.04.01.01.a. Describe the meaning, importance and economic impact of entrepreneurship on the AFNR industry and larger economy.	**ABS.04.01.01.b.** Classify the characteristics of successful entrepreneurs in AFNR businesses.	**ABS.04.01.01.c.** Demonstrate the application of entrepreneurial skills to conceptualize an AFNR business (e.g., idea generation, opportunity analysis, risk assessment, etc.).
ABS.04.01.02.a. Categorize the characteristics of the types of ownership structures used in AFNR businesses (e.g., sole proprietorships, cooperatives, partnerships and corporations).	**ABS.04.01.02.b.** Compare and contrast business plans for different types of ownership structures used in AFNR businesses.	**ABS.04.01.02.c.** Generate conclusions about the successes and failures of AFNR businesses within the global economics system as related to the business ownership structure.

ABS.04.01.03.a. Research and describe the components to include in a business plan for an AFNR business.	**ABS.04.01.03.b.** Analyze the information needed and strategies to obtain the information to complete an AFNR business plan (e.g., SMART goals and objectives, needs assessment, cash flow projection, etc.).	**ABS.04.01.03.c.** Prepare a business plan for an AFNR business.
ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.04.02.01.a. Identify and define the components of operational plans in AFNR businesses (e.g., location, supply and inventory management, production and distribution, organization structure, etc.).	**ABS.04.02.01.b.** Compare and contrast the strengths and weaknesses of operational plans from different AFNR businesses to determine best practices.	**ABS.04.02.01.c.** Make recommendations to improve operational plans for an AFNR business based on best practices.
ABS.04.02.02.a. Devise strategies to illustrate the production process of an AFNR business to produce a specific agricultural product.	**ABS.04.02.02.b.** Identify and assess alternative production systems for a specific agricultural product.	**ABS.04.02.02.c.** Create strategies to improve the production process of an agricultural product for an AFNR facility (e.g., SWOT- strengths, weaknesses, opportunities and threats, supply chain management, etc.).
ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.04.03.01.a. Assess and classify sources of risk for an AFNR business (e.g., financial risk, public perception of company, etc.).	**ABS.04.03.01.b.** risk management strategies for AFNR businesses (e.g., cash flow projection, analyze market trends, etc.).	**ABS.04.03.01.c.** Determine methods to match risk management strategies to risk situations in an AFNR business.
ABS.04.03.02.a. Research and summarize examples that illustrate the importance of risk and uncertainty within AFNR businesses.	**ABS.04.03.02.b.** Analyze alternative approaches to reducing risk for AFNR businesses (e.g., insurance for product liability, property, production or income loss for personnel life and health, etc.).	**ABS.04.03.02.c.** Prepare a comprehensive risk management and contingency plan for an AFNR business.

ABS.05. CCTC Standard: Use sales and marketing principles to accomplish AFNR business objectives.		
ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.05.01.01.a. Distinguish and explain markets related to AFNR businesses (e.g. commodity markets, energy markets, etc.).	**ABS.05.01.01.b.** Analyze and describe the role of trade and price in the market structure as it relates to AFNR businesses.	**ABS.05.01.01.c.** Evaluate and predict future trends for a specific AFNR product as related to markets, trade and price (e.g., corn, oil, wheat, etc.).
ABS.05.01.02.a. Research and summarize different forms of market competition found in AFNR businesses (e.g., direct competitors, indirect competitors, replacement competitors, etc.).	**ABS.05.01.02.b.** Compare and contrast different forms of market competition and how they can be applied to different AFNR businesses.	**ABS.05.01.02.c.** Design and conduct experiments to determine market competition effectiveness of different AFNR businesses.
ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.05.02.01.a. Identify and explain components of the sales process for AFNR businesses (e.g., understanding needs, develop solutions, close sale, etc.).	**ABS.05.02.01.b.** Apply the sales process to AFNR businesses and communicate ways of accomplishing the businesses' goals and objectives.	**ABS.05.02.01.c.** Analyze the sales process of AFNR businesses and create methods to suggest improvements.
ABS.05.02.02.a. Research and summarize examples of different types of sales calls used in AFNR businesses (e.g., cold calls, face-to-face meetings, follow up calls, etc.).	**ABS.05.02.02.b.** Assess different customer reactions that could be encountered during different types of sales calls used in AFNR businesses and prepare an appropriate response (e.g., objections, competitor prices, competing products, post-sale service, complaints about product, etc.).	**ABS.05.02.02.c.** Create strategies for developing plans for different types of sales calls used in AFNR businesses.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ABS.05.03.01.a. Identify and explain marketing principles used in AFNR businesses (e.g., 4 P's-product, place, price, promotion; attention, interest, desire, action, etc.).	**ABS.05.03.01.b.** Assess and select appropriate alternative marketing strategies for AFNR businesses using established marketing principles (e.g. value-adding, branding, niche marketing, etc.).	**ABS.05.03.01.c.** Deconstruct and analyze current AFNR marketing plans to determine the effectiveness of implementation of marketing principles and alternative marketing strategies.
ABS.05.03.02.a. Research and categorize different strategies used in marketing programs for AFNR businesses (e.g., Internet, direct to customer, social media, etc.).	**ABS.05.03.02.b.** Compare and contrast the strategies of marketing for products and services used in AFNR businesses (e.g., direct marketing, commodities, etc.).	**ABS.05.03.02.c.** Devise plans to implement and evaluate marketing strategies for products and services used in AFNR businesses.
ABS.05.03.03.a. Research and summarize the purpose, components and process to develop marketing plans for AFNR businesses.	**ABS.05.03.03.b.** Perform a market analysis to gather information for marketing plans for AFNR businesses (e.g., evaluation of competitors, customers, domestic and international policy, regulations and rules, standards, etc.).	**ABS.05.03.03.c.** Construct comprehensive marketing plans for AFNR businesses.



ANIMAL SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Animal Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Animal Systems (AS) Career Pathway encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, management, and processing, as applied to small animals, aquaculture, exotic animals, livestock, dairy, horses and/or poultry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of animal systems in AFNR settings.

SAMPLE CAREERS: Veterinarian, Livestock Producer, Animal Scientist, Embryo Technologist, Livestock Buyer, Animal Nutritionist, Livestock Geneticist, USDA Inspector, Meat Science Researcher, Feedlot Specialist

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for Animal Systems (AG-AS) from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of using biotechnology to enhance animal productivity and quality, see Biotechnology Systems BS.03.
For additional content frameworks on the topic of inspecting and harvesting animals, see Food Products and Processing Systems FPP.03.
For additional content frameworks on the topic of the classification of food products, see Food Products and Processing Systems FPP.03.
For additional content frameworks on the topic of meat grading, see Food Products and Processing Systems FPP.03.
For additional content frameworks on the topic of food preparation, see Food Products and Processing Systems FPP.03.
For additional content frameworks on the topic of trends in the food industry, see Food Products and Processing Systems FPP.04.

AS.01. CCTC Framework: Analyze historic and current trends impacting the animal systems industry.		
AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution on production practices and the environment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.01.01.01.a. Identify and summarize the origin, significance, distribution and domestication of different animal species.	**AS.01.01.01.b.** Evaluate and describe characteristics of animals that developed in response to the animal's environment and led to their domestication.	**AS.01.01.01.c.** Evaluate the implications of animal adaptations on production practices and the environment.
AS.01.01.02.a. Research and summarize major components of animal systems (e.g., livestock, poultry, companion animal, etc.).	**AS.01.01.02.b.** Describe the historical and scientific developments of different animal industries and summarize the products, services and careers associated with each.	**AS.01.01.02.c.** Predict trends and implications of future developments within different animal industries on production practices and the environment.
AS.01.02. Performance Indicator: Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.01.02.01.a. Identify and categorize terms and methods related to animal production (e.g., sustainable, conventional, humanely raised, natural, organic, etc.).	**AS.01.02.01.b.** Analyze the impact of animal production methods on end product qualities (e.g., price, sustainability, marketing, labeling, animal welfare, etc.).	**AS.01.02.01.c.** Evaluate the effectiveness of different production methods and defend the use of selected methods using data and evidence.
AS.01.02.02.a. Research and examine marketing methods for animal products and services (e.g., conventional, niche markets, locally grown, etc.).	**AS.01.02.02.b.** Calculate costs of marketing versus predicted increases in sales.	**AS.01.02.02.c.** Devise and evaluate marketing plans for an animal agriculture product or service.
AS.01.02.03.a. Summarize the types, purposes, and characteristics of effective record keeping and documentation practices for animal systems enterprises (e.g., managing records for animal identification, feeding, breeding, treatment, income/expense, etc.).	**AS.01.02.03.b.** Analyze and evaluate the accuracy and effectiveness of records used in an animal system business.	**AS.01.02.03.c.** Select and defend the use of a specific record management system based upon its effectiveness for a business related to animal systems.
AS.01.02.04.a. Identify and summarize wildlife management methods.	**AS.01.02.04.b.** Research and summarize local wildlife populations, challenges and ecological measures that are being utilized.	**AS.01.02.04.c.** Devise and evaluate plans to manage wildlife populations to achieve optimal ecological health.

AS.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.01.03.01.a. Distinguish between the types of laws pertaining to animal systems.	**AS.01.03.01.b.** Analyze the structure of laws governing animal industries, international trade and animal production policies.	**AS.01.03.01.c.** Evaluate the impact of laws pertaining to animal agriculture (e.g., pros, cons, effect on individuals, effect on businesses, etc.) and assess the compliance of production practices with established regulations.
AS.01.03.02.a. Research and summarize sustainability in animal systems.	**AS.01.03.02.b.** Analyze the local and global impact of sustainable animal agriculture practices on human and environmental systems.	**AS.01.03.02.c.** Select, evaluate and defend the use of sustainable practices in animal agriculture.
AS.02. CCTC Framework: Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.		
AS.02.01. Performance Indicator: Demonstrate management techniques that ensure animal welfare.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.02.01.01.a. Explain the implications of animal welfare and animal rights for animal systems.	**AS.02.01.01.b.** Design programs that assure the welfare of animals and prevent abuse or mistreatment.	**AS.02.01.01.c.** Implement and evaluate quality-assurance programs and procedures for animal production.
AS.02.01.02.a. Research and summarize the challenges involved in working with animals and resources available to overcome them (e.g., tools, technology, equipment, facilities, animal behavior signals, etc.).	**AS.02.01.02.b.** Analyze and document animal welfare procedures used to ensure safety and maintain low stress when moving and restraining animals.	**AS.02.01.02.c.** Devise, implement and evaluate safety procedures and plans for working with animals by species using information based on animal behavior and responses.
AS.02.01.03.a. Distinguish between animal husbandry practices that promote animal welfare and those that do not.	**AS.02.01.03.b.** Analyze and document animal husbandry practices and their impact on animal welfare.	**AS.02.01.03.c.** Devise economical recommendations to increase the welfare of animals in animal systems.
AS.02.01.04.a. Identify domestic livestock and companion animal behaviors and list safety procedures for working with those species.	**AS.02.01.04.b.** Interpret domestic livestock and companion animal behaviors and outline safety procedures for working with those species.	**AS.02.01.04.c.** Handle and work with domestic livestock, horses, and companion animal safely.
AS.02.01.05.a. Define bio-security in relation to domestic livestock, poultry, and companion animals.	**AS.02.01.05.b.** Explain the importance of bio-security in relation to domestic livestock and companion animals.	**AS.02.01.05.c.** Evaluate bio-security measures at a domestic livestock, poultry and/or companion animal facility.

AS.02.02. Performance Indicator: Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.02.02.01.a. Identify and categorize tools, technology and equipment used in animal husbandry and welfare to help provide an abundant and safe food supply.	**AS.02.02.01.b.** Utilize tools, technology and equipment to perform animal husbandry and welfare tasks.	**AS.02.02.01.c.** Select, evaluate and defend the use of specific tools, technology or equipment used to perform animal husbandry and welfare tasks.
AS.02.02.02.a. Research and summarize animal production practices that may pose health risks.	**AS.02.02.02.b.** Analyze consumer concerns with animal production practices relative to human health.	**AS.02.02.02.c.** Research and evaluate programs to assure the safety of animal products for consumption.
AS.02.02.03.a. Identify and describe animal tracking systems used in animal systems (e.g., livestock, poultry, companion animal, exotics, etc.).	**AS.02.02.03.b.** Analyze and summarize the impact of animal trace-back capabilities on producers and consumers.	**AS.02.02.03.c** Evaluate the effectiveness of animal and/or premise identification programs for a given species.
AS.03. CCTC Framework: Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.		
AS.03.01. Performance Indicator: Analyze the nutritional needs of animals.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.03.01.01.a. Identify and summarize essential nutrients required for animal health and analyze each nutrient's role in growth and performance.	**AS.03.01.01.b.** Differentiate between nutritional needs of animals in different growth stages and production systems (e.g., maintenance, gestation, natural, organic, etc.).	**AS.03.01.01.c.** Assess nutritional needs for an individual animal based on its growth stage and production system.
AS.03.01.02.a. Differentiate between nutritional needs of animal species.	**AS.03.01.02.b.** Correlate a species' nutritional needs to feedstuffs that could meet those needs.	**AS.03.01.02.b.** Design and defend the use of a nutritional program by demonstrating the relationship between the nutrient requirements and the feedstuffs provided.
AS.03.02 Performance Indicator: Analyze feed rations and assess if they meet the nutritional needs of animals.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.03.02.01.a. Compare and contrast common types of feedstuffs and the roles they play in the diets of animals.	**AS.03.02.01.b.** Determine the relative nutritional value of feedstuffs by evaluating their general quality and condition.	**AS.03.02.01.c.** Select appropriate feedstuffs for animals based on a variety of factors (e.g., economics, digestive system and nutritional needs, etc.).

AS.03.02.02.a. Examine the importance of a balanced ration for animals based on the animal's growth stage (e.g., maintenance, newborn, gestation, lactation, etc.).	**AS.03.02.02.b.** Appraise the adequacy of feed rations using data from the analysis of feedstuffs, animal requirements and performance.	**AS.03.02.02.c.** Select and utilize animal feeds based on nutritional requirements, using rations for maximum nutrition and optimal economic production.
AS.03.02.03.a. Examine the purpose, impact and mode of action of feed additives and growth promotants in animal production	**AS.03.02.03.b.** Compare and contrast methods that utilize feed additives and growth promotants with production practices that do not, (e.g., organic versus conventional production methods).	**AS.03.02.03.c.** Make and defend decisions regarding whether to use feed additives and growth promotants after researching and considering scientific evidence, production system needs and goals, and input from industry professionals.
AS.03.03 Performance Indicator: Utilize industry tools to make animal nutrition decisions.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.03.03.01.a. Identify and categorize tools and equipment used to meet animal nutrition needs and ensure an abundant and safe food supply.	**AS.03.03.01.b.** Utilize tools and equipment to perform animal nutrition tasks.	**AS.03.03.01.c.** Select, evaluate and defend the use of specific tools or equipment used to perform animal nutrition tasks.
AS.03.03.02.a. Examine and summarize the meaning of various components of feed labels and feeding directions.	**AS.03.03.02.b.** Analyze and apply information from a feed label and feeding directions to feed animals.	**AS.03.03.02.c.** Evaluate and summarize the potential impacts, positive and negative, of compliance and/or noncompliance with a feed label and feeding directions.
AS.03.03.03.a. Examine the use of technology to provide animal nutrition.	**AS.03.03.03.b.** Analyze technologies used to provide animal nutrition and summarize their potential benefits and consequences.	**AS.03.03.03.c.** Research and recommend technology improvements to provide proper nutrition to animals.
AS.04. CCTC Framework: Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.		
AS.04.01. Performance Indicator: Evaluate animals for breeding readiness and soundness.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.04.01.01.a. Identify and categorize the male and female reproductive organs of the major animal species.	**AS.04.01.01.b.** Analyze the functions of major organs in the male and female reproductive systems.	**AS.04.01.01.c.** Select breeding animals based on characteristics of the reproductive organs.
AS.04.01.02.a. Compare and contrast how age, size, life cycle, maturity level and health status affect the reproductive efficiency of male and female animals.	**AS.04.01.02.b.** Assess and describe factors that lead to reproductive maturity.	**AS.04.01.02.c.** Evaluate and select animals for reproductive readiness.
AS.04.01.03.a. Summarize the importance of efficient and economic reproduction in animals.	**AS.04.01.03.b.** Evaluate eproductive problems that occur in animals.	**AS.04.02.01.c.** Treat or cull animals with reproductive problems.

AS.04.02. Performance Indicator: Apply scientific principles to select and care for breeding animals.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.04.02.01.a. Summarize genetic inheritance in animals.	**AS.04.02.01.b.** Compare and contrast the use of genetically superior animals in the production of animals and animal products.	**AS.04.02.01.c.** Select and evaluate a breeding system based on the principles of genetics.
AS.04.02.02.a. Identify and summarize inheritance and terms related to inheritance in animal breeding (e.g., dominate, co-dominate, recessive, homozygous, heterozygous, etc.).	**AS.04.02.02.b** Demonstrate how to determine probability trait inheritance in animals.	**AS.04.02.02.c.** Select and evaluate breeding animals and determine the probability of a given trait in their offspring.
AS.04.02.03.a. Identify and summarize genetic defects that affect animal performance	**AS.04.02.03.b.** Analyze how DNA analysis can detect genetic defects in breeding stock	**AS.04.02.03.c.** Perform a DNA analysis and use the data to make and defend breeding decisions.
AS.04.02.04.a. Identify and summarize different needs of breeding animals based on their growth stages (e.g., newborn, parturition, gestation, gestation lengths, etc.).	**AS.04.02.04.b.** Analyze the care needs for breeding stock in each stage of growth.	**AS.04.02.04.c.** Create a plan to differentiate care of a species of breeding animals throughout their growth stages.
AS.04.03 Performance Indicator: Apply scientific principles to breed animals.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.04.03.01.a. Identify and categorize natural and artificial breeding methods (e.g., natural breeding, artificial insemination, estrous synchronization, flushing, cloning, etc.).	**AS.04.03.01.b.** Calculate the potential economic benefits of natural versus artificial breeding methods.	**AS.04.03.01.c.** Select animal breeding methods based on reproductive and economic efficiency.
AS.04.03.02.a. Analyze the materials, methods and processes of artificial insemination.	**AS.04.03.02.b.** Demonstrate artificial insemination techniques.	**AS.04.03.02.c.** Evaluate the implementation and effectiveness of artificial insemination techniques.
AS.04.03.03.a. Identify and summarize the advantages and disadvantages of major reproductive management practices, including estrous synchronization, superovulation, flushing and embryo transfer (e.g., cost, labor, equipment, etc.).	**AS.04.03.03.b.** Analyze the processes of major reproductive management practices, including estrous synchronization, superovulation, flushing and embryo transfer.	**AS.04.03.03.c.** Create and evaluate plans and procedures for estrous synchronization, superovulation, flushing, embryo transfer and other reproductive management practices.
AS.04.03.04.a. Examine the use of quantitative breeding values (e.g., EPDs, Performance records, pedigrees) in the selection of genetically superior breeding stock.	**AS.04.03.04.b.** Compare and contrast quantitative breeding value differences between genetically superior animals and animals of average genetic value.	**AS.04.03.04.c.** Select and assess animal performance based on quantitative breeding values for specific characteristics.

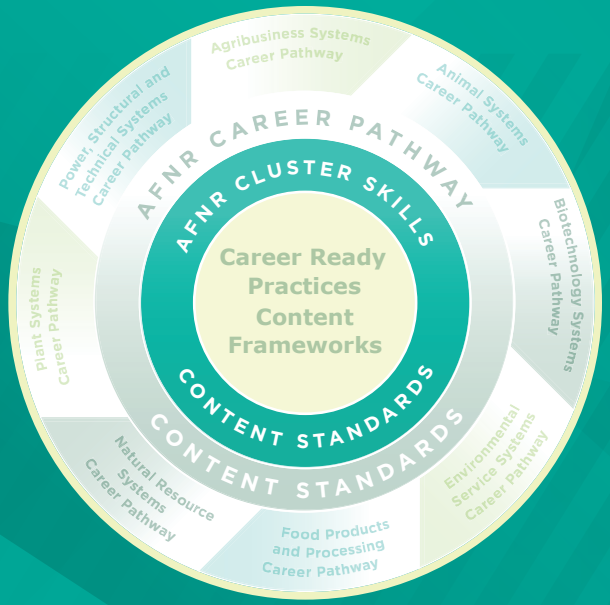
AS.05. CCTC Framework: Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.		
AS.05.01. Performance Indicator: Design animal housing, equipment and handling facilities for the major systems of animal production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.05.01.01.a. Differentiate between the types of facilities needed to house and produce animal species safely and efficiently.	**AS.05.01.01.b.** Critique designs for an animal facility and prescribe alternative layouts and adjustments for the safe, sustainable and efficient use of the facility.	**AS.05.01.01.c.** Design an animal facility focusing on animal requirements, economic efficiency, sustainability, safety and ease of handling.
AS.05.01.02.a. Identify and summarize equipment, technology and handling facility procedures used in modern animal production (e.g., climate control devices, sensors, automation, etc.).	**AS.05.01.02.b.** Analyze the use of modern equipment, technology and handling facility procedures and determine if they enhance the safe, economic and sustainable production of animals.	**AS.05.01.02.c.** Select, use and evaluate equipment, technology and handling procedures to enhance sustainability and production efficiency.
AS.05.01.03.a. Recognize illnesses and disorders based on symptoms and problems caused by disease, parasites, and disorders among companion, lab and/or domestic animals.	**AS.05.01.03.b.** Select preventive measures for controlling and limiting the spread of common diseases, and common parasites among companion and domestic animals**.**	**AS.05.01.03.c.** Evaluate preventive measures for controlling and limiting the spread of common diseases, and common parasites among companion and domestic animals, including vaccination, sanitation, observation, isolation, waste disposal, proper handling, protective clothing, and hand washing.
AS.05.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in animal production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.05.02.01.a. Identify and summarize the general standards that must be met in facilities for animal production (e.g., environmental, zoning, construction, etc.).	**AS.05.02.01.b.** Analyze animal facilities to determine if standards have been met.	**AS.05.02.01.c.** Evaluate facility designs and make recommendations to ensure that it meets standards for the legal, safe, ethical, economical and efficient production of animals.
AS.05.02.02.a. Distinguish between the types of laws and regulations pertaining to animal systems.	**AS.05.02.02.b.** Analyze the structure of laws pertaining to animal systems.	**AS.05.02.02.c.** Evaluate the impact of laws pertaining to animal systems.
AS.06. CCTC Framework: Classify, evaluate and select animals based on anatomical and physiological characteristics.		
AS.06.01. Performance Indicator: Classify animals according to taxonomic classification systems and use (e.g. agricultural, companion, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		

AS.06.01.01.a. Explain the importance of the binomial nomenclature system for classifying animals.	**AS.06.01.01.b.** Explain how animals are classified using a taxonomic classification system.	**AS.06.01.01.c.** Assess taxonomic characteristics and classify animals according to the taxonomic classification system.
AS.06.01.02.a. Compare and contrast major uses of different animal species (e.g., agricultural, companion, etc.).	**AS.06.01.02.b.** Appraise and evaluate the economic value of animals for various applications in the agriculture industry.	**AS.06.01.02.c.** Recommend different uses for an animal species based upon an analysis of local market needs.
AS.06.01.03.a. Identify and summarize common classification terms utilized in animal systems (e.g., external and internal body parts, maturity, mature male, immature female, animal products, breeds, etc.).	**AS.06.01.03.b.** Analyze the visual characteristics of an animal or animal product and select correct classification terminology when referring to companion and production animals.	**AS.06.01.03.c.** Apply knowledge of classification terms to communicate with others about animal systems in an effective and accurate manner.
AS.06.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.06.02.01.a. Research and summarize characteristics of a typical animal cell and identify the organelles.	**AS.06.02.01.b.** Analyze the functions of each animal cell structure.	**AS.06.02.01.c.** Correlate the functions of animal cell structures to animal growth, development, health and reproduction.
AS.06.02.02.a. Examine the basic functions of animal cells in animal growth and reproduction.	**AS.06.02.02.b.** Analyze the processes of meiosis and mitosis in animal growth, development, health and reproduction.	**AS.06.02.02.c.** Apply the processes of meiosis and mitosis to solve animal growth, development, health and reproductive problems.
AS.06.02.03.a. Identify and summarize the properties, locations, functions and types of animal cells, tissues, organs and body systems.	**AS.06.02.03.b**. Compare and contrast animal cells, tissues, organs, body systems types and functions among animal species.	**AS.06.02.03.c.** Apply knowledge of anatomical and physiological characteristics of animals to make production and management decisions.
AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.06.03.01.a. Identify and summarize how an animal's health can be affected by anatomical and physiological disorders.	**AS.06.03.01.b.** Compare and contrast desirable anatomical and physiological characteristics of animals within and between species.	**AS.06.03.01.c.** Evaluate and select animals to maximize performance based on anatomical and physiological characteristics that affect health, growth and reproduction

AS.06.03.02.a. Evaluate an animal against its optimal anatomical and physiological characteristics.	**AS.06.03.02.b.** Compare and contrast procedures to sustainably and efficiently develop an animal to reach its highest performance potential with respect to its anatomical and physiological characteristics.	**AS.06.03.02.c.** Choose, implement and evaluate sustainable and efficient procedures (e.g., selection, housing, nutrition and management) to produce consistently high-quality animals that are well suited for their intended purposes.
AS.06.03.03.a. Research and summarize the use of products and by-products derived from animals.	**AS.06.03.03.b.** Evaluate and select products from animals based on industry standards.	**AS.06.03.03.c.** Evaluate and select animals to produce superior animal products based on industry standards.
AS.07. CCTC Framework: Apply principles of effective animal health care.		
A**S.07.01. Performance Indicator:** Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.07.01.01.a. Identify and summarize specific tools and technology used in animal health management.	**AS.07.01.01.b.** Describe and demonstrate the proper use and function of specific tools and technology related to animal health management.	**AS.07.01.01.c.** Select and use tools and technology to meet specific animal health management goals.
AS.07.01.02.a. Explain methods of determining animal health and disorders.	**AS.07.01.02.b.** Perform simple health-check evaluations on animals and practice basic emergency response procedures related to animals.	**AS.07.01.02.c.** Determine when an animal health concern needs to be referred to an animal health professional.
AS.07.01.03.a. List and summarize the characteristics of wounds, common diseases, parasites and physiological disorders that affect animals.	**AS.07.01.03.b.** Identify and describe common illnesses and disorders of animals based on symptoms and problems caused by wounds, diseases, parasites and physiological disorders.	**AS.07.01.03.c.** Treat common diseases, parasites and physiological disorders of animals according to directions prescribed by an animal health professional.
AS.07.01.04.a. Identify and summarize characteristics of causal agents and vectors of diseases and disorders in animals.	**AS.07.01.04.b.** Research and analyze data to evaluate preventive measures for controlling and limiting the spread of diseases, parasites and disorders among animals.	**AS.07.01.04.c.** Design and implement a health maintenance and a disease and disorder prevention plan for animals in their natural and/or confined environments.
AS.07.01.05.a. Explain the clinical significance of common veterinary methods and treatment (e.g., aseptic techniques, antibiotic use, wound management, etc.).	**AS.07.01.05.b.** Assess the safety and effectiveness of facilities and equipment used for surgical and nonsurgical veterinary treatments and procedures.	**AS.07.01.05.c.** Identify and describe surgical and nonsurgical veterinary treatments and procedures to meet specific animal health care objectives.
AS.07.02. Performance Indicator: Analyze biosecurity measures utilized to protect the welfare of animals on a local, state, national, and global level.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		

AS.07.02.01.a. Summarize the importance of biosecurity to the animal industry at multiple levels (e.g., local, state, national, global).	**AS.07.02.01.b.** Analyze procedures at the local, state and national levels to ensure biosecurity of the animal industry.	**AS.07.02.01.c.** Design and evaluate a biosecurity plan for an animal production operation.
AS.07.02.02.a. Identify and describe zoonotic diseases including their historical significance and potential future implications.	**AS.07.02.02.b.** Analyze the health risk of different zoonotic diseases to humans and identify prevention methods.	**AS.07.02.02.c.** Research and evaluate the effectiveness of zoonotic disease prevention methods and procedures to identify those that are best suited to ensure public safety and animal welfare.
AS.08. CCTC Framework: Analyze environmental factors associated with animal production.		
AS.08.01. Performance Indicator: Design and implement methods to reduce the effects of animal production on the environment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.08.01.01.a. Identify and summarize the effects of animal agriculture on the environment (e.g., waste disposal, carbon footprint, air quality, environmental efficiencies, etc.).	**AS.08.01.01.b.** Assess the effectiveness of methods of reducing the effects of animal agriculture on the environment.	**AS.08.01.01.c.** Devise a plan that includes measures to reduce the impact of animal agriculture on the environment.
AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.08.02.01.a. Research and summarize environmental conditions that impact animals (e.g., weather, sources of water, food resources, etc.).	**AS. 08.02.01.b.** Critique the reliability and validity of evidence presented to support claims regarding the effects of environmental conditions on animal populations and performance (e.g., population changes, emerging species, extinction, etc.).	**AS. 08.02.01.c.** Apply valid and reliable research evidence to predict the potential effects of different environmental conditions for an animal population.
AS.08.02.01.a. Identify and summarize methods for ensuring optimal environmental conditions for animals.	**AS.08.02.02.b.** Implement and evaluate the effectiveness of methods to ensure optimal environmental conditions for animals.	**AS.08.02.02.c.** Devise and improve plans to establish favorable environmental conditions for animal growth and performance based on a variety of factors (e.g., economic feasibility, environmental sustainability, impact on animals, etc.).

AS.09. CCTC Framework: Apply effective management practices to non-livestock animal production.		
AS.09.01. Performance Indicator: Manage and maintain honeybees.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AS.09.01.01.a. Identify honeybees and their castes, (workers, drones, queens).	**AS.09.01.01.b.** Explain the honeybee year-long life cycle.	**AS.09.01.01.c.** Demonstrate seasonal management of honeybee colonies.
AS.09.01.02.a. Explain the importance of pollination in the production of food.	**AS.09.01.02.b.** Explain the factors that are affecting pollinator populations.	**AS.09.01.02.c.** List the crops that are dependent on bee pollination.
AS.09.01.03.a. List and identify the pests that affect the bee colonies.	**AS.09.01.03.b.**Control the pests that affect bee colonies.	**AS.09.01.03.c.** Demonstrate Integrated Pest management practices while protecting bee hives.
AS.09.01.04.a Identify types of honeybee housing.	**AS.09.01.04.b.** Label the parts of standard Langstroth hives.	**AS.09.01.04.c.** Construct bee hives and hive equipment.
AS.09.01.05.a. Explain reasons to inspect a beehive.	**AS.09.01.05.b.** Demonstrate use of a smoker and hive tool while inspecting a hive.	**AS.09.01.05.c.** Inspect bee hives for: harvestable products, pests, disease, and queen.
AS.09.01.06.a. Explain the various products from honeybee hives, (honey, wax, pollen, propolis, venom).	**AS.09.01.06.b.** Gather various hive products; Honey, wax, pollen, propolis, and venom.	**AS.09.01.06.c.** Process various hive products; Honey, wax, pollen, propolis, and venom.
AS.09.01.07.a. Identify tools and equipment used in beekeeping.	**AS.09.01.07.b.** Demonstrate the use of tools and equipment used in beekeeping.	**AS.09.01.07.c.** Maintain tools and equipment used in beekeeping.



AQUACULTURE SYSTEM CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Aquaculture Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Aquaculture (AQ) Career Pathway encompasses the study of content areas such as life processes, health, nutrition, genetics, management and processing, of aquatic organisms service and repair of aquaculture vessels, machines and equipment. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of aquaculture facilities in AFNR settings.

SAMPLE CAREERS: Aquaculture Technician, Fish Biologist, Fish Farm Manager, Fish Hatchery Supervisor, Fishing Harvesting Crew, Fish Processing Supervisor, Aquaculture Engineer, Fisheries Research Lab Manager, Aquaculture Research Scientist, Fish and Seafood Sales and Marketing, Aquaculture Veterinarians, Seafood Inspector, Fisheries Law Enforcement

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- **Pathway Content Standard—**This is a general statement indicating the broad area of knowledge
- **Performance Indicators** – These statements distill each content standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- **Sample Measurements** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of using biotechnology to enhance aquatic animal productivity and quality, see Biotechnology Systems BS.03.
For additional content frameworks on the topic of inspecting and harvesting aquatic organisms, see Food Products and Processing Systems FPP.03.

AQ.01. CCTC Framework: Analyze historic and current trends impacting the aquaculture systems industry.		
AQ.01.01. Performance Indicator: Evaluate the development and implications of aquatic species origin and distribution on production practices and the environment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.01.01.01.a. Identify and summarize the origin, significance, distribution and commercial importance of different aquatic species.	**AQ.01.01.01.b.** Evaluate and describe characteristics of aquatic organisms that developed in response to the aquatic specie's environment and led to their commercial use.	**AQ.01.01.01.c.** Evaluate the implications of aquatic organism's adaptations on production practices and the environment.
AQ.01.01.02.a. List and describe how the following species are detrimental to aquaculture production: sea stars, oyster drills, zebra mussels, lice, parasitic copepods, and worms.	**AQ.01.01.02.b.** Identify and describe aquaculture intensive and extensive management strategies for control of invasive species.	**AQ.01.01.02.c.** Evaluate the implications that invasive aquatic species have on commercial production of aquatic organisms.
AQ.01.01.03.a. Research and summarize major components of aquaculture (e.g., oyster farming, and commercial kelp beds, etc.).	**AQ.01.01.03.b.** Describe the historical and scientific developments of different aquaculture industries and summarize the products, services and careers associated with each.	**AQ.01.01.03.c.** Predict trends and implications of future developments within different sectors of the aquaculture industry on production practices and the environment.
AQ.01.02. Performance Indicator: Devise and apply management and record keeping skills to organize and operate an aquaculture business in an efficient manner.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.01.02.01.a. Identify and categorize terms and methods related to aquaculture production (e.g., sustainable, conventional, humanely raised, natural, organic, etc.).	**AQ.01.02.01.b.** Analyze the impact of aquaculture production methods on end product qualities (e.g., price, sustainability, marketing, labeling, animal welfare, etc.).	**AQ.01.02.01.c.** Evaluate the effectiveness of different production methods and defend the use of selected methods using data and evidence.
AQ.01.02.02.a. Research and examine marketing methods for aquaculture products and services (e.g., conventional, niche markets, locally grown, etc.).	**AQ.01.02.02.b.** Calculate costs of marketing versus predicted increases in sales.	**AQ.01.02.02.c.** Devise and evaluate marketing plans for an aquaculture product or service.
AQ.01.02.03.a. Summarize the types, purposes, and characteristics of effective record keeping and documentation practices for aquatic systems enterprises.	**AQ.01.02.03.b.** Analyze and evaluate the accuracy and effectiveness of records used in an aquaculture system business.	**AQ.01.02.03.c.** Select and defend the use of a specific record management system based upon its effectiveness for a business related to aquaculture systems.

AQ.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to aquaculture systems from a global perspective.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.01.03.01.a. Distinguish between the types of laws pertaining to aquaculture systems.	**AQ.01.03.01.b.** Analyze the structure of laws governing aquaculture industries, international trade and aquaculture production policies.	**AQ.01.03.01.c.** Evaluate the impact of laws pertaining to aquaculture systems (e.g., pros, cons, effect on individuals, effect on businesses, etc.) and assess the compliance of production practices with established regulations.
AQ.01.03.02.a. Research and summarize sustainability in aquaculture systems.	**AQ.01.03.02.b.** Analyze the local and global impact of sustainable aquaculture systems practices on human and environmental systems.	**AQ.01.03.02.c.** Select, evaluate and defend the use of sustainable practices in aquaculture systems.
AQ.02. CCTC Framework: Utilize best-practice protocols based upon aquatic animal behaviors and welfare.		
AS.02.01. Performance Indicator: Demonstrate management techniques that ensure aquatic animal welfare.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.02.01.01.a. Explain the implications of animal welfare and animal rights for aquaculture production.	**AQ.02.01.01.b.** Design programs that assure the welfare of aquatic animals and prevent abuse or mistreatment.	**AQ.02.01.01.c.** Implement and evaluate quality-assurance programs and procedures for aquatic animal production.
AQ.02.01.02.a. Research and summarize the challenges involved in working with aquatic animals and resources available to overcome them (e.g., tools, technology, equipment, facilities, animal behavior signals, etc.).	**AQ.02.01.02.b.** Analyze and document aquatic animal welfare procedures used to ensure safety and maintain low stress when moving aquatic animals.	**AQ.02.01.02.c.** Devise, implement and evaluate safety procedures and plans for working with aquatic animals.
AQ.03. CCTC Framework: Classify aquatic species according to hierarchical taxonomy and use.		
AQ.03.01. Performance Indicator: Identify aquatic species by their hierarchical taxonomy and use.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.03.01.01.a. Explain the importance of the binomial system of nomenclature.	**AQ.03.01.01.b**. Explain how aquatic species are classified using Linnaeus's taxonomical classification system.	**AQ.03.01.01.c.** Demonstrate the proper formatting and usage of binomial nomenclature.
AQ.03.01.02.a. Classify species of aquatic organisms as fresh water, marine, or diadromous, and by their genus and species	**AQ.03.01.02.b.** Compare and contrast the hierarchical classification of the major aquatic species.	**AQ.03.01.02.c.** Create a dichotomous key for several aquaculture species.

AQ.04. CCTC Framework: Evaluate, select and manage aquatic organisms based on anatomical and physiological characteristics.		
AQ.04.01. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various aquatic species.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.04.01.01.a. Identify the following external morphological features of a finfish: dorsal, pectoral, pelvic, anal, caudal and adipose fins, lateral line, and operculum.	**AQ.04.01.01.b.** Identify the following external morphologic features of a crustacean: carapace, abdomen, walking legs, and claws.	**AQ.04.01.01.c.** Explain how the components and systems of aquatic species anatomy and physiology relate to the production and use of aquatic species.
AQ.04.01.02.a. Diagram a typical aquatic species cell and identify the organelles.	**AQ.04.01.02.b.** Describe the functions of aquatic species cell structures.	**AQ.04.01.02.c.** Describe the molecular makeup of aquatic species cells and its importance in aquaculture production and management.
AQ.04.01.03.a. Describe the basic functions of aquatic species cells in growth and reproduction.	**AQ.04.01.03.b.** Detail the processes of meiosis and mitosis in aquatic species growth, development, health and reproduction.	**AQ.04.01.03.c.** Explain the application of the processes of meiosis and mitosis to aquatic species growth, development, health and reproduction.
AQ.04.01.03.a. Describe the basic functions of aquatic species cells in growth and reproduction.	**AQ.04.01.03.b.** Detail the processes of meiosis and mitosis in aquatic species growth, development, health and reproduction.	**AQ.04.03.03.c.** Explain the application of the processes of meiosis and mitosis to aquatic species growth, development, health and reproduction.
AQ.04.01.04.a. Describe the properties, locations, functions and types of aquatic species tissues.	**AQ.04.01.04.b.** Explain the relationship of aquatic species tissues to growth, performance and health.	**AQ.04.03.04.c.** Explain the importance and uses made of aquatic species tissues in the aquaculture industry.
AQ.04.01.05.a. Describe the properties, locations, functions and types of aquatic species organs.	**AQ.04.01.05.b.** Compare and contrast organ types and functions among aquatic species.	**AQ.04.01.05.c.** Relate the importance of aquatic species organs to the health, growth and reproduction of animals.
AQ.04.01.06.a. Describe the functions of the aquatic species body systems and system components.	**AQ.04.01.06.b.** Compare and contrast body systems and system adaptations between aquatic species.	**AS.04.01.06.c.** Explain the impact of aquatic species body systems on performance, health, growth and reproduction.
AQ.04.02. Performance Indicator: Select aquatic species for specific purposes and maximum performance based on anatomy and physiology.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.04.02.01.a. Identify ways aquatic species' health can be affected by anatomical and physiological disorders.	**AQ.04.02.01.b.** Compare and contrast desirable anatomical and physiological characteristics of aquatic plants and animals within and between species.	**AQ.04.02.01.c.** Evaluate and select aquatic species to maximize performance based on anatomical and physiological characteristics that affect health, growth and reproduction.

AQ.04.02.02.a. Create a program to develop an aquatic species to its highest potential performance.	**AQ.04.02.02.b.** Assess an aquatic species to determine if it has reached its optimal performance level based on anatomical and physiological characteristics.	**AQ.04.02.02.c.** Develop efficient procedures to produce consistently high-quality aquaculture species well suited for their intended purposes.
AQ.04.02.03.a. Describe the life cycle of aquaculture species.	**AQ.04.02.03.b.** Diagram the life cycle of tilapia, Atlantic salmon, eastern oysters, and American lobsters.	**AQ.04.02.03c.** Evaluate use of life cycle for production purposes.
AQ.04.02.04.a. Evaluate an aquatic animal against its optimal anatomical and physiological characteristics.	**AQ.04.02.04.b.** Compare and contrast procedures to sustainably and efficiently develop an aquatic animal to reach its highest performance potential with respect to its anatomical and physiological characteristics.	**AQ.04.02.04.c.** Choose, implement and evaluate sustainable and efficient procedures (e.g., selection, housing, nutrition and management) to produce consistently high-quality aquatic animals that are well suited for their intended purposes.
AQ.04.02.05.a. Research and summarize the use of products and by-products derived from aquatic animals.	**AQ.04.02.05.b.** Evaluate and select products from aquatic animals based on industry standards.	**AQ.04.02.05.c.** Evaluate and select aquatic animals to produce superior animal products based on industry standards.
AQ.05. CCTC F: Provide proper health care of aquaculture species.		
AQ.05.01. Performance Indicator: Prescribe and implement a prevention and treatment program for aquatic species diseases, parasites and other disorders.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.05.01.01.a. Explain methods of determining aquatic species health and disorders.	**AQ.05.01.01.b.** Identify protocols needed to diagnose, treat and prevent common aquatic diseases to maintain healthy populations.	**AQ.05.01.01.c.** Perform diagnostic tests to detect health problems in aquatic species.
AQ.05.01.02.a. Identify common diseases, parasites and physiological disorders that affect aquatic species.	**AQ.05.01.02.b.** Diagnose illnesses and disorders of aquatic species based on symptoms and problems caused by diseases, parasites and physiological disorders.	**AQ.05.01.02.c.** Treat common diseases, parasites and physiological disorders of aquatic species.
AQ.05.01.03.a. Explain characteristics of causative agents and vectors of diseases and disorders in aquatic species.	**AQ.05.01.03.b.**Evaluate the health and productivity of fish and shellfish populations.	**AQ.05.01.03.c.** Design and implement a health maintenance and disease and disorder prevention plan for aquatic species in their natural and/or confined environments.
AQ.05.01.04.a. Explain the clinical significance of common considerations in veterinary treatments, such as aseptic techniques.	**AQ.05.01.04.b**. Prepare aquatic species, facilities and equipment for surgical and nonsurgical veterinary treatments and procedures.	**AQ.05.01.04.c.** Perform surgical and nonsurgical veterinary treatments and procedures in aquatic animal health care.
AQ.05.01.05.a. List and describe the following symptoms: pop-eyes, piping, flashing, fin erosion, abnormal behavior, and skin abnormalities such as lesions and scale loss.	**AQ.05.01.05.b.** Prepare a treatment plan for the prevention of the following: pop-eyes, piping, flashing, fin erosion, abnormal behavior, and skin abnormalities such as lesions and scale loss.	**AQ.05.01.05.c.** Administer the proper treatment(s) for the following: pop-eyes, piping, flashing, fin erosion, abnormal behavior, and skin abnormalities such as lesions and scale loss.

AQ.05.01.06.a. List and define the categories of infectious diseases: bacterial, fungal, viral, and parasitic.	**AQ.05.01.06.b.** Explain the health risk of zoonotic diseases to humans and their historical significance and future implications.	**AQ.05.01.06.c.** Implement zoonotic disease prevention methods and procedures for the safe handling and treatment of aquatic animals.
AQ.05.01.07.a. List and define the categories of non-infectious diseases: nutritional, environmental, chemical, and physiological.	**.AQ.05.01.07.b.** Describe the following; physiochemical problems: gas bubble disease, oxygen deficiency, waterborne irritants and toxicity; nutritional and feed-related problems: starvation, deficiencies and imbalances and toxic organisms.	**AQ.05.01.07.c.** Diagnose and treat non-infectious diseases.
AQ.05.02. Performance Indicator: Provide for the biosecurity of aquatic species and production facilities.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.05.02.01.a. Explain the importance of biosecurity to the aquaculture industry.	**AQ.05.02.01.b.** Discuss procedures at the local, state and national levels to ensure biosecurity of the aquaculture industry.	**AQ.05.02.01.c.** Implement a biosecurity plan for an aquaculture production operation.
AQ.06. CCTC Framework: Evaluate and select aquatic species based on scientific principles of animal and plant production.		
AQ.06.01. Performance Indicator: Evaluate the male and female reproductive systems in selecting aquatic species.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.06.01.01.a. Explain the male and female reproductive organs of the major aquatic animal species.	**AQ.06.01.01.b.** Describe the functions of major organs in the male and female reproductive systems.	**AQ.06.01.01.c.** Select breeding species based on characteristics of the reproductive organs.
AQ.06.01.02.a. Explain how age, size, life cycle, maturity level and health status affect the reproductive efficiency of male and female aquatic animals.	**AQ.06.01.02.b.** Summarize factors that lead to reproductive maturity.	**AQ.06.01.02.c.** Evaluate and select aquatic animals for reproductive readiness.
AQ.07. CCTC Framework: Analyze reproduction facilities and select aquatic stock for reproduction.		
AQ.07.01. Performance Indicator: Determine appropriate reproduction method for aquatic species.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.07.01.01.a. List and describe various hatchery systems; ponds, raceways, tanks, etc.	**AQ.07.01.01.b.** Evaluate hatchery systems for suitability in rearing the following species: trout, salmon, tilapia, catfish, shrimp, lobster, oysters, crayfish, clams, and kelp.	**AQ.07.01.01.c.** Design and build appropriate hatchery for a given aquatic species.

AQ.07.01.02.a. Describe the sexual reproduction process in fish, crustaceans and mollusks.	**AQ.07.01.02.b.** Evaluate spawning techniques of prominent aquaculture species.	**AQ.01.02.c.** Spawn aquaculture species.
AQ.08. CCTC Framework: Apply Principles of hydrology to aquaculture.		
AQ.08.01. Performance Indicator: Manage water resources for Aquaculture.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.08.01.01.a. Describe the world's water supplies and discuss the many uses of water.	**AQ.08.01.01.b.** Analyize characteristics of water that influence the biosphere and sustain life.	**AQ.08.01.01.c.** Research and debate one or more current environmental issues associated with the supplies of groundwater and surface water.
AQ.08.01.02.a. Demonstrate knowledge of hydrogeology by differentiating between groundwater and surface water.	**AQ.08.01.02.b.** Describe interactions between groundwater and surface water.	**AQ.08.01.02.c.** Use groundwater-flow equations and Darcy's Law to explain how geology and meteorology affect groundwater and groundwater flow.
AQ.08.01.03.a. Define groundwater potential.	**AQ.08.01.03.b.** Identify differences in groundwater potential.	**AQ.08.01.03.c.** Delineate groundwater potential zones.
AQ.08.01.04.a. Identify environmental hazards associated with groundwater supplies.	**AQ.08.01.04.b.** Describe precautions taken to prevent/reduce contamination of groundwater supplies.	**AQ.08.01.04.c.** Test and document the quality of groundwater supplies.
AQ.08.01.05.a. Identify and describe how the following environmental factors impact aquaculture production: temperature, salinity, ammonia, nitrate, nitrite, dissolve oxygen, and pH.	**AQ.08.01.05.b.** Explain how aquaponics can be utilized to enhance sustainable aquaculture practices by reducing water consumption and waste production.	**AQ.08.01.05.c.** Analyze the pros and cons for the use of net pens for raising fish, in the world's oceans.
AQ.08.02. Performance Indicator: Apply principles of wastewater treatment to manage wastewater disposal following rules and regulations.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.08.02.01.a. Define wastewater.	**AQ.08.02.01.b.** Diagram the steps in wastewater treatment.	**AQ.08.02.01.c.** Demonstrate the use of water-testing instruments and water-treatment equipment to treat wastewater.
AQ.09. CCTC Framework: Evaluate housing, equipment and handling facilities for the major aquaculture species.		
AQ.09.01. Performance Indicator: Design aquatic species housing, equipment and handling facilities.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.09.01.01.a. Identify the following types of aquaculture systems: raceways, ponds, recirculating systems, and net pens or cages.	**AQ.09.01.01.b.** Critique designs for an aquaculture facility and prescribe alternative layouts and adjustments for the safe and efficient use of the facility.	**AQ.09.01.01.c.** Design an aquatic facility, focusing on aquatic species requirements, efficiency, safety and ease of handling.

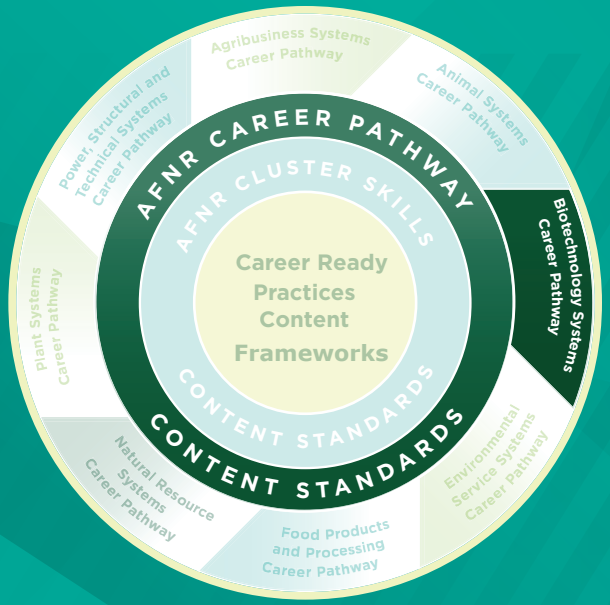
AQ.09.01.02.a. Identify equipment and handling facilities used in modern aquaculture production.	**AQ.09.01.02.b.** Explain how modern equipment and handling facilities enhance the safe and economic production of aquatic species.	**AQ.09.01.02.c.** Select equipment and implement handling procedures and improvements to enhance production efficiency of aquatic species.
AQ.09.01.03.a. Identify and describe the following parts of a recirculating aquaculture system (RAS): tank, sump or reservoir, pump, solid waste filter, U/V sterilizer, heat exchanger, bio-filter, and aeration.	**AQ.09.01.03.b.** Explain the basic electrical, plumbing and mechanical components of aquaculture systems.	**AQ.09.01.03.c.** Construct a recirculating aquaculture system (RAS) based on dynamic interaction including flow rate, size, capacity, plumbing, friction loss, species and component requirements.
AQ.09.01.04.a. Describe how the bio-filter of a recirculating aquaculture system (RAS) converts ammonia to nitrite, and nitrite to nitrat**e**.	**AQ.09.01.04.b.** Diagram the nitrogen cycle in relation to aquaculture.	**AQ.09.01.04.c.** Design and construct a functional bio filtration system.
AQ.09.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in aquaculture production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.09.02.01.a. List the general standards (e.g., environmental, zoning, construction) that must be met in facilities for aquaculture production.	**AQ.09.02.01.b.** Evaluate an aquaculture facility to determine if standards have been met.	**AQ.09.02.01.c.** Design a facility that meets standards for the legal, safe, ethical and efficient production of aquatic species.
AQ.09.03. Performance Indicator: Manage hazardous materials to assure a safe facility and to comply with applicable regulations.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.09.03.01.a. Identify types of hazardous materials.	**AQ.09.03.01.b.** Describe risks related to hazardous materials and describe health and safety practices to reduce risks from hazardous materials.	**AQ.09.03.01.c.** Describe the procedures for the treatment and disposal of hazardous materials and hazardous waste.
AQ.10. CCTC Framework: Manage vehicles, equipment, and vessels for aquaculture production.		
AQ.10.01. Performance Indicator: Design vehicles, vessels and equipment for aquaculture production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.10.01.01.a. Identify vehicles, vessels, tools and equipment used for aquaculture.	**AQ.10.01.01.b.** Critique designs for vehicles, vessels, tools and equipment used in aquaculture.	**AQ.10.01.01.c.** Design vehicles, vessels, tools and equipment used in aquaculture.
AQ.10.01.02.a. Repair and maintain vehicles, vessels, tools and equipment.	**AQ.10.01.02.b.** Determine costs and expenses of aquaculture vehicles, vessels, tools and equipment.	**AQ.10.01.02.c.** Build industry appropriate marine vehicles vessels, and ancillary infrastructure based on industry standards.

AQ.11. CCTC Framework: Apply principles of nutrition to ensure the proper growth, development, reproduction and economic production of aquatic species.		
AQ.11.01. Performance Indicator: Formulate feed rations to provide for the nutritional needs of aquatic species.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.11.01.01.a. Compare and contrast common types of feedstuffs and the roles they play in the diets of aquatic animals and their proper storage.	**AQ.11.01.01.b.** Determine the relative nutritional value of feedstuffs based on ingredients and by evaluating their general quality and condition.	**AQ.11.01.01.c.** Select appropriate feedstuffs for aquatic animals based on factors such as economics, digestive systems and nutritional needs.
AQ.11.01.02.a. List and describe the following nutritional requirements in aquaculture production: proteins, carbohydrates, fats, vitamins, and minerals**.**	**AQ.11.01.02.b.** Appraise the adequacy of feed rations using data from the analysis of feedstuffs, aquatic animal requirements and performance.	**AQ.11.01.02.c.** Formulate aquatic animal feeds based on nutritional requirements, using feed ingredients for maximum nutrition and optimal economic production.
AQ.11.01.03.a. Describe free access feeding with demand feeders, versus schedule feeding by hand or automatic feeder**.**	**AQ.11.01.03.b.** Feed fish a balance ration using standard industry practices.	**AQ.11.01.03.c.** Design a nutritional program for fish that utilizes standard industry practices.
AQ.12. CCTC Framework: Processing and marketing aquatic crops.		
AQ.12.01. Performance Indicator: Process aquatic crops to produce high quality product.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.12.01.01.a. Identify standards for food safety, recommendations and processes.	**AQ.12.01.01.b.** Explain the Best Aquaculture Practices (BAP) certification and describe Hazard Analysis and Critical Control Point (HACCP) Compliance.	**AQ.12.01.01.c.** Apply BAP and create a HACCP Plan for processing aquaculture products.
AQ.12.01.02.a. Describe the process in preparing aquatic species for retail sales.	**AQ.12.01.02.b.** Evaluate different methods to keep processed aquatic species fresh.	**AQ.12.01.02.c.** Prepare, preserve and market aquatic species for retail sales.
AQ.12.01.03.a. Describe the reasons for grading both before and during harvesting.	**AQ.12.01.03.b.** Evaluate the process of preparing an aquaculture product from harvest to final packaging.	**AQ.12.01.03.c.** Grade processed aquaculture product according to recognized standards.
AQ.12.01.04.a. Identify and describe specific aquaculture products and value added modifications.	**AQ.12.01.04.b.** Describe the process of creating value added aquaculture products.	**AQ.12.01.04.c.** Select and prepare value added aquaculture products or appropriate value added products by species.

AQ.12.02. Performance Indicator: Identify steps in the marketing process.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.12.02.01.a. Define marketing.	**AQ.12.02.01.b.** Explain the elements in developing a marketing plan.	**AQ.12.02.01.c.** Develop and execute a marketing plan for an aquatic crop.
AQ.12.02.02.a. Identify possible markets for aquatic crops.	**AQ.12.02.02.b.** Evaluate appropriate market for an aquatic crop.	**AQ.12.02.02.c.** Analyze the costs involved with executing a marketing plan.
AQ.13. CCTC Framework: Identify government and private organizations involved in the management of aquatic plants and animals and their environments.		
AQ.13.01. Performance Indicator: Discuss the need for government oversight and regulation for aquaculture.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.13.01.01.a. Identify state and local agencies that regulate aquaculture.	**AQ.13.01.01.b.** Describe the function of the following agencies as related to aquaculture: NOAA, DEEP, EPA, World Aquaculture Society, SeaGrant, FDA, USDA, Army Corps of Engineers, and United States Coast Guard.	**AQ.13.01.01.c.** Network with an aquaculture industry professional.
AQ.14. CCTC Framework: Evaluate water resources and quality.		
AQ.14.01. Performance Indicator: Obtain water for aquaculture enterprises.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.14.01.01.a. Identify sources of water for aquaculture enterprises.	**AQ.14.01.01.b.** Compare and contrast different water sources for aquaculture enterprises.	**AQ.14.01.01.c.** Summarize the legal, ethical and moral issues in obtaining water for aquaculture enterprises.
AQ.14.01.02.a. Distinguish between freshwater, saltwater, and brackish water.	**AQ.14.01.02.b.** Compare and contrast freshwater, saltwater, and brackish water.	**AQ.14.01.02.c.** Rear aquaculture species in freshwater, saltwater, and brackish water.
AQ.14.02. Performance Indicator: Calculate water usage in aquaculture enterprises.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.14.02.01.a. Explain the following terms as related to water: Cubic Foot, Acre-inch and Acre-Foot.	**CT-AQ.14.02.01.b.** Calculate water flow in both cubic foot per second and gallons per minute.	**AQ.14.02.01.c.** Convert water measurements between English and Metric units. Example gallons to liters, cubic feet to cubic meter, gallons per minute to liters per minute, etc.

AQ.14.03. Performance Indicator: Evaluate and monitor water quality for aquaculture production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.14.03.01.a. Identify water quality factors that are important in aquaculture systems.	**AQ.14.03.01.b.** Describe the water quality factors most likely to be involved with aquaculture losses.	**AQ.14.03.01.c.** Demonstrate proper technique for taking water samples to perform water quality assessments.
AQ.14.03.02.a. Discuss factors that affect dissolved oxygen levels in aquaculture systems.	**AQ.14.03.02.b.** Conduct dissolved oxygen test. Analyze and record test results.	**AQ.14.03.02.c.** Demonstrate methods of correcting dissolved oxygen deficiency in aquaculture systems.
AQ.14.03.03.a. Explain the importance of water temperature in aquaculture systems.	**AQ.14.03.03.b.** Take, record and analyze water temperature measurements.	**AQ.14.03.03.c.** Determine dissolved oxygen levels of a water sample based on water temperature.
AQ.14.03.04.a. Define acid, base and neutral pH as it relates to water quality in aquaculture systems.	**AQ.14.03.04.b.** Take, record and analyze pH measurements.	**AQ.14.03.04.c.** Demonstrate methods of correcting the pH of water in aquaculture systems.
AQ.14.03.05.a. Define turbidity and list the causes of turbidity in aquaculture systems.	**AQ.14.03.05.b.** Measure, record and analyze turbidity in an aquaculture system.	**AQ.14.03.05.c.** Assess methods of turbidity control in an aquaculture system.
AQ.14.03.06.a. Discuss total ammonia-nitrogen (TAN) in aquaculture systems.	**AQ.14.03.06.b.** Take, record and analyze TAN measurements.	**AQ.14.03.06.c.** Analyze management practices that will reduce TAN in aquaculture systems.
AQ.14.03.07.a. Explain the following as it relates to aquaculture systems: water hardness, carbon dioxide, salinity, iron, chlorine, and hydrogen sulfide.	**AQ.14.03.07.b.** Measure, record and analyze the following water quality factors as necessary**:** water hardness, carbon dioxide, salinity, iron, chlorine, and hydrogen sulfide.	**AQ.14.03.07.c.** Assess methods to control the following water quality factors**:** water hardness, carbon dioxide, salinity, iron, chlorine, and hydrogen sulfide.
AQ.14.03.08.a. Identify weeds and algae in aquaculture systems.	**AQ.14.03.08.b.** Explain methods to control weeds and algae in aquaculture systems.	**AQ.14.03.08.c.** Select appropriate management methods to control weeds and algae in aquaculture systems.
AQ.15. CCTC Framework: Integrate hydroponics within the management of aquaculture.		
AQ.15.01. Performance Indicator: Develop and implement sustainable aquaponics system.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
AQ.15.01.01.a. Define aquaponics.	**AQ.15.01.01.b.** Describe species of plants and animals suited for aquaponics.	**AQ.15.01.01.c.** Compare and contrast aquaponics to traditional farming and aquaculture**.**
AQ.15.01.02.a. Identify common plant species used in aquaponics.	**AQ.15.01.02.b.** Describe favorable attributes for plant species used in aquaponics	**AQ.15.01.02.c.** Choose plant species for use in an aquaponics system.
AQ.15.01.03.a. List plant nutrients required for growth.	**AQ.15.01.03.b.** Describe plant nutritional deficiencies.	**AQ.15.01.03.c.** Calculate amount of supplement plant nutrients needed in an aquaponics system.

AQ.15.01.04a. Identify common aquatic animal species for use in aquaponics.	**AQ.15.01.04.b.** Describe favorable attributes for aquatic animal species used in aquaponics.	**AQ.15.01.04.c.** Choose aquatic animal species for use in an aquaponics system.
AQ.15.01.05.a. Identify the following aquaponics systems: Float, Flood-and-Drain and Nutrient Film Technique (NFT).	**AQ.15.01.05.b.** Compare and contrast the following aquaponics systems; Float, Flood-and-Drain and Nutrient Film Technique (NFT).	**AQ.15.01.05.c.** Choose an aquaponics system based on aquatic animal and plant species to be grown.
AQ.15.01.06.a. Identify common pests found in aquaponics.	**AQ.15.01.06.b.** Describe Integrated Pest Management (IPM).	**AQ.15.01.06.c.** Develop a management program to control aquaponics pests.
AQ.15.01.07.a. Identify food safety concerns in aquaponics.	**AQ.15.01.07.b.** Review Good Agricultural Practices (GAPs) as it relates to aquaponics.	**AQ.15.01.07.c.** Create a management plan that incorporates GAPs to reduce food borne illness.
AQ.15.01.08.a. Define sustainability.	**AQ.15.01.08.b.** Discuss how aquaponics is sustainable.	**AQ.15.01.08.c.** Evaluate issue that must be overcome to make aquaponics sustainable.



BIOTECHNOLOGY SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Biotechnology Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Biotechnology Systems (BS) Career Pathway encompasses the study of using data and scientific techniques to solve problems concerning living organisms with an emphasis on applications to agriculture, food and natural resource systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of biotechnology in the context of AFNR.

SAMPLE CAREERS: Geneticist, Microbiologist, Biochemist, Lab Technician, Animal Scientist, Plant Scientist, Food Scientist

DEFINITIONS: Within each pathway, the standards are organized as follows:

- ***National Council for Agricultural Education (NCAE) Standard**** – These are the standards set forth by the National Council for Agricultural Education for Biotechnology Systems. They define what students should know and be able to do after completing instruction in a program of study focused on applying biotechnology to AFNR systems.
- ***Performance Indicators*** – These statements distill each performance element into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related performance element at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

NOTE: * State leaders and local educators are encouraged to also refer to the standards set forth for Health Sciences: Biotechnology Research and Development (HL-BRD) from the 2012 version of the Common Career and Technical Core Standards, by the National Association of State Directors of Career and Technical Education/National career Technical Education Foundation. The NCAE Standards provide guidance for development of a contextualized program of study for the HL-BRD career pathway, but do not cover all of the content areas outlined in the CCTC standards for HL-BRD. The following table provides guidance for individuals interested in using the NCAE Standards to develop a HL-BRD pathway contextualized to AFNR.

Relationship Between NCAE Standards for Biotechnology Systems and CCTC Standards for Health Sciences: Biotechnology Research and Development
NCAE Standard – BS.01: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.). • *Provides contextualized content standards related to:* o **CCTC Standard – HL-BRD.1:** Summarize the goals of biotechnology research and development within legal and ethical protocols. o **CCTC Standard – HL-BRD.6:** Summarize and explain the larger ethical, moral and legal issues related to biotechnology research, product development and use in society.
NCAE Standard – BS.02: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.). • *Provides contextualized content standards related to:* o **CCTC Standard – HL-BRD.3:** Demonstrate basic knowledge of recombinant DNA, genetic engineering, bioprocessing, monoclonal antibody production, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics to conduct biotechnology research and development. o **CCTC Standard – HL-BRD.4:** Demonstrate the principles of solution preparation, sterile techniques, contamination control, and measurement and calibration of instruments used in biotechnology research.
NCAE Standard – BS.03: Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, etc.). • *Provides contextualized content standards related to:* o **CCTC Standard – HL-BRD.2 -** Apply the fundamentals of biochemistry, cell biology, genetics, mathematical concepts, microbiology, molecular biology, organic chemistry and statistics to conduct effective biotechnology research and development of products. o **CCTC Standard – HL-BRD.5:** Determine processes for product design and production and how that work contributes to an understanding of the biotechnology product development process.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of media related to plant growth, see Plant Systems PS.01.
For additional content frameworks on the topic of genetics, see Animal Systems AS.04.
For additional content frameworkson the topic of microorganisms, see Environmental Service Systems ESS.03.

BS.01. NCAE Standard: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).		
BS.01.01. Performance Indicator: Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.01.01.01.a. Research and summarize the evolution of biotechnology in agriculture.	**BS.01.01.01.b.** Analyze the developmental progression of biotechnology and the evolution of scientific knowledge.	**BS.01.01.01.c.** Evaluate and explain how scientists use the practices of science and engineering to build upon previous findings in current and emerging biotechnology research.
BS.01.01.02.a. Examine and categorize current applications and gains achieved in applying biotechnology to agriculture.	**BS.01.01.02.b.** Assess and summarize current work in biotechnology being done to add value to agricultural and society.	**BS.01.01.02.c.** Evaluate the outcomes and impacts of biotechnology on the globalization of agriculture.
BS.01.01.03.a. Distinguish between current and emerging applications of biotechnology in agriculture.	**BS.01.01.03.b.** Analyze and document emerging problems and issues associated with agricultural biotechnology.	**BS.01.01.03.c.** Design a potential application of biotechnology to meet emerging agricultural and societal needs.
BS.01.01.04.a. Compare and contrast the benefits and risks of biotechnology compared with alternative approaches to improving agriculture.	**BS.01.01.04.b.** Assess the benefits and risks associated with using biotechnology to improve agriculture.	**BS.01.01.04.c.** Evaluate the short-term and long-term benefits and risks of applying biotechnology to agriculture.
BS.01.02. Performance Indicator: Evaluate the scope and implications of regulatory agencies on applications of biotechnology in agriculture and protection of public interests (e.g., health, safety, environmental issues, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.01.02.01.a. Compare and contrast differences between regulatory systems worldwide.	**BS.01.02.01.b.** Assess and summarize the role and scope of agencies that regulate biotechnology.	**BS.01.02.01.c.** Explain and critique a decision made by a major agency that regulates agricultural biotechnology.
BS.01.02.02.a. Research and document major regulatory issues related to biotechnology in agriculture.	**BS.01.02.02.b.** Analyze the impact major regulatory issues have on public acceptance of biotechnology in agriculture.	**BS.01.02.02.c.** Critique and propose a solution for a major regulatory issue pertaining to biotechnology in agriculture.
BS.01.02.03.a. Explain the relationship between regulatory agencies and the protection of public interests such as health, safety and the environment.	**BS.01.02.03.b.** Research and summarize factors and data that regulatory agencies use to evaluate the potential risks a new application of biotechnology may pose to health, safety and the environment.	**BS.01.02.03.c.** Evaluate data to determine if new technologies present a major regulatory issue to health, safety and/or the environment.

BS.01.03. Performance Indicator: Analyze the relationship and implications of bioethics, laws and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.01.03.01.a. Research and summarize the emergence, evolution and implications of bioethics associated with biotechnology in agriculture.	**BS.01.03.01.b.** Analyze the implications bioethics may have on future advancements in AFNR.	**BS.01.03.01.c.** Devise and support an argument for or against an ethical issue associated with biotechnology in agriculture.
BS.01.03.02.a. Research and summarize legal issues related to biotechnology in agriculture (e.g., protection of intellectual property through patents, copyright, trademarks, etc.).	**BS.01.03.02.b.** Determine the significance and impacts of legal issues related to biotechnology in agriculture.	**BS.01.03.02.c.** Propose a solution for a legal issue associated with biotechnology in agriculture.
BS.01.03.03.a. Research and summarize public perceptions of biotechnology in agriculture (e.g., social and cultural issues).	**BS.01.03.03.b.** Analyze the impact of public perceptions on the application of biotechnology in different AFNR systems.	**BS.01.03.03.c.** Design studies to examine public perceptions of scientifically-based arguments regarding biotechnology in agriculture and reflect on the reasons why the public may support or resist significant breakthroughs using biotechnology.
BS.02. NCAE Standard: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).		
BS.02.01. Performance Indicator: Read, document, evaluate and secure accurate laboratory records of experimental protocols, observations and results.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.02.01.01.a. Compare and contrast common record-keeping methods used in a laboratory (e.g., paper notebook, electronic notebook, etc.).	**BS.02.01.01.b.** Maintain and interpret laboratory records documented in a laboratory to ensure data accuracy and integrity (e.g., avoid bias, record any conflicts of interest, avoid misinterpreted results, etc.).	**BS.02.01.01.c.** Evaluate the strengths and weaknesses of using research documentation and propose improvements to ensure study reproduction and utility in future studies.

BS.02.01.02.a. Research and summarize the need for data and information security in a laboratory and demonstrate best practices.	**BS.02.01.02.b.** Assess when security procedures for data and information collected in a laboratory should be implemented.	**BS.02.01.02.c.** Devise a strategy for ensuring the security of data and information collected in a laboratory.
BS.02.01.03.a. Evaluate the role of bioinformatics in agriculture and summarize the types of databases that are available (e.g., genomic, transcriptomics, etc.).	**BS.02.01.03.b.** Analyze and document the security procedures for data collected using bioinformatics.	**BS.02.01.03.c.** Critique an application of bioinformatics to solve an agricultural issue and recommend procedures for keeping the information safe.
BS.02.02. Performance Indicator: Implement standard operating procedures for the proper maintenance, use and sterilization of equipment in a laboratory.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.02.02.01.a. Identify, interpret, and implement standard operating procedures for laboratory equipment.	**BS.02.02.01.b.** Develop a maintenance program for laboratory equipment based upon the standard operating procedures.	**BS.02.02.01.c.** Perform ongoing maintenance of laboratory equipment according to the standard operating procedures (e.g., calibration, testing, etc.).
BS.02.02.02.a. Categorize and identify laboratory equipment according to its purpose in scientific research.	**BS.02.02.02.b.** Manipulate basic laboratory equipment and measurement devices (e.g., water bath, electrophoresis equipment, micropipettes, laminar flow hood, etc.).	**BS.02.02.02.c.** Operate advanced laboratory equipment and measurement devices (e.g., thermal cycler, imaging system, etc.).
BS.02.02.03.a. Differentiate between sterilization techniques for equipment in a laboratory (e.g., media bottles vs. laminar flow hood, etc.).	**BS.02.02.03.b.** Create a plan for sterilizing equipment in a laboratory according to standard operating procedures.	**BS.02.02.03.c.** Perform sterilization techniques for equipment in a laboratory using standard operating procedures.
BS.02.03. Performance Indicator: Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.02.03.01.a. Classify and document basic aseptic techniques in the laboratory.	**BS.02.03.01.b.** Demonstrate advanced aseptic techniques in the laboratory (e.g., sterile work area, sterile handling, personal hygiene, etc.).	**BS.02.03.01.c.** Conduct assays and experiments under aseptic conditions.
BS.02.03.02.a. Examine and implement standard operating procedures for the use of biological materials according to directions and their classification (e.g., proper handling of bacteria or DNA before, during and after use).	**BS.02.03.02.b.** Analyze and select an appropriate standard operating procedure for working with biological materials based upon their classification.	**BS.02.03.02.c.** Create a standard operating procedure for a biological process.

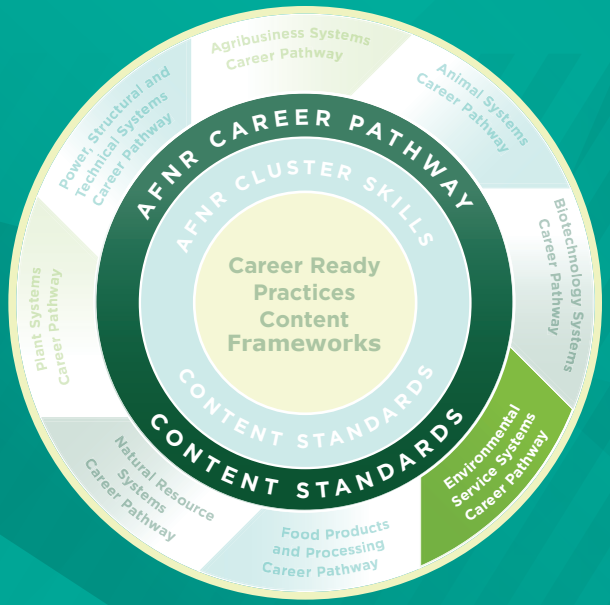
BS.02.03.03.a. Categorize and label the types of solutions that are commonly prepared in a laboratory (e.g., buffers, reagents, media, etc.).	**BS.02.03.03.b.** Formulate and prepare solutions using standard operating procedures (e.g., proper labeling, storage, etc.).	**BS.02.03.03.c.** Verify the physical properties of solutions (e.g., molarity, percent mass/volume, dilutions, etc.).
BS.02.04. Performance Indicator: Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.02.04.01.a. Classify different types of personal protective equipment and demonstrate how to properly utilize the equipment.	**BS.02.04.01.b.** Assess the need for personal protective equipment in a variety of situations and select the appropriate equipment to wear when working with biological and chemical materials.	**BS.02.04.01.c.** Evaluate the benefits and limitations of personal protective equipment.
BS.02.04.02.a. Classify and describe hazards associated with biological and chemical materials.	**BS.02.04.02.b.** Inventory biological and chemical materials and maintain accurate records of supplies and expiration dates.	**BS.02.04.02.c.** Create a plan for stocking and maintaining supplies of biological and chemical materials in a laboratory.
BS.02.04.03.a. Summarize what happens to waste after it leaves the laboratory and identify opportunities to reduce waste and unnecessary costs.	**BS.02.04.03.b.** Perform waste disposal according to the standard operating procedures.	**BS.02.04.03.c.** Propose a management plan to reduce laboratory waste and prevent ecological or health problems related to waste disposal.
BS.02.05. Performance Indicator: Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.02.05.01.a. Differentiate types of organisms and demonstrate safe handling to maintain organism purity and personal safety (e.g., plant and animal tissue, cell cultures, microbes, etc.).	**BS.02.05.01.b.** Characterize the physical and biological properties of organisms.	**BS.02.05.01.c.** Isolate, maintain, quantify and store cell cultures according to standard operating procedures.
BS.02.05.02.a. Compare and contrast the structures of DNA and RNA and investigate how genotype influences phenotype.	**BS.02.05.02.b.** Analyze and interpret the molecular basis for heredity and the tools and techniques used in DNA and RNA manipulations.	**BS.02.05.02.c.** Evaluate factors that influence gene expression.

BS.02.05.03.a. Extract and purify DNA and RNA according to standard operating procedures.	**BS.02.05.03.b.** Perform electrophoretic techniques and interpret electrophoresis fragmentation patterns (e.g., gel electrophoresis, southern blotting, etc.).	**BS.02.05.03.c.** Manipulate and analyze DNA and RNA through advanced scientific procedures (e.g., southern blotting, cloning, PCR, RT-PCR, etc.).
BS.02.05.04.a. Examine and document the role and applications of proteins in agricultural biotechnology.	**BS.02.05.04.b.** Demonstrate protein separation techniques and interpret the results.	**BS.02.05.04.c.** Evaluate the biochemical properties of proteins to explain their function and predict potential uses.
BS.02.05.05.a. Synthesize the relationship between proteins, enzymes and antibodies.	**BS.02.05.05.b.** Analyze and document how antibodies are formed and describe how they can be used in agricultural biotechnology.	**BS.02.05.05.c.** Use antibodies to detect and quantify antigens by conducting an Enzyme-Linked Immunosorbent Assay (ELISA).
BS.03. NCAE Standard: Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).		
BS.03.01. Performance Indicator: Apply biotechnology principles, techniques and processes to create transgenic species through genetic engineering.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.03.01.01.a. Summarize biological, social, agronomic and economic reasons for genetic modification of eukaryotes.	**BS.03.01.01.b.** Analyze and document the processes and describe the techniques used to produce transgenic eukaryotes (e.g., microbial synthetic biology, gene knockout therapy, traditional gene insertion, etc.).	**BS.03.01.01.c.** Design and conduct experiments to evaluate an existing transgenic eukaryote.
BS.03.01.02.a. Summarize the process of transformation of eukaryotic cells with transgenic DNA.	**BS.03.01.02.b.** Assess and argue the pros and cons of transgenic species in agriculture.	**BS.03.01.02.c.** Transform plant or animal cells by performing a cellular transformation.
BS.03.01.03.a. Analyze the benefits and risks associated with the use of biotechnology to increase productivity and improve quality of living species (e.g., plants, animals such as aquatic species, etc.).	**BS.03.01.03.b.** Research and evaluate genetic engineering procedures used in the production of living species.	**BS.03.01.03.c.** Conduct field or clinical trials for genetically modified species.
BS.03.01.04.a. Define and summarize epigenetics and synthesize the relationship between mutation, migration and evolution of transgenes in the environment.	**BS.03.01.04.b.** Analyze data to identify changes and patterns of transgenic species in the environment.	**BS.03.01.04.c.** Conduct studies to track the movement of transgenes in the environment.

BS.03.02. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance the production of food through the use of microorganisms and enzymes.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.03.02.01.a. Summarize reasons for detecting microbes and identify sources of microbes**.**	**BS.02.02.01.b.** Assess and describe the use of biotechnology to detect microbes.	**BS.02.02.01.c.** Design and perform an assay to detect a target microorganism in food, water or the environment.
BS.03.02.02.a. Examine enzymes, the changes they cause and the physical and chemical parameters that affect enzymatic reactions (e.g., food, cellulosic bioenergy, etc.).	**BS.03.02.02.b.** Analyze processes by which enzymes are produced through biotechnology.	**BS.03.02.02.c.** Conduct studies using scientific techniques to improve or discover enzymes for use in biotechnology (e.g., microbial strain selection).
BS.03.02.03.a. Identify and categorize foods produced through the use of biotechnology (e.g., fermentation, etc.) to change the chemical properties of food for an intended purpose (e.g., create desirable nutritional profile, preservation, flavor, etc.)	**BS.03.02.03.b.** Compare and contrast the effectiveness, purpose, and outcomes associated with biotechnology as well as conventional processes used in food processing.	**BS.03.02.03.c.** Process food using biotechnology to achieve an intended purpose (e.g., preservation, flavor enhancement, etc.).
BS.03.03. Performance Indicator: Apply biotechnology principles, techniques and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.03.03.01.a. Examine the consequences of agricultural practices on natural populations.	**BS.03.03.01.b.** Analyze how biotechnology can be used to monitor the effects of agricultural practices on natural populations.	**BS.03.03.01.c.** Evaluate the impact of modified organisms on the natural environment.
BS.03.03.02.a. Define and summarize industrial biotechnology and categorize the benefits and risks associated with its use in manufacturing (e.g., fabrics, plastics, etc.).	**BS.03.03.02.b.** Apply the processes used in the production of molecules for use in industrial applications.	**BS.03.03.02.c.** Monitor and evaluate processes used in the synthesis of a molecule.
BS.03.03.03.a. Research and summarize the potential applications of bioprospecting in biotechnology and agriculture.	**BS.03.03.03.b.** Assess and document the pros and cons of bioprospecting to achieve a research or product development objective.	**BS.03.03.03.c.** Propose opportunities to use bioprospecting after weighing the short-term and long-term impacts on the environment.

BS.03.04. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals, biodiversity, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.03.04.01.a. Research and describe the aims and techniques involved in selective plant-breeding process.	**BS.03.04.01.b.** Choose techniques and identify tools used to monitor and direct plant breeding.	**BS.03.04.01.c.** Perform plant-breeding techniques (e.g., plant tissue culture, etc.).
BS.03.04.02.a. Examine and classify biotechnology processes applicable to animal health (e.g., genetic testing, etc.).	**BS.03.04.02.b.** Assess the benefits, risks and opportunities associated with using biotechnology to promote animal health.	**BS.03.04.02.c.** Design animal-care protocols to ethically monitor and promote animal systems associated with biotechnology.
BS.03.04.03.a. Research and categorize the types of pharmaceuticals developed for animals and humans through biotechnology.	**BS.03.04.03.b.** Distinguish the difference between plant-based and animal-based pharmaceuticals and describe their role in agriculture.	**BS.03.04.03.c.** Evaluate the process used to produce pharmaceuticals from transgenic organisms (e.g., hormones for animals, etc.).
BS.03.04.04.a. Summarize the need for global biodiversity and applications of biotechnology to reduce threats to biodiversity.	**BS.03.04.04.b.** Assess whether current threats to biodiversity will have an unsustainable impact on human populations.	**BS.03.04.04.c.** Select and utilize techniques to measure biodiversity in a population.
BS.03.05. Performance Indicator: Apply biotechnology principles, techniques and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.03.05.01.a. Examine and synthesize the need for biofuels (e.g., cellulosic bioenergy, etc.).	**BS.03.05.01.b.** Analyze the impact of the production and use of biofuels on the environment.	**BS.03.05.01.c.** Evaluate and support how biofuels could solve a global issue (e.g., environmental, agricultural, etc.).
BS.03.05.02.a. Differentiate between biomass and sources of biomass.	**BS.03.05.02.b.** Assess the characteristics of biomass that make it useful for biofuels production.	**BS.03.05.02.c.** Conduct a review of the technologies used to create biofuels from biomass and weigh the pros and cons of each method.
BS.03.05.03.a. Research and explain the process of fermentation and its potential applications.	**BS.03.05.03.b.** Correlate the relationship between fermentation and the process used to produce alcohol from biomass.	**BS.03.05.03.c.** Produce alcohol and co-products from biomass.
BS.03.05.04.a. Define and summarize the process of transesterification and its potential applications.	**BS.03.05.04.b.** Analyze and document the process used to produce biodiesel from biomass.	**BS.03.05.04.c.** Produce biodiesel and co-products from biomass.

BS.03.05.05.a. Examine the process of methanogenesis and its potential applications.	**BS.03.05.05.b.** Analyze and describe the process used to produce methane from biomass.	**BS.03.05.05.c.** Produce methane and co-products from biomass.
BS.03.06. Performance Indicator: Apply biotechnology principles, techniques and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
BS.03.06.01.a. Compare and contrast the use of natural organisms and genetically-engineered organisms in the treatment of wastes.	**BS.03.06.01.b.** Analyze the process by which organisms are genetically engineered for waste treatment.	**BS.03.06.01.c.** Conduct studies to evaluate the treatment of a waste product using a genetically engineered organism.
BS.03.06.02.a. Summarize the purpose of microorganisms in biological waste management.	**BS.03.06.02.b.** Assess and describe the processes involved in biotreatment of biological wastes.	**BS.03.06.02.c.** Monitor and evaluate the treatment of biological wastes with microorganisms.
BS.03.06.03.a. Analyze the role of microorganisms in industrial chemical waste treatment.	**BS.03.06.03.b.** Evaluate and describe the processes involved in biotreatment of industrial chemical wastes.	**BS.03.06.03.c.** Monitor and review the treatment of industrial chemical wastes with microorganisms.
BS.03.06.04.a. Provide examples of instances in which bioremediation can be applied to clean up environmental contaminants.	**BS.03.06.04.b.** Analyze and summarize the risks and benefits of using biotechnology for bioremediation.	**BS.03.06.04.c.** Design a bioremediation project including plans to evaluate the effectiveness of the effort.



ENVIRONMENTAL SERVICE SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Environmental Service Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Environmental Service Systems (ESS) Career Pathway encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of environmental service systems in AFNR settings.

SAMPLE CAREERS: Environmental Conservationist, Waste Management Specialist, Water Quality Specialist, Environmental Sampling Specialist, Naturalist, Hazardous Material Handler, Hazardous Material Technician, Toxicologist, Solid Waste Manager

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the frameworks for Environmental Service Systems (AG-ESS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on energy, see Natural Resource Systems NRS.02 and NRS.03.
For additional content frameworks on precision technology, specifically Geographic Information Systems, see Natural Resource Systems NRS.03.
For additional content frameworks on precision technology, see Power, Structural and Technical Systems PST.05.

ESS.01. CCTC Framework: Use analytical procedures and instruments to manage environmental service systems.		
ESS.01.01. Performance Indicator: Analyze and interpret laboratory and field samples in environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.01.01.01.a. Identify sample types and sampling techniques used to collect laboratory and field data.	**ESS.01.01.01.b.** Determine the appropriate sampling techniques needed to generate data.	**ESS.01.01.01.c.** Collect and prepare sample measurements using appropriate data collection techniques.
ESS.01.01.02.a. Identify methods of statistical analysis commonly used in research (e.g., mean, standard deviation, standard error, error bars, etc.).	**ESS.01.01.02.b.** Summarize the purpose of statistical analysis methods commonly used in environmental service systems research and explain examples of their use in practice.	**ESS.01.01.02.c.** Utilize data analysis to identify trends in a data sample and assess the confidence that can be drawn from those conclusions.
ESS.01.02. Performance Indicator: Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.01.02.01.a. Identify basic laboratory equipment and explain their uses.	**ESS.01.02.01.b.** Demonstrate the proper use and maintenance of basic laboratory equipment.	**ESS.01.02.01.c.** Calibrate and use laboratory equipment according to standard operating procedures.
ESS.01.02.02.a. Identify basic environmental monitoring instruments and explain their uses.	**ESS.01.02.02.b.** Demonstrate the proper use and maintenance of environmental monitoring instruments.	**ESS.01.02.02.c.** Calibrate and use environmental monitoring instruments according to standard operating procedures.
ESS.02. CCTC Framework: Evaluate the impact of public policies and regulations on environmental service system operations.		
ESS.02.01. Performance Indicator: Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.02.01.01.a. Distinguish between the types of laws associated with environmental service systems.	**ESS.02.01.01.b.** Analyze the structure of laws associated with environmental service systems.	**ESS.02.01.01.c.** Evaluate the impact of laws associated with environmental service systems for their impact on wildlife, people, the environment and the economy.

ESS.02.01.02.a. Distinguish between the types of government agencies (i.e., local, state and federal) associated with environmental service systems.	**ESS.02.01.02.b.** Analyze the specific purpose of government agencies associated with environmental service systems.	**ESS.02.01.02.c.** Evaluate the impact and effectiveness of government agencies (i.e., local, state, and federal) associated with environmental service systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions, etc.).
ESS.02.01.03.a Research policies, practices and initiatives common in business and advocacy groups associated with environmental service systems (e.g., zero-waste, LEED-certified, locally-grown, etc.).	**ESS.02.01.03.b.** Assess the intent, feasibility and effectiveness of policies, practices and initiatives common in business and advocacy groups associated with environmental service systems.	**ESS.02.01.03.c.** Evaluate the impact of policies, practices and initiatives common in business and advocacy groups associated with environmental service systems on wildlife, people, the environment and the economy.
ESS.02.02. Performance Indicator: Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.02.02.01.a. Research and categorize the purpose, implementation and impact of greenhouse gas emission policies (e.g., cap-and-trade, emission offsetting, zero-emissions, carbon-neutrality, carbon sequestration, etc.).	**ESS.02.02.01.b.** Assess the effectiveness and impact of greenhouse gas emissions policies.	**ESS.02.02.01.c.** Devise new policies for controlling greenhouse gas emissions that reduce atmospheric carbon levels while generating additional economic activity.
ESS.02.02.02.a. Research the impact of environmental service systems regulations on international trade.	**ESS.02.02.02.b.** Analyze how environmental service systems regulations can both negatively and positively affect international trade.	**ESS.02.02.02.c.** Interpret and evaluate the impact of specific environmental service regulation policies (e.g., Clean Air Act, EISA, Clean Water Act, Superfund, etc.) on international trade.
ESS.02.02.03.a. Examine and summarize the impact that population growth has on environmental service systems.	**ESS.02.02.03.b.** Analyze the correlation between increased population size and the need for regulation of environmental service systems.	**ESS.02.02.03.c.** Predict the impact of future population growth on the regulation of environmental service systems and evaluate how changes made today will impact future regulations.
ESS.02.02.04.a. Research current policies related to fracking and shale oil gas.	**ESS.02.02.04.b.** Assess whether current policies related to fracking and shale oil gas sufficiently address the needs of environmental service systems.	**ESS.02.02.04.c.** Evaluate current fracking policies and create suggestions for modification of these policies to more thoroughly address the needs related to environmental, economic and social sustainability.

ESS.02.03. Performance Indicator: Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.02.03.01.a. Research and summarize how the perception and regulation of environmental service systems has changed over time.	**ESS.02.03.01.b.** Analyze and summarize specific changes to perceptions and regulations of environmental service systems and their impact on reducing the ecological, economical and sociological impact.	**ESS.02.03.01.c.** Evaluate the impact of specific historical figures, or organizations, on the perception and regulation of environmental service systems.
ESS.02.03.02.a. Examine how social views and movements (e.g., zero-waste philosophy, carbon footprints, recycling, etc.) have affected the implementation and need for regulation of environmental service systems.	**ESS.02.03.02.b.** Assess the effectiveness of specific social movements related to regulation of environmental service systems.	**ESS.02.03.02.c.** Research current issues related to modern or future environmental service systems and devise strategies for engaging the public to address these issues through social movements.
ESS.03. CCTC Framework: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.		
ESS.03.01. Performance Indicator: Apply meteorology principles to environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.03.01.01.a. Distinguish between the different components and structural layers of the earth's atmosphere.	**ESS.03.01.01.b.** Differentiate how components of the atmosphere (e.g., weather systems and patterns, structure of the atmosphere, etc.) affect environmental service systems.	**ESS.03.01.01.c.** Utilize meteorological data to assess the impact of atmospheric conditions on environmental service systems.
ESS.03.01.02.a. Analyze how meteorological conditions influence air quality.	**ESS.03.01.02.b.** Analyze and articulate the relationship between meteorological conditions, air quality and air pollutants.	**ESS.03.01.02.c.** Interpret data measuring air pollution to determine its threat on human populations and ecological interactions.
ESS.03.01.03.a. Research climate change and summarize evidence that climate change is occurring.	**ESS.03.01.03.b.** Assess the environmental, economic and social consequences of climate change	**ESS.03.01.03.c.** Evaluate the predicted impacts of global climate change on environmental service systems.
ESS.03.01.04.a. Examine and summarize factors that affect the earth's balance of energy.	**ESS.03.01.04.b.** Analyze the basics of the greenhouse effect and describe how the greenhouse effect alters the earth's balance of energy.	**ESS.03.01.04.c.** Utilize data to predict and forecast future levels of greenhouse gas pollution and outline steps necessary to mitigate the resulting damage.

ESS.03.02. Performance Indicator: Apply soil science and hydrology principles to environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.03.02.01.a. Differentiate and distinguish land uses, capability factors and land capability classes.	**ESS.03.02.01.b.** Use a soil survey to determine the land capability classes for different parcels of land in an area.	**ESS.03.02.01.c.** Design a master land-use management plan for a given area that utilizes land capability classes in order to minimize erosion and flooding, maximize development and preservation of topsoil, et cetera.
ESS.03.02.02.a. Research and describe the process of soil formation through weathering.	**ESS.03.02.02.b.** Differentiate rock types and relate the chemical composition of mineral matter in soils to the parent material.	**ESS.03.02.02.c.** Evaluate the soil composition in order to predict the impact of that soil on environmental service systems.
ESS.03.02.03.a. Examine and explain how the physical qualities of the soil influence the infiltration and percolation of water.	**ESS.03.02.03.b.** Assess the physical qualities of the soil that determine its potential for filtration of groundwater supplies and likelihood for flooding.	**ESS.03.02.03.c.** Conduct tests of soil to determine its potential for filtration of groundwater supplies and likelihood for flooding.
ESS.03.02.04.a. Summarize environmental hazards associated with groundwater supplies.	**ESS.03.02.04.b.** Assess the effectiveness of precautions taken to prevent or reduce contamination of groundwater supplies.	**ESS.03.02.04.c.** Evaluate the methods used in a given example to protect groundwater supplies.
ESS.03.02.05.a. Research and summarize hydrogeology and differentiate between groundwater and surface water.	**ESS.03.02.05.b.** Analyze how interactions between groundwater and surface water affect flow and availability of water.	**ESS.03.02.05.c.** Construct explanations and solutions to situations involving the declining availability of water that incorporate groundwater flow equations as well as human activity.
ESS.03.02.06.a. Research and describe how groundwater and surface water interactions affect the existence of wetlands.	**ESS.03.02.06.b.** Analyze the importance of the roles played by wetlands in regards to water availability, prevention of flooding and other factors.	**ESS.03.02.06.c.** Evaluate and select strategies for wetlands preservation and restoration that maximize services provided by wetlands while taking human concerns into consideration.
ESS.03.03. Performance Indicator: Apply chemistry principles to environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.03.03.01.a. Examine and summarize how chemistry affects soil structure and function (e.g., pH, cation-exchange capacity, filtration capability, flooding likelihood, etc.).	**ESS.03.03.01.b.** Analyze the soil chemistry of a sample.	**ESS.03.03.01.c.** Evaluate a sample's soil chemistry and assess how the results may impact considerations in environmental service systems.
ESS.03.03.02.a. Examine and summarize how chemistry affects water quality and function (e.g., oxygen saturation, pH, biomagnification, etc.).	**ESS.03.03.02.b.** Analyze the water chemistry of a sample.	**ESS.03.03.02.c.** Evaluate a sample's water chemistry and assess how the results may impact considerations in environmental service systems.

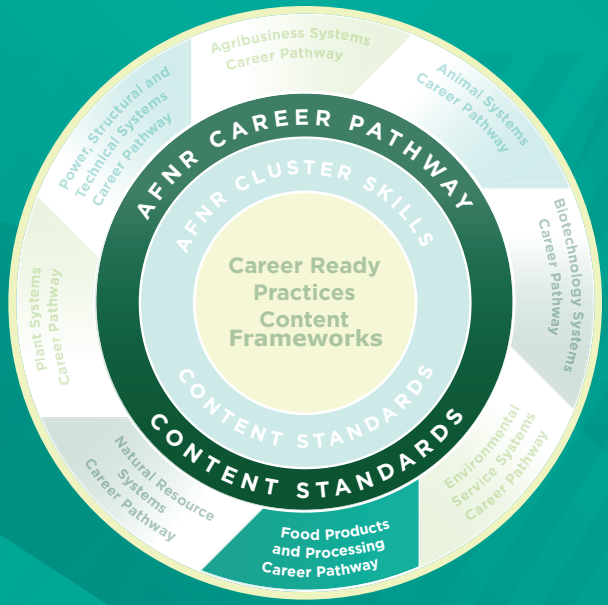
ESS.03.03.03.a. Examine and summarize how chemistry affects air quality and function (e.g., heat retention, formation of smog and acid rain, etc.).	**ESS.03.03.03.b.** Analyze how components of atmospheric chemistry (e.g., air chemical components, heat, moisture, etc.) affect air quality.	**ESS.03.03.03.c.** Assess the impact of atmospheric chemistry on operational decisions in environmental service systems.
ESS.03.03.04.a. Examine and summarize the relationship between water and soil chemistry and the formation of different kinds of wetlands (e.g., fens, peat bogs, potholes, etc.).	**ESS.03.03.04.b.** Assess how different kinds of wetlands are formed based on the different kinds of soil and water chemistry present in each case.	**ESS.03.03.04.c.** Evaluate the services provided by types of wetlands and predict how different types of wetlands respond to pressures due to human activity.
ESS.03.04. Performance Indicator: Apply microbiology principles to environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.03.04.01.a. Describe the microbial biodiversity found in soil and summarize the contribution of microbial biodiversity to the physical and chemical characteristics of soil.	**ESS.03.04.01.b.** Assess how the activities of microorganisms in soil affect environmental service systems and ecosystem biodiversity.	**ESS.03.04.01.c.** Evaluate how soil microorganisms in environmental service systems can be used to minimize waste, maximize nutrient cycling and increase ecosystem biodiversity.
ESS.03.04.02.a. Research and describe how microbial populations in an ecosystem affect carbon cycling.	**ESS.03.04.02.b.** Analyze the microbial populations present in an area and assess how carbon cycling is affected.	**ESS.03.04.02.c.** Develop strategies for negating air pollutants based on soil microbial populations (e.g., carbon sequestration and rates of decomposition).
ESS.03.04.03.a. Examine and explain the role that microbes play in wastewater treatment.	**ESS.03.04.03.b.** Assess the impact of wastewater treatment on environmental service systems.	**ESS.03.04.03.c.** Evaluate modern uses of microbial waste water treatment and devise strategies to further reduce the environmental, economic and social impact of wastewater treatment.
ESS.03.04.04.a. Research the purposes of bioassay tests and describe potential applications for environmental service systems.	**ESS.03.04.04.b.** Analyze procedures for a bioassay test.	**ESS.03.04.04.c.** Conduct bioassay tests related to environmental service systems and interpret results.
ESS.03.05. Performance Indicator: Apply ecology principles to environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.03.05.01.a. Research the role that biodiversity plays in environmental service systems and how biodiversity can be measured.	**ESS.03.05.01.b.** Calculate the amount of biodiversity in a given area using an appropriate method (e.g., quadrat assessment, transect measurements, etc.).	**ESS.03.05.01.c.** Evaluate the biodiversity of an area and predict the impact of changing the levels of biodiversity on environmental service systems.
ESS.03.05.02.a. Examine and explain the role played by habitats on environmental service systems.	**ESS.03.05.02.b.** Assess the impact of the current rate of habitat loss on environmental service systems.	**ESS.03.05.02.c.** Evaluate the importance of habitat to environmental service systems and devise strategies to minimize the future loss of habitats.

ESS.03.05.03.a. Research and explain how carrying capacities relate to environmental service systems (e.g., waste processing, rate or production of pollution, disease, etc.).	**ESS.03.05.03.b.** Assess and describe the impact of a population exceeding its carrying capacity on environmental service systems.	**ESS.03.05.03.c.** Devise a strategy for monitoring and supporting environmental service systems through management of a species' carrying capacity.
ESS.03.05.04.a. Examine and describe how ecological interactions can be used to assess environmental service systems (i.e., macroinvertebrates and/or amphibians as bioindicators).	**ESS.03.05.04.b.** Evaluate the benefits and drawbacks of using bioindicator species in environmental service systems.	**ESS.03.05.04.c.** Utilize evidence from bioindicator species to detect pollutants in a given area.
ESS.04. CCTC Framework: Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).		
ESS.04.01. Performance Indicator: Use pollution control measures to maintain a safe facility and environment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.04.01.01.a. Identify and distinguish types of pollution and distinguish between point source and nonpoint source pollution.	**ESS.04.01.01.b.** Assess how industrial and nonindustrial pollution has damaged the environment.	**ESS.04.01.01.c.** Evaluate evidence for a given area for industrial and nonindustrial pollution.
ESS.04.01.02.a. Research ways in which pollution can be managed and prevented and propose solutions to meet the needs of local systems.	**ESS.04.01.02.b.** Conduct tests to determine the presence and extent of pollution.	**ESS.04.01.02.c.** Create a plan for pollution remediation, management or prevention for a given area.
ESS.04.01.03.a. Interpret the conditions necessary for waste to be labeled as hazardous.	**ESS.04.01.03.b.** Classify examples of pollution as hazardous or nonhazardous.	**ESS.04.01.03.c.** Construct a plan for handling hazardous waste in given situations.
ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste in environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.04.02.01.a. Compare and contrast different types of solid waste and options for treating solid waste.	**ESS.04.02.01.b.** Analyze environmental hazards created by different types of solid waste, solid waste accumulation and solid waste disposal.	**ESS.04.02.01.c.** Develop a plan for solid waste disposal for a given situation that considers the environmental hazards, economic realities and social concerns associated with this task.
ESS.04.02.02.a. Examine and describe the components of disposing waste in sanitary landfills.	**ESS.04.02.02.b.** Analyze and document basic sanitary landfill operating procedures and design.	**ESS.04.02.02.c.** Evaluate sanitary landfill procedures for environmental, economic and social sustainability.
ESS.04.02.03.a. Research and summarize the benefits and processes of composting.	**ESS.04.02.03.b.** Apply scientific principles to explain the benefits and processes of composting.	**ESS.04.02.03.c.** Evaluate the appropriateness of composting methods in different situations.
ESS.04.02.04.a. Examine and describe the importance and potential impact of recycling.	**ESS.04.02.04.b.** Analyze and document different recycling methods and classify materials that can be recycled.	**ESS.04.02.04.c.** Survey and evaluate recycling programs and procedures.

ESS.04.03. Performance Indicator: Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.04.03.01.a. Categorize chemical and physical properties of drinking water.	**ESS.04.03.01.b.** Analyze and document all steps in the public drinking water treatment process according to applicable standards.	**ESS.04.03.01.c.** Evaluate samples of water and the processes necessary to verify that the samples are safe for consumption according to applicable standards.
ESS.04.03.02.a. Research methods commonly used to treat wastewater and septic waste.	**ESS.04.03.02.b.** Analyze and document the steps necessary to ensure that wastewater and septic waste can be safely released into the environment.	**ESS.04.03.02.c.** Evaluate examples of wastewater and/or septic waste for its potential to cause environmental, economic and/or social problems.
ESS.04.04. Performance Indicator: Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.04.04.01.a. Research conventional energy sources and list conservation measures to reduce the impact on environmental service systems.	**ESS.04.04.01.b.** Assess the advantages and disadvantages of conventional energy sources in regards to environmental service systems.	**ESS.04.04.01.c.** Evaluate the impact burning of fossil fuels has on environmental service systems.
ESS.04.04.02.a. Research alternative energy sources and describe the motivations for seeking alternatives to conventional energy sources as they relate to environmental monitoring.	**ESS.04.04.02.b.** Identify advantages and disadvantages of alternative energy sources as they pertain to environmental service systems.	**ESS.04.04.02.c.** Evaluate the impact alternative energy sources have on environmental conditions.
ESS.04.04.03.a. Examine the factors that affect energy consumption and describe how these factors are related to environmental monitoring.	**ESS.04.04.03.b.** Analyze and document the main categories of energy consumption.	**ESS.04.04.03.c.** Evaluate strategies for reducing energy consumption to determine the most effective course of action based on the needs of environmental service systems.
ESS.04.04.04.a. Research the impact on environmental service systems that occur because of energy consumption.	**ESS.04.04.04.b.** Analyze and document the most significant impacts that energy consumption has on environmental monitoring.	**ESS.04.04.04.c.** Devise a strategy for improving future energy consumption in a manner consistent with the intents of environmental service systems.
ESS.04.04.05.a. Examine and explain how energy consumption and the carbon cycle relate to environmental monitoring.	**ESS.04.04.05.b.** Calculate the impact of the carbon cycle imbalance (due to energy consumption) and assess how this imbalance affects environmental service systems.	**ESS.04.04.05.c.** Use data from environmental monitoring to evaluate methods for reducing the imbalance in the carbon cycle through changes to energy consumption.

ESS.04.04.06.a. Research and describe the purpose and applications of life cycle assessments to environmental service systems.	**ESS.04.04.06.b.** Interpret a life cycle assessment and explain how it can be utilized in environmental service systems to assess the potential ecological impact of an energy source.	**ESS.04.04.06.c.** Conduct a life cycle assessment for a given source of energy and use this assessment to determine the best option for energy in regards to environmental service systems.
ESS.05. CCTC Framework: Use tools, equipment, machinery and technology common to tasks in environmental service systems.		
ESS.05.01. Performance Indicator: Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.05.01.01.a. Examine the importance and describe applications of surveying and mapping for environmental service systems.	**ESS.05.01.01.b.** Apply surveying and mapping principles to a situation involving environmental service systems and identify and explain the use of equipment for surveying and mapping.	**ESS.05.01.01.c.** Demonstrate surveying and cartographic skills to make site measurements in order to address concerns and needs within an environmental service systems situation.
ESS.05.01.02.a. Research the methods in which GIS can be used in environmental service systems (e.g., tracing of point pollution, control of the spread of invasive species, etc.).	**ESS.05.01.02.b.** Apply GIS skills to a situation specific to environmental service systems.	**ESS.05.01.02.c.** Interpret and evaluate GIS data to come to a conclusion about a scenario specific to environmental service systems.
ESS.05.01.03.a. Research how advancements in technology (e.g., unmanned aerial vehicles and drones, genetic modification, fracking, alternative energy, etc.) have changed environmental service systems.	**ESS.05.01.03.b.** Analyze and document examples of utilization of breaking technology in environmental service systems.	**ESS.05.01.03.c.** Evaluate trends in technology and develop predictions about how these advancements will change environmental service systems.
ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
ESS.05.02.01.a. Research and summarize methods used to determine water quality (e.g., dissolved oxygen, chemical tests, macroinvertebrates, etc.) and determine if a source of water has been contaminated.	**ESS.05.02.01.b.** Assess different measurements of water quality to determine their effectiveness and limitations.	**ESS.05.02.01.c.** Evaluate a sample of water to determine its quality and if it has been contaminated.
ESS.05.02.02.a. Research and summarize methods and tools used to measure soil health and determine if an area of land has been contaminated (e.g., soil probes, core monolith, soil fertility tests, etc.).	**ESS.05.02.02.b.** Assess different measurements of soil quality (e.g., soil horizons, soil texture, organic matter, soil respiration, etc.) to determine their effectiveness and limitations.	**ESS.05.02.02.c.** Evaluate a sample of soil to determine its quality and if it has been contaminated.

ESS.05.02.03.a. Research and summarize methods and tools used to determine air quality and determine if pollution is present (e.g., CO_2 probe, particulate matter sampler, etc.).	**ESS.05.02.03.b.** Assess different measurements of air quality (e.g., ozone, carbon monoxide, particulate matter, etc.) to determine their effectiveness and limitations.	**ESS.05.02.03.c.** Perform an evaluation of air quality to determine and assess its impact of human and ecological populations.
ESS.05.02.04.a. Research and summarize methods used to determine ecological health and determine if an ecosystem is threatened (e.g., quadrat analysis, bioindicators, mark-recapture, etc.).	**ESS.05.02.04.b.** Assess different measurements of assessing ecological health (e.g., quadrat biodiversity assessments, transect surveys, population counts, detection of disease and invasive species, etc.) to determine their effectiveness and limitations.	**ESS.05.02.04.c.** Evaluate a habitat to determine its ecological quality and if it is threatened.



FOOD PRODUCTS AND PROCESSING SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Food Products and Processing Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Food Products and Processing Systems (FPP) Career Pathway encompasses the study of food safety and sanitation; nutrition, biology, microbiology, chemistry and human behavior in local and global food systems; food selection and processing for storage, distribution and consumption; and the historical and current development of the food industry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of food products and processing systems in AFNR settings.

SAMPLE CAREERS: Food Scientist, Meat Processor, Biochemist, Food Inspector, Meat Grader, Microbiologist, Quality Control Specialist, Nutritionist

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for Food Products and Processing Systems (AG-FPP) from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of animal product and species identification, see Animal Systems AS.01.
For additional content frameworks on the topic of using biotechnology to enhance the production of food, see Biotechnology Systems BS.02.
For additional content frameworks on the topic of the applications of biotechnology to improve food products, see Biotechnology Systems BS.03.
For additional content frameworks on the topic of employability skills, see Career Ready Practices CRP.01.

FPP.01. CCTC Framework: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.		
FPP.01.01. Performance Indicator: Analyze and manage operational and safety procedures in food products and processing facilities.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.01.01.01.a. Research and summarize the purposes and objectives of safety programs in food products and processing facilities (e.g., Sanitation Standard Operating Procedures (SSOP); Good Manufacturing Practices (GMP); worker safety, etc.).	**FPP.01.01.01.b.** Analyze and document attributes and procedures of current safety programs in food products and processing facilities.	**FPP.01.01.01.c.** Construct plans that ensure implementation of safety programs for food products and processing facilities.
FPP.01.01.02.a. Research and categorize types of equipment used in food products and processing systems.	**FPP.01.01.02.b.** Assess specifications and maintenance needs for equipment and facilities used in food products and processing systems (e.g., specifications for machines, sanitation procedures, repair protocol, etc.).	**FPP.01.01.02.c.** Devise and implement strategies to maintain equipment and facilities for food products and processing systems.
FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.01.02.01.a. Examine and identify contamination hazards associated with food products and processing (e.g., physical, chemical and biological).	**FPP.01.02.01.b.** Outline procedures to eliminate possible contamination hazards associated with food products and processing.	**FPP.01.02.01.c.** Identify sources of contamination in food products and/or processing facilities and develop ways to eliminate contamination.
FPP.01.02.02.a. Research and summarize procedures of safe handling protocols (e.g., Hazard Analysis and Critical Control Points Plan (HACCP); Critical Control Point procedures (CCP); Good Agricultural Practices Plan (GAP), etc.).	**FPP.01.02.02.b.** Construct plans that ensure implementation of safe handling procedures on food products.	**FPP.01.02.02.c.** Examine, interpret and report outcomes from safe handling procedures and results from quality assurance tests.
FPP.01.02.03.a. Research and summarize the purposes and objectives of quality assurance tests on food products (e.g., produce safety regulation, safe food transport, food contaminants, etc.).	**FPP.01.02.03.b.** Design and construct experiments for quality assurance tests on food products.	**FPP.01.02.03.c.** Interpret and evaluate results of quality assurance tests on food products and examine steps to implement corrective procedures.
FPP.01.02.04.a. Describe the effects food-borne pathogens have on food products and humans.	**FPP.01.02.04.b.** Explain, document and execute the procedures of microbiological tests used to detect food-borne pathogens.	**FPP.01.02.04.c.** Conduct and interpret microbiological tests for food-borne pathogens.

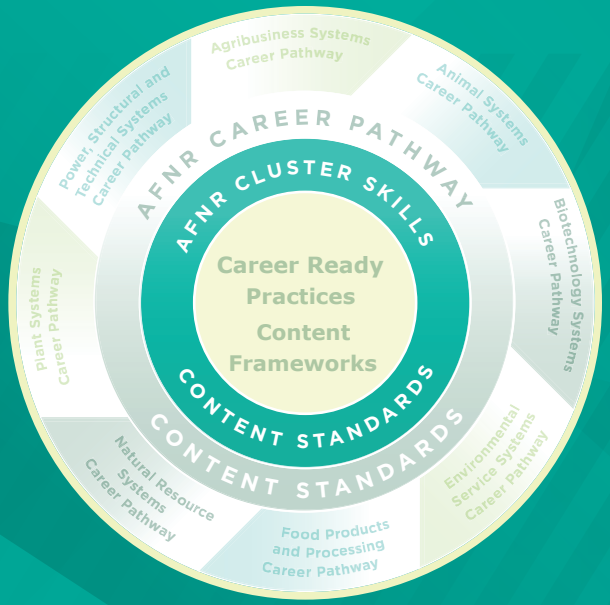
FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.01.03.01.a. Identify and summarize purposes of food storage procedures (e.g., first in/first out, temperature regulation, monitoring, etc.).	**FPP.01.03.01.b.** Analyze characteristics of food products and determine appropriate storage procedures.	**FPP.01.03.01.c.** Prepare plans that ensure implementation of proper food storage procedures.
FPP.01.03.02.a. Research and describe different electronic and paper-based documentation methods used to meet food safety and quality goals in food products and processing systems.	**FPP.01.03.02.b.** Demonstrate and explain methods of documentation procedures within food products and processing systems.	**FPP.01.03.02.c.** Implement and evaluate the effectiveness of a documentation procedure used within a food products and processing facility and recommend improvements.
FPP.02. CCTC Framework: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.		
FPP.02.01. Performance Indicator: Apply principles of nutrition and biology to develop food products that provide a safe, wholesome and nutritious food supply for local and global food systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.02.01.01.a. Research and summarize properties of common food constituents (e.g., proteins, carbohydrates, fats, vitamins, minerals).	**FPP.02.01.01.b.** Compare and contrast the relative value of food constituents relative to food product qualities (e.g., taste, appearance, etc.).	**FPP.02.01.01.c.** Analyze the properties of food products to identify food constituents and evaluate nutritional value.
FPP.02.01.02.a. Research and report methods of nutritional planning to meet essential needs for the human diet (e.g., MyPlate).	**FPP.02.01.02.b.** Compare and contrast the nutritional needs of different human diets.	**FPP.02.01.02.c.** Construct methods to design a healthy daily food guide for a variety of nutritional needs.
FPP.02.02. Performance Indicator: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.02.02.01.a. Examine and describe the basic chemical makeup of different types of food.	**FPP.02.02.01.b.** Explain how the chemical and physical properties of foods influence nutritional value and eating quality.	**FPP.02.02.01.c.** Design and conduct experiments to determine the chemical and physical properties of food products.
FPP.02.02.02.a. Identify common food additives and identify their properties (e.g., preservatives, antioxidants, buffers, stabilizers, colors, flavors, etc.).	**FPP.02.02.02.b.** Describe the purpose of common food additives and how they influence the chemistry of food.	**FPP.02.02.02.c.** Devise and apply strategies to determine what additives are utilized and why they are included in a variety of food products.

FPP.02.02.03.a. Research and summarize the application of biochemistry in the development of new food products (e.g., value added food products, genetically engineered food products, etc.).	**FPP.02.02.03.b.** Analyze how food products and processing facilities use biochemistry concepts to develop new food products.	**FPP.02.02.03.c.** Develop and implement plans to engineer new food items using biochemistry concepts.
FPP.02.03. Performance Indicator: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.02.03.01.a. Examine and explain the importance of food labeling to the consumer.	**FPP.02.03.01.b.** Examine, interpret and explain the meaning of required components on a food label.	**FPP.02.03.01.c.** Determine a strategy to prepare and label foods according to the established standards of regulatory agencies.
FPP.02.03.02.a. Research and summarize relevant factors in planning and developing a new food product (e.g., regulation, creativity, economics, etc.).	**FPP.02.03.02.b.** Determine consumer preference and market potential for a new food product using a variety of methods (e.g., double-blind testing, etc.).	**FPP.02.03.02.c.** Design new food products that meet a variety of goals (e.g., consumer preferences, market, nutritional needs, regulatory requirements, etc.).
FPP.03. CCTC Framework: Select and process food products for storage, distribution and consumption.		
FPP.03.01. Performance Indicator: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.03.01.01.a. Summarize characteristics of quality and yield grades of food products.	**FPP.03.01.01.b.** Analyze factors that affect quality and yield grades of food products.	**FPP.03.01.01.c.** Outline procedures to assign quality and yield grades to food products according to industry standards.
FPP.03.01.02.a. Summarize procedures to select raw food products based on yield grades and quality grades.	**FPP.03.01.02.b.** Assemble procedures to perform quality-control inspections of raw food products for processing.	**FPP.03.01.02.c.** Develop, apply and evaluate care and handling procedures to maintain original food quality and yield.
FPP.03.01.03.a. Identify and describe protocols for inspection and harvesting techniques for animal food products (e.g., pre-mortem and post-mortem inspections, Food Safety Inspection Service guidelines (FSIS), etc.).	**FPP.03.01.03.b.** Examine and evaluate inspection and harvesting of animals using regulatory agency approved or industry-approved techniques.	**FPP.03.01.03.c.** Examine and respond to consumer concerns about the inspection and harvesting techniques of animals using accurate information based on regulatory agency approved or industry-approved techniques.
FPP.03.01.04.a. Identify and describe foods derived from different classifications of food products (e.g., meat, egg, poultry, fish, dairy, fruits, vegetables, grains, legumes, oilseeds, etc.).	**FPP.03.01.04.b.** Examine and summarize desirable qualities of food products derived from different classifications of food products.	**FPP.03.01.04.c.** Evaluate and grade food products from different classifications of food products.

FPP.03.02. Performance Indicator: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.03.02.01.a. Identify and explain English and metric measurements used in the food products and processing industry.	**FPP.03.02.01.b.** Compare weights and measurements of products and perform conversions between units of measure.	**FPP.03.02.01.c.** Design plans to formulate and package food products using a variety of weights and measures.
FPP.03.02.02.a. Differentiate between methods and materials used for processing food for different markets (e.g., fresh food products, ready to eat food products, etc.).	**FPP.03.02.02.b.** Outline appropriate methods and prepare foods for sale and distribution for different markets.	**FPP.03.02.02.c.** Evaluate food quality factors on foods prepared for different markets (e.g., shelf life, shrinkage, appearance, weight, etc.).
FPP.03.02.03.a. Identify methods of food preservation and give examples of foods preserved by each method.	**FPP.03.02.03.b.** Analyze and document food preservation processes and methods on a variety of food products.	**FPP.03.02.03.c.** Devise and apply strategies to preserve different foods using various methods and techniques.
FPP.03.02.04.a. Summarize types of materials and methods used in food packaging and presentation.	**FPP.03.02.04.b.** Analyze the degree of desirable food qualities of foods stored in various packaging.	**FPP.03.02.04.c.** Construct and implement methods of selecting packaging materials to store a variety of food products.
FPP.03.03. Performance Indicator: Create food distribution plans and procedures to ensure safe delivery of food products.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.03.03.01.a. Assess and describe the environmental impact of distributing food locally and globally.	**FPP.03.03.01.b.** Research and document ways to reduce environmental impact from food distribution activities.	**FPP.03.03.01.c.** Devise and defend a strategy to determine ways for food distribution to reduce environmental impacts.
FPP.03.03.02.a. Examine the various paths food products take to get from food processing centers to consumers.	**FPP.03.03.02.b.** Interpret safety procedures used in food distribution to ensure a safe product is being delivered to consumers.	**FPP.03.03.02.c.** Make recommendations to improve safety procedures used in food distribution scenarios to ensure a safe product is being delivered to consumers.
FPP.03.03.03.a. Research and summarize different types of market demands for food products (e.g., local food, organic, non-GMO, etc.).	**FPP.03.03.03.b.** Assess and explain how market demand for food products influences the distribution of food products.	**FPP.03.03.03.c.** Propose distribution plans for food products that meet specific market demands.

FPP.04. CCTC Framework: Explain the scope of the food industry and the historical and current developments of food product and processing.		
FPP.04.01. Performance Indicator: Examine the scope of the food industry by evaluating local and global policies, trends and customs for food production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.04.01.01.a. Research and summarize examples of policy and legislation that affect food products and processing systems in the United States and around the world (e.g., labeling, GMOs, biosecurity, food system policy, dietary guidelines, etc.).	**FPP.04.01.01.b.** Analyze the similarities and differences amongst policies and legislation that affect the food products and processing system in the U.S. or around the world.	**FPP.04.01.01.c.** Articulate and defend a personal point of view on policies and legislation that affect the food products and processing system in the U.S. or around the world.
FPP.04.01.02.a. Examine the impact of consumer trends on food products and processing practices (e.g., health and nutrition, organic, information about food products, local food movements, farm-to-fork supply chains, food system transparency, etc.).	**FPP.04.01.02.b.** Construct and implement methods to obtain data on food consumer trends in a specific market.	**FPP.04.01.02.c.** Devise and implement a strategy to create food products that meet a specific consumer trend in a specific market.
FPP.04.01.03.a. Compare and contrast cultural differences regarding food products and processing practices.	**FPP.04.01.03.b.** Analyze food production and distribution outcomes based on cultural customs.	**FPP.04.01.03.c.** Propose and implement culturally sensitive food processing and distribution practices.
FPP.04.02. Performance Indicator: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.04.02.01.a. Describe and explain the components of the food products and processing industry (e.g., processing, distribution, byproducts, etc.).	**FPP.04.02.01.b.** Analyze and document significant changes and trends in the food products and processing industry.	**FPP.04.02.01.c.** Predict and defend upcoming changes and trends in the food products and processing industry.
FPP.04.02.02.a. Identify and explain environmental and safety concerns about the food supply.	**FPP.04.02.02.b.** Research and summarize current issues related to the safety and environmental concerns about foods and food processing (e.g., GMOs, irradiation, microorganisms, contamination, etc.).	**FPP.04.02.02.c.** Examine and respond to consumer concerns about the environment and safety of the food supply using accurate information regarding food products and processing systems and practices.
FPP.04.02.03.a. Research and describe current and emerging technologies related to food products and processing (e.g., high pressure processing of foods, automation, biotechnology, etc.).	**FPP.04.02.03.b.** Evaluate desirable and undesirable outcomes of emerging technologies used in the food products and processing systems.	**FPP.04.02.03.c.** Research and evaluate the feasibility of implementing a current or emerging technology to improve a current food product or process used in a facility.

FPP.04.03. Performance Indicator: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence the local and global food systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
FPP.04.03.01.a. Examine and summarize the purposes of organizations that influence or regulate the food products and processing industry.	**FPP.04.03.01.b.** Evaluate the changes in the food products and processing industry brought about by industry organizations or regulatory agencies.	**FPP.04.03.01.c.** Construct and implement methods to obtain data about organizations, groups and regulatory agencies that affect the food products and processing industry.
FPP.04.03.02.a. Examine and describe the importance and usage of regulatory oversight of food safety and security in food products and processing (e.g., internationally, nationally, state and local).	**FPP.04.03.02.b.** Assess and summarize the application of industry standards in the food products and processing industry.	**FPP.04.03.02.c.** Construct and implement plans that ensure adherence to industry standards for food products and processing facilities.



MARINE TRADES CAREER PATHWAY

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Marine Trades (MT) Career Pathway encompasses the study of including content areas such as boat building, service and repair of aquaculture vessels, machines and equipment, seamanship, navigation, boat safety and operations. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of marine trades.

SAMPLE CAREERS: Marine Engineer, Marine Architect, Shipping Broker, Boatswain, Ship Fitter, Shipwright, Captain, 1st Mate, Harbor Pilot, Ship Builder, Boat Builder, Ship Steward, Boat Mechanic, Ocean Engineer.

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

Pathway Content Standard—This is a general statement indicating the broad area of knowledge

- Covered in each pathway ***Performance Indicators*** – These statements distill each content standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of using power, structural and technical systems to enhance boat building and mechanical skills, see Power, Structural and Technical Systems PST.01.and PST.04.

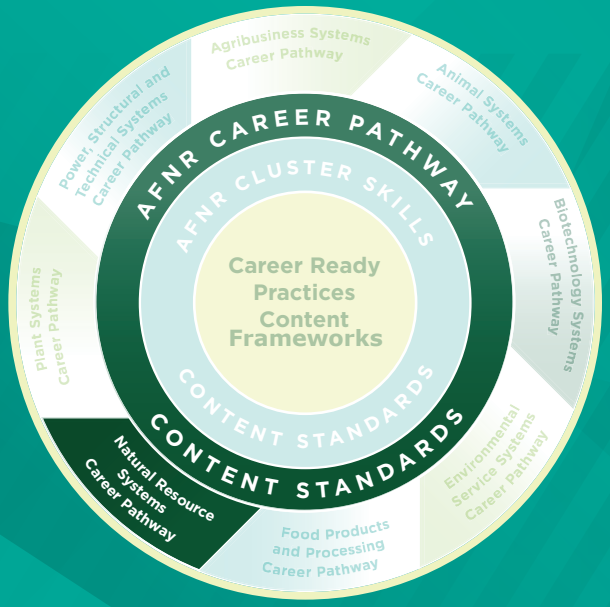
For additional content frameworks on the topic of safety in marine trades see Cluster Skills, CS.03.

MT.01. CCTC Framework: Assess factors that have influenced the evolution of marine trades (e.g., historical events, societal trends, ethical and legal implications, etc.).		
MT.01.01. Performance Indicator Investigate and explain the relationship between past, current and emerging trends in marine trades (e.g., major innovators, historical developments, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.01.01.01.a. Research and summarize the evolution of marine trades in the U.S.A.	**MT.01.01.01.b.** Analyze the developmental progression of marine trades and the evolution of scientific knowledge.	**MT.01.01.01.c.** Evaluate the implications of modern technology and the future of marine trades.
MT.01.02. Performance Indicator: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence marine trades.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.01.02.01.a. Examine and summarize the purposes of organizations that influence or regulate boating, shipbuilding navigation, safety, etc. in marine trades.	**MT.01.02.01.b.** Evaluate the changes marine trades brought about by industry organizations or regulatory agencies.	**MT.01.02.01.c.** Construct and implement methods to obtain data about organizations, groups and regulatory agencies that affect marine trades.
MT.02. CCTC Framework: Plan, build and maintain marine vessels.		
MT.02.01. Performance Indicator: Create sketches and plans for marine vessels.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.02.01.01.a. Interpret and explain the meaning of symbols used in sketches of marine vessels.	**MT.02.01.01.b.** Apply scale measurement and dimension to develop sketches of marine vessels.	**MT.02.01.01.c.** Create sketches of a marine vessel by applying principles of design.
MT.02.01.02.a. Read and interpret the parts and/or views of plans for a marine vessel.	**MT.02.01.02.b.** Construct plans for marine vessels using current technology (e.g., drafting software, computer-aided design, etc.).	**MT.02.01.02.c.** Evaluate, plan and design functional and efficient facilities for marine vessel building and maintenance.
MT.02.02. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair wooden boats.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.02.02.01.a Examine the criteria in selecting materials for constructing, maintaining, and/or repairing wooden boats.	**MT.02.02.01.b**. Analyze and assess samples of materials or products for quality and efficiency of workmanship.	**MT.02.02.01.c.** Select materials for a project based upon an analysis of the project and the quality of the materials.

MT.02.02.02.a. Summarize and categorize the information needed to complete a bill of materials and cost estimate a wooden boats.	**MT.02.02.02.b.** Analyze a project plan to prepare a bill of materials and an estimate of material costs.	**MT.02.02.02.c.** Create a project cost estimate, including materials, labor and management for a wooden boat.
MT.02.02.03.a. Identify types of wooden boats.	**MT.02.02.03.b.** Compare and contrast classes of wooden boats and their capacity.	**MT.02.02.03.c.** Select wooden boat type to meet quality and requirements of a client.
MT.02.02.04.a. Assemble material for wooden boat construction.	**MT.02.02.04.b.** Level haul, set up crossbeams, fabricate sub-sole components, cut bulkheads for a wooden boat.	**MT.02.02.04.c.** Fit and assemble crossbeams, sub-sole components, bulkheads, and moldings for a wooden boat.
MT.02.02.05.a. Identify finish materials for wooden boats.	**MT.02.02.05.b.** Select proper finish materials for wooden boats.	**MT.02.02.05.c.** Prepare wooden boat and apply finish.
MT.02.03. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair fiberglass boats.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.02.03.01.a. Identify the different processes in building fiberglass boats; open mold, split mold, plug, etc.	**MT.02.03.01.b.** Select appropriate process to build mold for a fiber glass boat.	**MT.02.03.01.c.** Build fiberglass boat mold.
MT.02.03.02.a. Assemble material for fiberglass boat construction.	**MT.02.03.02.b.** Use appropriate mold to build a fiberglass boat.	**MT.02.03.02.c.** Finish fiberglass boat.
MT.03. CCTC Framework: Service and repair outboard boat motors.		
MT.03.01. Performance Indicator: Troubleshoot, service and repair outboard motors using manufacturers' guidelines.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.03.01.01.a. Identify and classify components of outboard boat motors.	**MT.03.01.01.b.** Analyze and explain how the components of outboard boat motors interrelate during operation.	**MT.03.01.01.c.** Evaluate service and repair needs for outboard boat motors using a variety of performance tests (e.g., manuals, computer-based diagnostics, etc.).
MT.03.01.02.a. Identify types of two-stroke engines.	**MT.03.01.02.b.** Explain basic principles of two-stroke cycle engine.	**MT.03.01.02.c.** Compare and contrast two-stroke engines to four-stroke engines.
MT.03.01.03.a. Explain steps in diagnosing outboard boat motor problems.	**MT.03.01.03.b.**Disassemble and inspect outboard boat motor.	**MT.03.01.03.c.** Diagnose, repair and assemble outboard boat motors.
MT.03.01.04.a. Identify and locate outboard boat motor fuel system components, (fuel tank, lines, filters, etc.).	**MT.03.01.04.b**. Determine and make appropriate fuel oil mixture according to manufacturer's recommendation for outboard boat motor.	**MT.03.01.04.c.** Remove clean, inspect and install outboard motor fuel system components, fuel tank, lines, filters, etc.).
MT.03.01.05.a. Identify types and functions of outboard boat motor lubricant systems.	**MT.03.01.05.b**. Check outboard boat motors for proper oil pressure and level.	**MT.03.01.05.c.** Diagnose and repair outboard boat motor lubricant system problems.
MT.03.01.06.a. Explain the principles of the outboard boat motor cooling system.	**MT.03.01.06.b**. Service and/or replace thermostat and thermostat housing on an outboard boat motor.	**MT.03.01.06.c.** Disassemble, diagnose, repair and assemble outboard boat motor water pumps.

MT.03.01.07.a. Identify the components of an outboard boat motor lower unit.	**MT.03.01.07.b**. Explain how to adjust outboard boat motor lower unit trim and tilt.	**MT.03.01.07.c.** Disassemble, diagnose, repair and assemble outboard boat motor lower unit.
MT.03.02. Performance Indicator: Service electrical systems and components of marine vessels using a variety of troubleshooting and/or diagnostic methods.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.03.02.01.a. Compare and contrast basic units of electricity (e.g., volts, amps, watts, and ohms) and the principles that describe their relationship (e.g., Ohm's Law, Power Law, etc.).	**MT.03.02.01.b.** Assess the tools used to measure the basic units of electrical circuits in marine vessels, and perform the measurements.	**MT.03.02.01.c.** Analyze and design electrical circuits for marine vessels using knowledge of the basic units of electricity.
MT.03.02.02.a. Compare and contrast the characteristics of electronic components used on marine vessels (e.g., battery, resistor, diode, transistor, capacitor, etc.).	**MT.03.02.02.b.** Analyze and interpret electrical system symbols and diagrams.	**MT.03.02.02.c.** Conduct testing procedures to evaluate and repair malfunctioning electrical components and systems used in marine vessels.
MT.03.02.03.a. Classify the uses of electrical sensors and controls in marine vessels.	**MT.03.02.03.b.** Distinguish and select materials and tools used in electrical control circuit installation.	**MT.03.02.03.c.** Plan and install electrical control circuits and/or circuit boards to assure proper operation within marine vessels.
MT.04. CCTC Framework: Safely operate, and demonstrate the use of navigational tools to operate marine vessels.		
MT.04.01. Performance Indicator: Operate marine vessels while observing all safety precautions.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.04.01.01.a. List all safety equipment required for safe operation of a marine vessel on coastal and inland waters.	**MT.04.01.01.b.** Identify and name all safety equipment required for safe operation of a marine vessel on coastal and inland waters.	**MT.04.01.01.c.** Inspect marine vessel to ensure it holds required safety equipment for operations on coastal and inland waters.
MT.04.01.02.a. Identify types of boat trailers.	**MT.04.01.02.b.** Summarize the steps in launching and retrieving boats from and to a trailer.	**MT.04.01.02.c.** Launch and retrieve a boat from and to a trailer.
MT.04.01.03.a. Identify reasons for completing a float plan.	**MT.04.01.03.b.** Analyze information needed to complete a float plan.	**MT.04.01.03.c.** Complete a float plan.
MT.04.01.04.a. List potential hazards when operating a marine vessel.	**MT.04.01.04.b.** Explain procedures to follow for the following hazards: mechanical failure, running aground, personal injury, crew overboard, capsizing.	**MT.04.01.04.c.** Complete an accident report.
MT.04.01.05.a. List pre-trip procedures.	**MT.04.01.05.b.** Create a safety demonstration for passengers of a marine vessel.	**MT.04.01.05.c.** Conduct a pre-trip safety demonstration.
MT.04.01.06a. Identify procedures to follow when operating a marine vessel in coastal and inland waters.	**MT.04.01.06.b.** Discuss the "rules of the road" when operating a marine vessel in coastal and inland waters.	**MT.04.01.06.c.** Operate a marine vessel in coastal and inland waters.

MT.04.02. Performance Indicator: Demonstrate how to read navigational charts.		
MT.04.02.01.a. Identify symbols, abbreviations and terms used on paper and electronic navigational charts.	**MT.04.02.01.b.** Plot a course on a paper and/or electronic chart.	**MT.04.02.01.c.** Safely operate a marine vessel using a paper or electronic navigational chart.
MT.05. CCTC Standard: Design, build, operate and maintain underwater marine vehicles and equipment.		
MT.05.01. Performance Indicator: Operate underwater equipment while observing all safety precautions.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.05.01.01.a. Identify reasons for completing a safety plan.	**MT.05.01.01.b.** List all safety measures required for safe operation of underwater equipment in underwater missions.	**MT.05.01.01.c.** Identify and name all safety equipment required for safe operation of underwater equipment in underwater missions.
MT.05.01.02.a. Identify types of launch and recovery systems for underwater vehicles and equipment.	**MT.05.01.02.b.** Summarize the steps in launching and retrieving underwater vehicles and equipment from a vessel.	**MT.05.01.02.c.** Safely launch and retrieve underwater vehicles and equipment from a vessel.
MT.05.02. Performance Indicator: Select appropriate vehicles or equipment for use in underwater missions or projects.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.05.02.01.a Examine the tasks required to be completed in an undersea mission or project.	**MT.05.02.01.b.** Analyze and assess different tools, equipment or designs used for the completion of an undersea mission or project.	**MT.05.02.01.c.** Select equipment for an undersea mission or project based upon an analysis of the project and the quality of available equipment or materials.
MT.05.02.02.a. Summarize and categorize the information needed to complete a bill of materials and cost estimate for underwater vehicles and equipment.	**MT.05.02.02.b.** Analyze a project plan to prepare a bill of materials and an estimate of material costs for an underwater mission or project.	**MT.05.02.02.c.** Create a project cost estimate, including materials, labor and management for an underwater mission or project.
MT.05.02.03.a. Identify types of systems on underwater vehicles and equipment: buoyancy, control, remote sensing, etc.	**MT.05.02.03.b.** List the types of systems found on a particular underwater vehicle or piece of underwater equipment	**MT.05.02.03.c.** Test, maintain and repair systems found on underwater vehicles and equipment
MT.05.03. Performance Indicator: Create designs and plans for Remotely Operated Underwater Vehicles and/or Remote Sensing equipment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
MT.05.03.01.a. Identify current technology, tools and subsystems in use in underwater vehicles and equipment.	**MT.05.03.01.b.** Analyze and assess different tools, equipment or designs used for the completion of an undersea mission or project.	**MT.05.03.01.c.** Create a system design for a Remotely Operated Vehicle or piece of Remote Sensing equipment



NATURAL RESOURCE SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Natural Resource Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Natural Resource Systems (NRS) Career Pathway encompasses the study of the management, protection, enhancement and improvement of soil, water, wildlife, forests and air as natural resources. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of natural resource systems in AFNR settings.

SAMPLE CAREERS: Aquaculturist, Range Conservationist, Rangeland Scientist, Silviculturist, Timber Manager, Trapper, Logging Operations Inspector, Natural Resource Scientist, Park Manager, Water Resources Manager, Wildlife Manager, Forest Ranger

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for Natural Resource Systems (AG-NRS) from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of wildlife laws and agencies, see Environmental Service Systems ESS.02.
For additional content frameworks on the topic of energy, see Environmental Service Systems ESS.03 and ESS.04.
For additional content frameworks on the topic of climate change, see Environmental Service Systems ESS.03.
For additional content frameworks on the topic of precision technologies, specifically Geographic Information Systems, see Environmental Service Systems ESS.05.
For additional content frameworks on the topic of precision technologies, see Power, Structural and Technical Systems PST.05.
For additional content frameworks on the topic of food safety see, Food Products and Processing Systems FPP.01.

NRS.01. CCTC Framework: Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.		
NRS.01.01. Performance Indicator: Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.01.01.01.a. Summarize and classify the different kinds of natural resources using common classification schemes (e.g., living versus non-living, renewable versus nonrenewable, native versus introduced, etc.).	**NRS.01.01.01.b.** Assess the characteristics of a natural resource to determine its classification.	**NRS.01.01.01.c.** Devise strategies for the preservation of natural resources based on their classification.
NRS.01.01.02.a. Summarize the components that comprise all ecosystems.	**NRS.01.01.02.b.** Analyze the interdependence of organisms within an ecosystem (e.g., food webs, niches, impact of keystone species, etc.) and assess the dependence of organisms on nonliving components (climate, geography, energy flow, nutrient cycling, etc.).	**NRS.01.01.02.c.** Conduct analyses of ecosystems and document the interactions of living species and non-living resources.
NRS.01.01.03.a. Summarize and classify different kinds of living species based on evolutionary traits.	**NRS.01.01.03.b.** Analyze how biodiversity develops through evolution, natural selection and adaptation; explain the importance of biodiversity to ecosystem function and availability of natural resources.	**NRS.01.01.03.c.** Evaluate biodiversity in ecosystems and devise strategies to enhance the function of an ecosystem and the availability of natural resources by increasing the level of biodiversity.
NRS.01.02. Performance Indicator: Classify different types of natural resources in order to enable protection, conservation, enhancement and management in a particular geographical region.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.01.02.01.a. Explain the purpose of classifying organisms and using dichotomous keys.	**NRS.01.02.02.b.** Apply identification techniques to determine the species of an herbaceous plant.	**NRS.01.02.01.c.** Create dichotomous keys to reflect trees, fish and wildlife found in Connecticut.
NRS.01.02.02.a. Research and examine the characteristics used to identify trees and woody plants.	**NRS.01.02.02.b.** Apply identification techniques to determine the species of a tree or woody plant.	**NRS.01.02.02.c.** Evaluate the species of trees present to assess the health of an ecosystem (e.g., presence of native versus invasive species, biodiversity, etc.).
NRS.01.02.03.a. Research and examine the characteristics used to identify herbaceous plants.	**NRS.01.02.03.b.** Apply identification techniques to determine the species of an herbaceous plant.	**NRS.01.02.03.c.** Evaluate the species of herbaceous plants present to assess the health of an ecosystem (e.g., presence of native versus invasive plants, biodiversity, etc.).

NRS.01.02.04.a. Research and examine the characteristics used to identify wildlife and insects.	**NRS.01.02.04.b.** Apply identification techniques to determine the species of wildlife or insect.	**NRS.01.02.04.c.** Evaluate the species of wildlife and insects present to assess the health of an ecosystem.
NRS.01.02.05.a. Research and examine the characteristics used to identify aquatic species.	**NRS.01.02.05.b.** Apply identification techniques to determine the species of an aquatic organism.	**NRS.01.02.05.c.** Evaluate the aquatic species present to assess the health of an ecosystem.
NRS.01.02.06.a. Research the purpose and value of resource inventories and population studies.	**NRS.01.02.06.b.** Explain how animals are added to the endangered species list.	**NRS.01.02.06.c.** Predict and justify your selection of species of wildlife that may be added to the endangered species list.
NRS.01.02.07.a. Research and examine the characteristics used to identify non-living resources (e.g., soil types, climate, geography, etc.).	**NRS.01.02.07.b.** Apply identification techniques to determine the types of non-living resources in an area.	**NRS.01.02.07.c.** Evaluate the non-living resources present in an area to determine the best practices for improving, enhancing and protecting an ecosystem.
NRS.01.02.08.a. Research the purpose and value of resource inventories and population studies.	**NRS.01.02.08.b.** Apply procedures for conducting resource inventories and population studies.	**NRS.01.02.08.c.** Conduct an assessment of the resource inventories or population in a given area.
NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.01.03.01.a. Classify different kinds of biogeochemical cycles and the role they play in natural resources systems.	**NRS.01.03.01.b.** Assess the role that the atmosphere plays in the regulation of biogeochemical cycles.	**NRS.01.03.01.c.** Evaluate and make recommendations to lessen the impact of human activity on the ability of the atmosphere to regulate biogeochemical cycles.
NRS.01.03.02.a. Research and summarize how climate factors influence natural resource systems.	**NRS.01.03.02.b.** Analyze the impact that climate has on natural resources and debate how this impact has changed due to human activity.	**NRS.01.03.02.c.** Assess the primary causes of climate change and design strategies to lessen its impact on natural resource systems.
NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.01.04.01.a. Summarize the roles and properties of watersheds.	**NRS.01.04.01.b.** Assess the function of watersheds and their effect on natural resources.	**NRS.01.04.01.c.** Evaluate and defend the importance of watersheds to ecosystem function.
NRS.01.04.02.a. Examine and describe the importance of groundwater and surface water to natural resources.	**NRS.01.04.02.b.** Analyze how different classifications of ground and surface water affect ecosystem function.	**NRS.01.04.02.c.** Devise and apply strategies to manage, protect, enhance or improve sources of groundwater or surface water based on its properties.
NRS.01.04.03.a. Compare and contrast riparian zones and riparian buffers based on their function.	**NRS.01.04.03.b.** Assess techniques used in the creation, enhancement and management of riparian zones and riparian buffers.	**NRS.01.04.03.c.** Devise and apply strategies for the creation, enhancement and management of riparian zones and riparian buffers.

NRS.01.04.04.a. Identify the following water quality indicators: pH, temperature, nitrates, nitrites, ammonia, dissolved oxygen, and turbidity.	**NRS.01.04.04.b.** Conduct water quality test on an aquatic habitat.	**NRS.01.04.04.c.** Monitor and evaluate a local aquatic habitat water quality.
NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.01.05.01.a. Research and describe the stages of ecological succession.	**NRS.01.05.01.b.** Analyze and summarize examples of stages of succession.	**NRS.01.05.01.c.** Evaluate the stages of succession present in an ecosystem and predict which species will become more prevalent through future stages of succession.
NRS.01.05.02.a. Compare and contrast the impact of habitat disturbances and habitat resilience.	**NRS.01.05.02.b.** Analyze and summarize examples of habitat disturbances and habitat resilience.	**NRS.01.05.02.c.** Interpret signs of habitat disturbances and resilience in an ecosystem and use these signs to assess the health of an ecosystem.
NRS.01.05.03.a. Compare and contrast techniques associated with sustainable forestry (e.g., timber stand improvement, diversity improvement, reforestation, etc.).	**NRS.01.05.03.b.** Analyze a forest in order to determine which forestry techniques would improve that habitat.	**NRS.01.05.03.c.** Devise a forest management plan that improves the habitat while sustainably maximizing the amount of timber that can be harvested.
NRS.01.05.04.a. Compare and contrast techniques associated with soil management (e.g., soil survey and interpretation, erosion control, etc.).	**NRS.01.05.04.b.** Analyze a plot of land in order to determine which soil management techniques would be most applicable.	**NRS.01.05.04.c.** Devise a soil management plan to minimize erosion and maximize biodiversity, plant productivity, and the formation of topsoil.
NRS.01.06. Performance Indicator: Apply ecological concepts and principles to living organisms in natural resource systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.01.06.01.a. Differentiate between population ecology, population density and population dispersion and describe the importance of these concepts to natural resource systems.	**NRS.01.06.01.b.** Analyze the factors that influence population density and population dispersion in natural resource systems.	**NRS.01.06.01.c.** Create a management plan for a population of a species in an ecosystem given its population ecology, population density and population dispersion in natural resource systems.
NRS.01.06.02.a. Research and summarize examples of invasive species.	**NRS.01.06.02.b.** Analyze factors that influence the establishment and spread of invasive species and determine the appropriate steps to prevent or minimize the impact of invasive species.	**NRS.01.06.02.c.** Evaluate the presence and impact of invasive species on natural resources in a given area and devise a plan to prevent, control or eliminate invasive species from that habitat.

NRS.02.01. CCTC Framework: Analyze the interrelationships between natural resources and humans.		
NRS.02.01. Performance Indicator: Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.02.01.01.a. Distinguish between the types of laws associated with natural resources systems.	**NRS.02.01.01.b.** Analyze the structure of laws associated with natural resources systems.	**NRS.02.01.01.c.** Evaluate the impact of laws associated with natural resources systems (e.g., mitigation, water regulations, carbon emissions, game limits, invasive species, etc.).
NRS.02.01.02.a. Distinguish between the types of agencies associated with natural resources systems.	**NRS.02.01.02.b.** Analyze the specific purpose of agencies associated with natural resources systems.	**NRS.02.01.02.c.** Evaluate the impact and effectiveness of agencies associated with natural resources systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions, etc.).
NRS.02.02. Performance Indicator: Assess the impact of human activities on the availability of natural resources.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.02.02.01.a. Summarize the relationship between natural resources, ecosystems and human activity.	**NRS.02.02.01.b.** Assess and explain how different kinds of human activity affect the use and availability of natural resources (i.e., agriculture, industry, transportation, etc.).	**NRS.02.02.01.c.** Evaluate how the availability of natural resources can be improved through changes to human activity.
NRS.02.02.02.a. Categorize the primary causes of extinction of living species due to human activity (e.g., overharvesting, habitat loss, invasive species, pollution, etc.).	**NRS.02.02.02.b.** Assess causes of extinction and describe how those causes related to loss of biodiversity.	**NRS.02.02.02.c**. Devise a strategy for preventing the loss of species and biodiversity that takes into account the primary causes of species extinction from human activity.
NRS.02.03.02.a. Research and assess how historical figures played a prominent role in shaping how natural resources are viewed and used today (e.g., Aldo Leopold, Teddy Roosevelt, John Muir, Rachel Carson, Gaylord Nelson, etc.).	**NRS.02.03.02.b.** Examine and describe the relationship between current trends in natural resource systems and historical figures that played a prominent role in shaping how natural resources are viewed and used today.	**NRS.02.03.02.c.** Anticipate and predict how society's views and use of natural resources will continue to change as a result of historical figures and trends in modern society.
NRS.02.02.04.a. Examine and describe the manner in which modern lifestyles are related to the depletion of natural resources.	**NRS.02.02.04.b.** Identify solutions to improve the sustainability of modern lifestyles.	**NRS.02.02.04.c.** Evaluate how modern lifestyles affect resource consumption and energy use and devise a strategy to prevent the complete loss of a natural resource.

NRS.02.03. Performance Indicator: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.02.03.01.a. Summarize and categorize the different social considerations in regards to the use of natural resources (e.g., public versus private, laws and regulations, economics, green technology, etc.).	**NRS.02.03.01.b.** Analyze how social considerations can affect the use and sustainability of natural resources.	**NRS.02.03.01.c.** Develop predictions for how the management, protection, enhancement and improvement of natural resources will evolve through social considerations (e.g., establishment of national parks, public opinion, and fishing, reduction of waste and energy consumption, etc.).
NRS.02.03.02.a. Research and assess how historical figures played a prominent role in shaping how natural resources are viewed and used today (e.g., Aldo Leopold, Teddy Roosevelt, John Muir, Rachel Carson, Gaylord Nelson, etc.).	**NRS.02.03.02.b.** Examine and describe the relationship between current trends in natural resource systems and historical figures that played a prominent role in shaping how natural resources are viewed and used today.	**NRS.02.03.02.c.** Anticipate and predict how society's views and use of natural resources will continue to change as a result of historical figures and trends in modern society.
NRS.02.03.03.a. Research how technology has affected the use and views of natural resources.	**NRS.02.03.03.b.** Analyze and document how some technological advancements changed how natural resources were used and viewed (e.g., Industrial Revolution, fossil fuels, green technology, etc.).	**NRS.02.03.03.c.** Anticipate and predict how future technological advancements may affect the use and views of natural resources.
NRS.02.04. Performance Indicator: Examine and explain how economics affects the use of natural resources.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.02.04.01.a. Compare and contrast how the economic value of a natural resource affects its availability.	**NRS.02.04.01.b.** Assess whether economic value increases or decreases the conservation, protection, improvement and enhancement of natural resources.	**NRS.02.04.01.c.** Devise a plan to improve the conservation, protection, improvement and enhancement of natural resources based on economic value and practices.
NRS.02.04.02.a. Research the impact of the use of natural resources on local, state and national economies (e.g., outdoor recreation, energy production, preservation, etc.).	**NRS.02.04.02.b.** Assess the importance of the use of natural resources on local, state and national economies.	**NRS.02.04.02.c.** Anticipate and predict how changes to the availability of natural resources because of human activity may impact a local, state and national economy.
NRS.02.04.03.a. Compare and contrast the economic impact of green technology and alternative energy.	**NRS.02.04.03.b.** Analyze and document how the adoption of green technology and/or alternative energy affected a local, state or national economy.	**NRS.02.04.03.c.** Anticipate and predict the economic impact green technology and alternative energy.

NRS.02.05. Performance Indicator: Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.02.05.01.a. Examine and describe ways in which a message regarding natural resources may be communicated to the public through standard media sources (e.g., press, radio, TV, public appearances, etc.).	**NRS.02.05.01.b.** Assess the effectiveness of different methods for communicating natural resource messages.	**NRS.02.05.01.c.** Devise and implement a strategy for communicating a natural resources message through media.
NRS.02.05.02.a. Research and summarize how social media and the Internet have changed how people perceive and utilize natural resources (e.g., greater awareness of conservation issues, calls to action, etc.).	**NRS.02.05.02.b.** Assess how to most effectively communicate a message about the conservation, management, enhancement and improvement of natural resources via social media and the Internet.	**NRS.02.05.02.c.** Anticipate and predict how messages about the conservation, management, enhancement and improvement of natural resources will change because of social media and the Internet.
NRS.02.05.03.a. Examine and describe how communication can be used to influence behavior, call people to action and instill a sense of civic behavior related to the conservation, management, enhancement and improvement of natural resources.	**NRS.02.05.03.b.** Analyze and summarize examples of how communication can be used to influence behavior, call people to action and instill a sense of civic behavior related to the conservation, management, enhancement and improvement of natural resources.	**NRS.02.05.03.c.** Create a communication plan to influence the behavior of people, call people to action and instill a sense of civic behavior related to the conservation, management, enhancement and improvement of natural resources.
NRS.03. CCTC Framework: Develop plans to ensure sustainable production and processing of natural resources.		
NRS.03.01. Performance Indicator: Sustainably produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.03.01.01.a. Summarize forest harvesting methods.	**NRS.03.01.01.b.** Assess harvesting methods in regards to their economic value, environmental impact, and other factors.	**NRS.03.01.01.c**. Develop a forest harvesting plan that ensures economic, environmental and social sustainability.
NRS.03.01.02.a. Research and describe methods by which wildlife can be sustainably harvested (e.g., controlled harvests, hunting licenses, regulations, etc.).	**NRS.03.01.02.b.** Assess and apply techniques used to harvest wildlife in regards to sustainability, practicality and other factors.	**NRS.03.01.02.c.** Develop a method for the sustainable harvest of wildlife species.
NRS.03.01.03.a. Compare and contrast the costs and benefits (e.g., impacts on environment, economic, wildlife, etc.) of mineral extraction to a local, state and/or national economy.	**NRS.03.01.03.b.** Assess the economic impact of mineral extraction in regards to the costs and benefits to a local, state and/or national economy.	**NRS.03.01.03.c.** Evaluate methods used to extract and process minerals for economic, environmental and social sustainability.

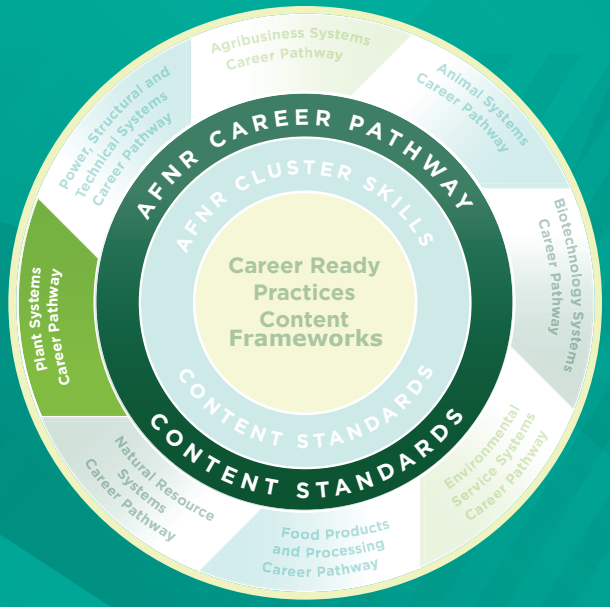
NRS.03.01.04.a. Compare and contrast the costs and benefits (e.g., impacts on environment, economic, wildlife, etc.) of fossil fuels to a local, state and/or national economy.	**NRS.03.01.04.b.** Assess the economic impact of fossil fuel extraction in regards to the costs and benefits to a local, state and/or national economy.	**NRS.03.01.04.c.** Evaluate methods used to extract and process fossil fuels for economic, environmental and social sustainability.
NRS.03.01.05.a. Compare and contrast the costs and benefits (e.g., environmental impacts, etc.) of shale oil from fracking to a local, state and/or national economy.	**NRS.03.01.05.b.** Assess the economic impact of shale oil extraction (i.e., fracking) in regards to the costs and benefits to a local, state and/or national economy.	**NRS.03.01.05.c.** Evaluate methods used to extract and process shale oil for economic, environmental and social sustainability.
NRS.03.01.06.a. Compare and contrast the costs and benefits (e.g., environmental impacts, etc.) of alternative sources of energy (e.g., hydroelectric, solar, wind, biofuels, geothermal, etc.).	**NRS.03.01.06.b.** Assess and evaluate factors that affect the economic, environmental and social sustainability in regards to the use of alternative sources of energy.	**NRS.03.01.06.c.** Assess trends in energy production and consumption in order to predict how the impact of alternative energy will change in the future.
NRS.03.01.07.a. Research and summarize how recreational uses of natural resources can be changed to improve sustainability.	**NRS.03.01.07.b.** Assess different options for improving the sustainability of outdoor recreation based on its impact on natural resources and likelihood of acceptance.	**NRS.03.01.07.c.** Evaluate an example of outdoor recreation and develop suggestions for how that activity can be made more sustainable in a manner that is acceptable to those who take part in that activity.
NRS.03.01.08.a. Categorize aquatic species used for commercial and recreational purposes.	**NRS.03.01.08.b.** Analyze and apply techniques used to acquire aquatic species for their environmental, economic and social sustainability.	**NRS.03.01.08.c.** Develop recommendations for the sustainable harvest of aquatic species.
NRS.03.02. Performance Indicator: Sustainably produce, harvest, process and use sap from maple trees.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.03.02.01.a. Explain how to identify sugar maple trees by buds, bark and silhouette.	**NRS.03.02.01.b.** Explain the process of how a tree produces sap.	**NRS.03.02.01.c.** Manage a forest stand for maple syrup production.
NRS.03.02.02.a. Explain the history of maple syrup production in North America.	**NRS.03.02.02.b.** Discuss and / or explain how the production process has changed over the past three centuries.	**NRS.03.02.02.c.** Demonstrate historic methods of making maple syrup.
NRS.03.02.03.a. Identify different methods of collecting sap from trees, (buckets, plastic tubing, and plastic tubing with vacuum pumps.)	**NRS.03.02.03.b.** Identify equipment and supplies used in the production of maple syrup.	**NRS.03.02.03.c.** Demonstrate how to tap trees to collect sap.
NRS.03.02.04.a. Explain the process of boiling sap into syrup and syrup into sugar including using reverse osmosis process.	**NRS.03.02.04.b.** Compare and contrast different methods of boiling sap into syrup.	**NRS.03.02.04.c.** Boil sap into syrup.
NRS.03.02.05.a. Identify grades of maple syrup.	**NRS.03.02.05.b.** Demonstrate proper syrup filtration including the use of a filter press and cone filter, calculate correct amount of DE filter aid per volume of syrup in order to package and market maple syrup according to grade.	**NRS.03.02.05.c.** Process maple syrup into other maple products, (sugar, candy, etc.).

NRS.03.02.06.a. Identify factors that affect the quality of maple syrup.	**NRS.03.02.06.b.** Demonstrate proper sap collection, storage and sanitation procedures.	**NRS.03.02.06.c.** Taste test maple syrup and determine potential off flavors.
NRS.03.02.07.a. Explain ratio of maple sap to maple syrup.	**NRS.03.02.07.b.** Determine brix using a sap refractometer or sap hydrometer and calculate sap to syrup ration using Jones' Rule of 86.	**NRS.03.02.07.c.** Calculate whether finished syrup is light or heavy and determine best method to adjust the product properly.
NRS.03.03. Performance Indicator: Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.03.03.01.a. Summarize how to use maps and technologies to identify directions and land features, calculate actual distance and determine the elevations of points.	**NRS.03.03.01.b.** Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems, etc.) to locate natural resources.	**NRS.03.03.01.c.** Evaluate the availability of and threats to natural resources using cartographic skills, tools, and technologies (e.g., spread of invasive species, movement of wildlife populations, changes to biodiversity of edge of habitat versus interior, etc.).
NRS.03.03.02.a. Identify the following components of a topographical map: contour lines, wetlands, buildings, compass, and scale.	**NRS.03.03.02.b.** Plot a hike using a topographical map making note of total miles, elevation change, and other geographic features.	**NRS.03.03.02.c.** Take a hike using a topographic map.
NRS.03.03.03.a. Describe basic applications of global positioning systems in natural resources.	**NRS.03.03.03.b.** Analyze an area's resources using GIS technologies.	**NRS.03.03.03.c.** Use GIS data for a given area to devise a management plan for the management, conservation, improvement, and enhancement of its natural resources.
NRS.04. CCTC Framework: Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.		
NRS.04.01. Performance Indicator: Demonstrate natural resource protection, maintenance, enhancement and improvement techniques.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.04.01.01.a. Identify and categorize different kinds of streams.	**NRS.04.01.01.b.** Assess and explain indicators of the biological health of a stream.	**NRS.04.01.01.c.** Create an enhancement plan for a stream.
NRS.04.01.02.a. Identify and categorize different kinds of streams.	**NRS.04.01.02.b.** Assess and explain indicators of the biological health of a stream.	**NRS.04.01.02.c.** Create an enhancement plan for a stream.
NRS.04.01.03.a. Identify and categorize characteristics of a healthy forest.	**NRS.04.01.03.b.** Assess and apply the methods used to improve a forest stand.	**NRS.04.01.03.c.** Create a timber stand improvement plan for a forest.

NRS.04.01.04.a. Identify and categorize characteristics of a healthy wildlife habitat.	**NRS.04.01.04.b.** Assess and apply methods of wildlife habitat improvement.	**NRS.04.01.04.c.** Devise a comprehensive improvement plan for a wildlife habitat.
NRS.04.01.05.a. Identify and categorize characteristics of healthy rangeland.	**NRS.04.01.05.b.** Assess and apply methods of rangeland improvement.	**NRS.04.01.05.c.** Evaluate and revise a rangeland management plan.
NRS.04.01.06.a. Identify recreational uses of natural resources in New England.	**NRS.04.01.06.b.** Assess and apply management techniques for improving outdoor recreation opportunities.	**NRS.04.01.06.c.** Evaluate the impact of recreational activities on natural resources and create an improvement plan.
NRS.04.01.07.a. Identify and categorize characteristics of healthy marine and coastal natural resources.	**NRS.04.01.07.b.** Assess and apply methods to improve marine and coastal natural resources.	**NRS.04.01.07.c.** Create an improvement plan for marine or coastal natural resources.
NRS.04.02. Performance Indicator: Diagnose plant and wildlife diseases and follow protocols to prevent their spread.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.04.02.01.a. Classify causes of diseases in plants and the correct authorities to whom some diseases should be reported.	**NRS.04.02.01.b.** Analyze a plant disease based on its symptoms, identify if the disease needs to be reported to authorities and determine which authorities it should be reported to.	**NRS.04.02.01.c.** Create a management plan to reduce infection and the spread of plant diseases in natural resource systems.
NRS.04.02.02.a. Classify causes of diseases in wildlife and aquatic species and determine the correct authorities to whom some diseases should be reported.	**NRS.04.02.02.b.** Analyze a wildlife or aquatic species disease based on its symptoms, identify if the disease needs to be reported to authorities and determine which authorities it should be reported to.	**NRS.04.02.02.c.** Create a management plan to reduce infection and spread of wildlife or aquatic species diseases in natural resource systems.
NRS.04.03. Performance Indicator: Prevent or manage introduction of ecologically harmful species in a particular region.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.04.03.01.a. Categorize harmful and beneficial insects, as well as signs of insect damage to natural resources.	**NRS.04.03.01.b.** Analyze signs of insect infestation, identify if it needs to be reported to authorities and determine to which authorities it should be reported.	**NRS.04.03.01.c**. Create a management plan to reduce spread of harmful insects in natural resource systems.
NRS.04.03.02.a. Identify and classify invasive species common to a particular region.	**NRS.04.03.02.b.** Analyze signs of the spread of invasive species, identify if it needs to be reported to authorities and determine which authorities it should be reported to.	**NRS.04.03.02.c.** Create a management plan to reduce spread of harmful invasive species in natural resource systems.
NRS.04.03.03.a. Research and summarize strategies and benefits of preventing the introduction of harmful species to a particular region.	**NRS.04.03.03.b.** Assess and implement a plan for preventing the spread of harmful species for its effectiveness.	**NRS.04.03.03.c.** Identify potentially invasive species and devise strategies to prevent ecological damage that would result from the introduction of that species.

NRS.04.04. Performance Indicator: Manage fires in natural resource systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities, at different levels of proficiency, to assess students' attainment of knowledge and skills related to this performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.04.04.01.a. Differentiate between desirable and undesirable fires and research the role fire plays in a healthy ecosystem.	**NRS.04.04.01.b**. Assess and apply techniques used to fight wildfires, manage prescribed fires and ensure human safety.	**NRS.04.04.01.c.** Develop a prevention plan for harmful fires for a particular region.
NRS.04.04.02.a. Research and summarize how fire management techniques have evolved.	**NRS.04.04.02.b.** Assess the effectiveness of techniques previously and currently used to prevent harmful fires.	**NRS.04.04.02.c.** Anticipate and predict how fire management techniques will evolve in the future.

NRS.0.05. Performance Indicator: Develop skill in the safe use of natural resources related tools and equipment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
NRS.0.05.01.a. Identify the following tools in natural resources: GPS unit, diameter tape, telemetry unit, seines, aquatic net, water meter, animal tag or band, Biltmore stick, Secchi disk, analog refractometer, and hydrometer.	**NRS.0.05.01.b** Demonstrate the proper use for the following tools in natural resources: GPS unit, diameter tape, telemetry unit, seines, aquatic net, water meter, animal tag or band, Biltmore stick, Secchi disk, analog refractometer, and hydrometer.	**NRS.0.05.01.c.** Utilize the following tools in managing natural resources; following tools in natural resources: GPS unit, diameter tape, telemetry unit, seines, aquatic net, water meter, animal tag or band, Biltmore stick, Secchi disk, analog refractometer, and hydrometer.
NRS.0.05.02.a Identify tools, materials and equipment for use in natural resources.	**NRS.0.05.02.b.** Describe the proper safe use or function of tools, materials and equipment for use in natural resources.	**NRS.0.05.02.c.** Demonstrate the safe use of tools, materials and equipment for use in natural resources.



PLANT SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Plant Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content frameworks outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Plant Systems (PS) Career Pathway encompasses the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as wells as growth and cultural practices through the study of crops, turf grass, trees, shrubs and/or ornamental plants. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of plant systems in AFNR settings.

SAMPLE CAREERS: Plant Breeder, Soil & Water Specialist, Plant Pathologist, Botanist, Forest Geneticists, Greenhouse Managers, Crop Farm Managers, Floriculturist, Agronomist

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for Plant Systems (AG-PS) from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:

For additional content frameworks on the topic of plant breeding, see Biotechnology Systems BS.02.
For additional content frameworks on the topic of plant productivity and quality, see Biotechnology Systems BS.03.
For additional content frameworks on the topic of precision technologies, see Power, Structural and Technical Systems PST.05.
For additional content frameworks on the topic of invasive plant species, see Natural Resource Systems NRS.01, NRS.02, NRS.03, and NRS.04.
For additional content frameworks on the topic of composting, see Environmental Service Systems ESS.04.

PS.01. CCTC Framework: Develop and implement a crop management plan for a given production goal that accounts for environmental factors.		
PS.01.01. Performance Indicator: Determine the influence of environmental factors on plant growth.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.01.01.01.a. Identify and summarize the three measurements of light – color, intensity and duration – that affect plant growth.	**PS.01.01.01.b.** Analyze and describe plant responses to light color, intensity and duration.	**PS.01.01.01.c.** Analyze plant responses to varied light color, intensity and duration and recommend modifications to light for desired plant growth.
PS.01.01.02.a. Identify and summarize the effects of air and temperature on plant metabolism and growth.	**PS.01.01.02.b.** Determine the optimal air and temperature conditions for plant growth.	**PS.01.01.02.c.** Design, implement and evaluate a plan to maintain optimal air and temperature conditions for plant growth.
PS.01.01.03.a. Identify and summarize the effects of water quality on plant growth, (e.g., pH, dissolved solids, etc.).	**PS.01.01.03.b.** Analyze and describe plant responses to water conditions.	**PS.01.01.03.c.** Analyze plant responses to water conditions and recommend modifications to water for desired plant growth.
PS.01.02. Performance Indicator: Prepare and manage growing media for use in plant systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.01.02.01.a. Identify the major components of growing media and describe how growing media support plant growth.	**PS.01.02.01.b**. Describe the physical and chemical characteristics of growing media and explain the influence they have on plant growth.	**PS.01.02.01.c.** Formulate and prepare growing media for specific plants or crops.
PS.01.02.02.a. Identify the major components of growing media and describe how growing media support plant growth.	**PS.01.02.02.b.** Describe the physical and chemical characteristics of growing media and explain the influence they have on plant growth.	**PS.01.02.02.c.** Formulate and prepare growing media for specific plants or crops.
PS.01.02.03.a. Identify the categories of soil water.	**PS.01.02.03.b.** Discuss how soil drainage and water-holding capacity can be improved.	**PS.01.02.03.c.** Determine the hydraulic conductivity for soil and how the results influence irrigation practices.
PS.01.03. Performance Indicator: Apply knowledge of nutrient role and fertilizer analysis.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.01.03.01.a. Describe the role of N, P, and K in regards to vegetative growth, root development, seed production, and plant stress.	**PS.01.03.01.b.** Explain the appearance of plants that have a deficiency of N, P, and/or K.	**PS.01.03.0.c.** Create a fertilizer plan for a plant species to ensure the plant receives the proper amount of N, P and K

PS.01.03.02.a. Identify the following from a label of a fertilizer container: percentage of N, P, and K, and calculate the actual amount of the nutrient(s) in the container.	**PS.01.03.02.b.** Select an N, P, and K fertilizer based on a plants nutrient requirement.	**PS.01.03.02.c.** Fertilize plants with N, P, and k based on the nutrient need of the plant.
PS.01.04. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.01.04.01.a. Identify the essential nutrients for plant growth and development and their major functions (e.g., nitrogen, phosphorous, potassium, etc.).	**PS.01.04.01.b.** Analyze the effects of nutrient deficiencies and symptoms and recognize environmental causes of nutrient deficiencies.	**PS.01.04.01.c.** Monitor plants for signs of nutrient deficiencies and prepare a scouting report to correct elements negatively affecting plant growth in a field or greenhouse.
PS.01.04.02.a. Discuss the influence of pH and cation exchange capacity on the availability of nutrients.	**PS.01.04.02.b.** Contrast pH and cation exchange capacity between mineral soil and soilless growing media.	**PS.01.04.02.c.** Adjust the pH of growing media for specific plants or crops.
PS.01.04.03.a. Collect soil and plant tissue samples using generally accepted procedures and explain how incorrect sample collection will affect the results of a laboratory analysis.	**PS.01.04.03.b.** Interpret laboratory analyses of soil and tissue samples.	**PS.01.04.03.c.** Prescribe fertilizer applications based on the results of a laboratory analysis of soil and plant tissue samples.
PS.01.04.04.a. Identify fertilizer sources of essential plant nutrients; explain fertilizer formulations, including organic and inorganic; and describe different methods of fertilizer application.	**PS.01.04.04.b.** Calculate the amount of fertilizer to be applied based on nutrient recommendation and fertilizer analysis.	**PS.01.04.04.c.** Calibrate application equipment to meet plant nutrient needs.
PS.01.04.05.a. Research and summarize production methods focused on soil management (e.g., crop rotation, companion planting, cover crops, etc.).	**PS.01.04.05.b.** Assess and describe the short- and long-term effects production methods have on soil.	**PS.01.04.05.c.** Devise a plan for soil management for a selected production method.
PS.01.04.06.a. Summarize the impact of environmental factors on nutrient availability (e.g., moisture, temperature, pH, etc.).	**PS.01.04.06.b.** Assess and describe the impact environmental factors have on a crop.	**PS.01.04.06.c.** Devise a plan to meet plant nutrient needs based on environmental factors present.
PS.02. CCTC Framework: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.		
PS.02.01. Performance Indicator: Classify plants according to taxonomic systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.02.01.01.a. Identify and summarize systems used to classify plants based on specific characteristics.	**PS.02.01.01.b.** Compare and contrast the hierarchical classification of agricultural and ornamental plants.	**PS.02.01.01.c.** Classify agricultural and ornamental plants according to the hierarchical classification system

PS.02.01.02.a. Describe the morphological characteristics used to identify agricultural and herbaceous plants (e.g., life cycles, growth habit, plant use and as monocotyledons or dicotyledons, woody, herbaceous, etc.).	**PS.02.01.02.b.** Identify and describe important plants to agricultural and ornamental plant systems by common names.	**PS.02.01.02.c.** Identify and describe important plants to agricultural and ornamental plant systems by scientific names.
PS.02.01.03.a. Explain the life cycle of annuals, biennials, and perennial plants.	**PS.02.01.03.b.** Classify plants, grown in Connecticut as having an annual, biennial, or perennial life cycle.	**PS.02.01.03.c.** Evaluate reasons why species of plants can be annual in one growing zone and perennial in another growing zone.
PS.02.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.02.02.01.a. Identify and describe the function(s) of the following plant parts: leaf, blade, petiole, flower, stamen, pistil, stem, nodes, roots, and root hairs.	**PS.02.02.01.b.** Determine if a plant is a monocot or dicot based on its parts.	**PS.02.02.01.c.** Compare and contrast monocot and dicot plants.
PS.02.02.01.a. Identify structures in a typical plant cell and summarize the function of plant cell organelles.	**PS.02.02.01.b.** Compare and contrast mitosis and meiosis.	**PS.02.02.01.c.** Apply the knowledge of cell differentiation and the functions of the major types of cells to plant systems.
PS.02.02.02.a. Identify and summarize the components, the types and the functions of plant roots.	**PS.02.02.02.b.** Analyze root tissues and explain the pathway of water and nutrients into and through root tissues.	**PS.02.02.02.c.** Correlate the active and passive transport of minerals into and through the root system to plant nutrition.
PS.02.02.03.a. Identify and summarize the components and the functions of plant stems.	**PS.02.02.03.b.** Analyze and describe the difference in arrangement of vascular tissue between monocot and dicot plant stems.	**PS.02.02.03.c.** Evaluate the function of the xylem, phloem and cambium tissues and the impact on plant systems.
PS.02.02.04.a. Research and summarize leaf morphology and the functions of leaves.	**PS.02.02.04.b.** Analyze how leaves capture light energy and summarize the exchange of gases.	**PS.02.02.04.c.** Devise a plan for plant management practices that takes into account leaf structure and functions.
PS.02.02.05.a. Identify and summarize the components of a flower, the functions of a flower and the functions of flower components.	**PS.02.02.05.b.** Apply knowledge of flower structure to differentiate between the types of flowers and flower inflorescence (e.g., complete, incomplete, perfect, imperfect).	**PS.02.02.05.c.** Evaluate flower structures and analyze the impact of plant structure on plant breeding, production and use.
PS.02.02.06.a. Identify and summarize the functions and components of seeds and fruit.	**PS.02.02.06.b.** Analyze and categorize the major types of seeds and fruit.	**PS.02.02.06.c.** Evaluate the impact of different seed and fruit structures to plant culture and use.

PS.02.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.02.03.01.a. Summarize the importance of photosynthesis to plant life on earth and the process of photosynthesis, including the types (c3, c4, Cam), its stages (e.g., light-dependent and light independent reactions), and its products and byproducts.	**PS.02.03.01.b.** Apply knowledge of photosynthesis to analyze how various environmental factors will affect the rate of photosynthesis.	**PS.02.03.01.c.** Evaluate the impact of photosynthesis and the factors that affect it on plant management, culture and production problems.
PS.02.03.02.a. Summarize the stages of cellular respiration including their products and byproducts.	**PS.02.03.02.b.** Analyze the factors that affect cellular respiration processes and rate in a crop production setting.	**PS.02.03.02.c.** Evaluate the impact of plant respiration on plant growth, crop management and post-harvest handling decisions.
PS.02.03.03.a. Summarize primary growth and the role of the apical meristem.	**PS.02.03.03.b.** Analyze plant growth and assess the process of secondary plant growth.	**PS.02.03.03.c.** Relate the principles of primary and secondary growth to plant systems.
PS.02.03.04.a. Identify and categorize the five groups of naturally occurring plant hormones and synthetic plant growth regulators.	**PS.02.03.04.b.** Analyze and identify the plant responses to plant growth regulators and different forms of tropism.	**PS.02.03.04.c.** Select and defend the use of specific plant growth regulators to produce desired responses from plants.
PS.02.03.05.a. Compare and contrast the effects of transpiration, translocation and assimilation on plants.	**PS.02.03.05.b.** Identify and analyze the factors affecting transpiration, translocation and assimilation rate and products.	**PS.02.03.05.c.** Devise plans for plant management that applies knowledge of transpiration, translocation and assimilation on plant growth.
PS.03. CCTC Framework: Propagate, culture and harvest plants and plant products based on current industry standards.		
PS.03.01. Performance Indicator: Demonstrate plant propagation techniques in plant system activities.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.03.01.01.a. Identify examples of and summarize pollination, cross-pollination and self-pollination of flowering plants.	**PS.03.01.01.b.** Examine and apply the process of plant pollination and/or fertilization.	**PS.03.01.01.c.** Select and defend the use of pollination methods and practices used to maximize crop pollination.
PS.03.01.02.a. Demonstrate sowing techniques for providing favorable conditions to meet the factors of seed germination.	**PS.03.01.02.b.** Handle seed to overcome seed dormancy mechanisms and to maintain seed viability and vigor.	**PS.03.01.02.c.** Conduct tests associated with seed germination rates, viability and vigor.
PS.03.01.03.a. Summarize optimal conditions for asexual propagation and demonstrate techniques used to propagate plants by cuttings, division, separation, layering, budding and grafting.	**PS.03.01.03.b.** Manage the plant environment to support asexual reproduction.	**PS.03.01.03.c.** Evaluate asexual propagation practices based on productivity and efficiency.

PS.03.01.04.a. Define micropropagation, discuss advantages associated with the practice and summarize the main stages of the process.	**PS.03.01.04.b.** Demonstrate aseptic micropropagation techniques.	**PS.03.01.04.c.** Propagate plants by micropropagation.
PS.03.01.05.a. Summarize the principles of recombinant DNA technology and the basic steps in the process.	**PS.03.01.05.b.** Compare and contrast the potential risks and advantages associated with genetically modified plants.	**PS.03.01.05.c.** Evaluate the impact of using genetically modified crops on other production practices.
PS.03.01.06.a. Identify advantages and disadvantages of hybrid plants**..**	**PS.03.01.06.b.** Compare and contrast single cross hybrids with double-cross hybrids.	**PS.03.01.06.c.** Evaluate the impact hybrid plants have on the increase yields of plants.
PS.03.02. Performance Indicator: Develop and implement a management plan for plant production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.03.02.01.a. Research and summarize the importance of starting with pest- and disease-free propagation material.	**PS.03.02.01.b.** Inspect propagation material for evidence of pests or disease.	**PS.03.02.01.c.** Produce pest- and disease-free propagation material.
PS.03.02.02.a. List and summarize the reasons for preparing growing media before planting.	**PS.03.02.02.b.** Prepare soil and growing media for planting with the addition of amendments.	**PS.03.02.02.c.** Analyze how mechanical planting equipment performs soil preparation and seed placement.
PS.03.02.03.a. Determine seeding rate need for specified plant population or desired quantity of finished plants.	**PS.03.02.03.b.** Apply pre-plant treatments required of seeds and plants and evaluate the results.	**PS.03.02.03.c.** Adjust and calibrate mechanized seeding and/or planting equipment for desired seed application rate.
PS.03.02.04.a. Observe and record environmental conditions during the germination, growth and development of a crop.	**PS.03.02.04.b.** Monitor the progress of plantings and determine the need to adjust environmental conditions.	**PS.03.02.04.c.** Prepare and implement a plant production schedule based on predicted environmental conditions and desired market target (e.g., having plants ready to market on a specific day such as Mother's Day, organic production, low maintenance landscape plants, etc.).
PS.03.02.05.a. Summarize the stages of plant growth and the reasons for controlling plant growth.	**PS.03.02.05.b.** Demonstrate proper techniques to control and manage plant growth through mechanical, cultural or chemical means.	**PS.03.02.05.c.** Prepare plant production schedules utilizing plant growth knowledge to get plants to their optimal growth stage at a given time.
PS.03.02.06.a. Identify and categorize structures and technologies used for controlled atmosphere production of plants.	**Ps.03.02.06.b.** Compare and contrast the types of technologies used for controlled atmosphere production.	**PS.03.02.06.c.** Research, select and defend technology for use in controlled atmosphere production.
PS.03.02.07.a. Summarize the use of hydroponic and aquaponic systems for plant production.	**PS.03.02.07.b.** Compare and contrast the types of systems used in hydroponic and aquaponics plant production.	**PS.03.02.07.c.** Research, select and defend the use of a hydroponic or aquaponics plant system.

PS.03.03. Performance Indicator: Develop and implement a plan for integrated pest management for plant production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.03.03.01.a. Identify and categorize plant pests, diseases and disorders.	**PS.03.03.01.b.** Identify and analyze major local weeds, insect pests and infectious and noninfectious plant diseases.	**PS.03.03.01.c.** Devise solutions for plant pests, diseases and disorders.
PS.03.03.02.a. Diagram the life cycle of major plant pests and diseases.	**PS.03.03.02.b.** Predict pest and disease problems based on environmental conditions and life cycles.	**PS.03.03.02.c.** Design and implement a crop scouting program.
PS.03.03.03.a. Identify and summarize pest control strategies associated with integrated pest management and the importance of determining economic threshold.	**PS.03.03.03.b.** Demonstrate pesticide formulations including organic and synthetic active ingredients and selection of pesticide to control specific pest.	**PS.03.03.03.c.** Employ pest management strategies to manage pest populations, assess the effectiveness of the plan and adjust the plan as needed.
PS.03.03.04.a. Distinguish between risks and benefits associated with the materials and methods used in plant pest management.	**PS.03.03.04.b.** Examine and apply procedures for the safe handling, use and storage of pesticides including personal protective equipment and reentry interval.	**PS.03.03.04.c.** Evaluate environmental and consumer concerns regarding pest management strategies.
PS.03.04. Performance Indicator: Apply principles and practices of sustainable agriculture to plant production.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.03.04.01.a. Compare and contrast the alignment of different production systems (conventional and organic) with USDA sustainable practices criteria.	**PS.03.04.01.b.** Analyze the alignment of modern technologies used in production systems (e.g., precision agriculture, GE crops, etc.) with USDA sustainable practices criteria.	**PS.03.04.01.c.** Research, prepare and defend plans for a plant systems enterprise that aligns with USDA sustainable practices criteria.
PS.03.04.02.a. Summarize national/international and local/regional food production systems.	**PS.03.04.02.b.** Compare and contrast the impact on greenhouse gas, carbon footprint of the national/international production system with local/regional production system markets.	**PS.03.04.02.c.** Select and defend the use of nationally/internationally grown or locally/regionally grown for a production operation system.
PS.03.04.03.a. Identify and summarize impacts of environmental conditions on plants.	**PS.03.04.03.b.** Compare and contrast differing research conclusions related to environmental factors and their effect on plants.	**PS.03.04.03.c.** Evaluate evidence supporting claims on how environmental conditions effect plants.

PS.03.05. Performance Indicator: Harvest, handle and store crops according to current industry standards.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.03.05.01.a. Identify and summarize harvesting methods and equipment.	**PS.03.05.01.b.** Assess the stage of growth to determine crop maturity or marketability and demonstrate proper harvesting techniques.	**PS.03.05.01.c.** Analyze the processed used by mechanical harvesting equipment.
PS.03.05.02.a. Research and summarize reasons for calculating crop loss and or damage.	**PS.03.05.02.b.** Evaluate crop yield and loss data and make recommendations to reduce crop loss.	**PS.03.05.02.c.** Implement and evaluate the effectiveness of plans to reduce crop loss.
PS.03.05.03.a. Research and summarize how safety is ensured at each stage of the following processes: harvesting, processing and storing.	**PS.03.05.03.b.** Research and analyze practices used to maintain a safe product through harvest, processing, storage and shipment (e.g., Food Safety Modernization Act, Good Agricultural Practices, etc.).	**PS.03.05.03.c.** Research laws and apply regulations to ensure the production of plants and plant products that are safe for distribution and use.
PS.03.05.04.a. Identify and categorize plant preparation methods for storing and shipping plants and plant products.	**PS.03.05.04.b.** Analyze the proper conditions required to maintain the quality of plants and plant products held in storage and during shipping.	**PS.03.05.04.c.** Monitor and evaluate environmental conditions in storage facilities for plants and plant products.
PS.03.05.05.a. Summarize the reasons for preparing plants and plant products for distribution.	**PS.03.05.05.b.** Demonstrate techniques for grading, handling and packaging plants and plant products for distribution.	**PS.03.05.05.c.** Evaluate techniques for grading, handling and packaging plants and plant products.
PS.04. CCTC Framework: Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).		
PS.04.01. Performance Indicator: Evaluating, identifying and preparing plants to enhance an environment.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.04.01.01.a. Identify and categorize plants by their purpose (e.g., floral plants, landscape plants, house plants, etc.).	**PS.04.01.01.b.** Demonstrate proper use of plants in their environment (e.g., focal and filler plants in floriculture, heat tolerant and shade plants in a landscape design, etc.).	**PS.04.01.01.c.** Install plants according to a design plan that uses the proper plants based on the situation and environment.
PS.04.01.02.a. Summarize the applications of design in agriculture and ornamental plant systems.	**PS.04.01.02.b.** Create a design utilizing plants in their proper environments.	**PS.04.01.02.c.** Evaluate a design and provide feedback and suggestions for improvement (e.g., a floral arrangement, a landscape or a landscape plan, etc.).

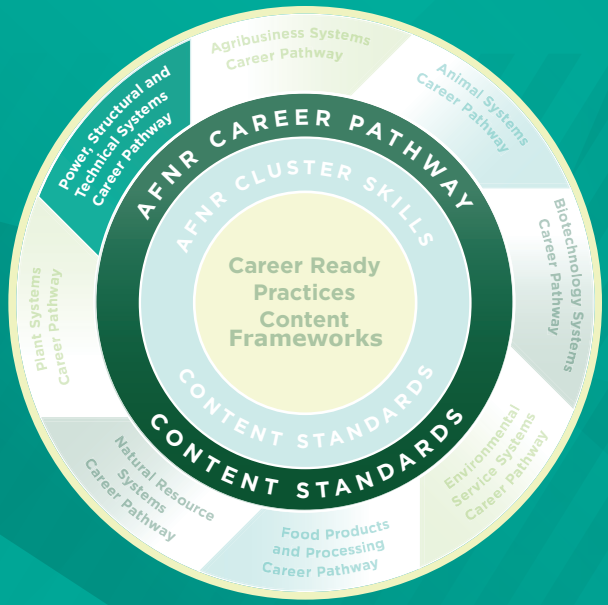
PS.04.02. Performance Indicator: Create designs using plants.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.04.02.01.a. PS.04.02.01.a. Explain conditioning products as they relate to foliage and flower products.	**PS.04.02.01.b.** Demonstrate appropriate conditioning and storage of cut flowers.	**PS.04.02.01.c.** Evaluate the condition and estimate life span of cut flowers used for floral arrangements.
PS.04.02.02.a. Research and summarize the principles and elements of design for use in plant systems.	**PS.04.02.02.b.** Apply principles and elements of design that form the basis of artistic impression.	**PS.04.02.02.c.** Analyze designs to identify use of design principles and elements.
PS.04.02.03.a. Identify and categorize tools used for design (e.g., computer landscape software, drawing tools, florist tools, etc.).	**PS.04.02.03.b.** Demonstrate the use of tools used for creating designs.	**PS.04.02.03.c.** Choose and properly use appropriate tools to create a desired design.
PS.04.02.04.a. Explain the concept of landscape ecology and summarize factors that shape the ecology of a landscape (e.g., composition, structure, function, etc.).	**PS.04.02.04.b.** Research and provide examples of ecological factors incorporated into landscape designs.	**PS.04.02.04.c.** Utilize green technologies and sustainable practices that prevent or limit negative environmental impacts.
PS.05. CCTC Framework: Implement management strategies for greenhouse crop production.		
PS.05.01. Performance Indicator: Manage greenhouse construction.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.05.01.01.a. Describe characteristics of successful greenhouses and create a list of factors for planning and designing greenhouse facilities. Factors must include physical location, market potential, utilities, climatic conditions, and production goals.	**PS.05.01.01.b.** Explain how greenhouses promote plant growth through light, air movement, temperature, and humidity control.	**PS.05.01.01.c.** Compare general maintenance and upkeep requirements for a variety of greenhouses in relation to the type of structure and associated systems. Create a checklist of prescribed maintenance, preventative maintenance, monitoring, and troubleshooting schedules for greenhouse facilities and equipment. Demonstrate the mechanical skills needed for the general maintenance and repair of greenhouses and associated systems (such as basic wiring, plumbing, and general construction).

PS.05.02. Performance Indicator: Evaluate and implement greenhouse environmental controls.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.05.02.01.a. Demonstrate effective methods to meet water requirements for healthy plant growth. Examine and explain how water pH influences plant growth. Research from multiple technical texts the function and operating principles of greenhouse irrigation systems (such as misting, drip, and overhead systems) to meet watering requirements for the purposes of maintaining optimum moisture level for a variety of plants.	**PS.05.02.01.b.** Assess the procedures required for producing multiple commercial plant species in a controlled environment, and apply these procedures to produce a variety of specific greenhouse crops. Evaluate environmental factors that affect greenhouse crops to justify management methods.	**PS.05.02.01.c.** Evaluate the greenhouse climate and recommend the proper climate control equipment to maintain an optimum growing climate, including but not limited to ventilation, humidifiers, heating, cooling, and shading. Provide written justification for each recommendation.
PS.05.02. Performance Indicator: Use recognized methods to operate a greenhouse business.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.05.02.01.a. Research, develop, and implement greenhouse production schedules for a representative sampling of greenhouse crops that includes at least the following: plant selection, plant material cost (seed, plug, cuttings), growth media, fertilizers, water, testing kits, pricing guides, profit margin, labor, and other expenses.	**PS.05.02.01.b.** Accurately maintain an activity recordkeeping system and apply proper financial recordkeeping skills as they relate to a greenhouse industry. Demonstrate the ability to analyze records by generating reports and completing related applications.	**PS.05.02.c.** Accurately maintain an activity recordkeeping system and apply proper financial recordkeeping skills as they relate to a greenhouse industry. Demonstrate the ability to analyze records by generating reports and completing related applications.
PS.06. CCTC Framework: Apply physical science principles and engineering applications to solve problems in plant science systems.		
PS.06.01. Performance Indicator: Apply physical science and engineering principles to assess and select tools for maintenance of AFNR plant science systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.06.01.01.a. Select and safely use the following hand tools and equipment in the landscape industry: garden rake, leaf rake, shovel, spade, hand shears, loppers, rotary spreader, and drop spreader.	**PS.01.01.01.b.** Calculate the maintenance and purchase cost of tools, machines and equipment used in plant science systems.	**PS.01.01.01.c.** Devise and document processes to safely implement and evaluate the safe use of plant science systems related tools, machinery and equipment.

PS.07. CCTC Framework: Demonstrate principles of turf grass production and management		
PS.07.01. Performance Indicator: Describe the importance of the turf industry.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.07.01.01.a. Explain the size and scope of the turf industry.	**PS.07.01.01.b.** Research and report on career and entrepreneurship opportunities in the turf industry.	**PS.07.01.01c.** Develop a plan that leads to college and a career in the turf industry.
PS.08. CCTC Framework: Examine the principles of plant science as related to turf management		
PS.08.01. Performance Indicator: Distinguish turf from other plant crops.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.08.01.01.a. List the benefits that turf provides individuals and the environment.	**PS.08.01.01.b.** Explain the four main applications of turf: lawns, utility, sports turf, and golf courses.	**PS.08.01.c.** Compare and contrast sod production versus seed production of turf.
PS.08.02. Performance Indicator: Describe the morphology of turf grass.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.08.02.01.a. Identify the basic morphological structures of turf grass.	**PS.08.02.01.b.** Explain the difference between rhizomes, stolons and tillers in turf grass.	**PS.08.0201.c.** Collect and classify turf grass varieties according to their inflorescence and seed heads.
PS.08.03. Performance Indicator: Explain turf grass types.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.08.03.01.a. Explain the following in terms of selecting types of turf grass; growth habit and zone of growth.	**PS.08.03.01.b.** Distinguish the differences between warm-season turf grasses and cool-season turf grasses.	**PS.08.03.01.c.** Research turf grass varieties that are suited to grow in Connecticut for the four main applications of turf, lawns, utility, sports turf and golf courses.
PS.09. CCTC Framework: Implement a plan for the establishment of a lawn.		
PS.09.01. Performance Indicator: Explain site preparation as it relates to establishment of a lawn.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.09.01.01.a. Make a list of steps in order to prepare a site for establishing a lawn.	**PS.09.01.01.b.** Conduct a soil analysis of a site selected for a lawn.	**PS.09.01.01c.** Prepare a site to establish a lawn utilizing a soil analysis for determine fertilization requirements and pH adjustments.

PS.09.01.02.a. Identify various methods of planting turf grass seed.	**PS.09.01.02.b.** Select a seed or seed blend for selected lawn site.	**PS.09.01.02.c.** Plant turf grass seed on a prepared site.
PS.09.01.03.a. List the advantages for using sod vs planting seeds when establishing a lawn.	**PS.09.01.03.b.** Explain the steps involved in laying sod.	**PS.09.01.03.c.** Lay sod on a prepared site to establish a lawn.
PS.10. CCTC Framework: Manage an established lawn.		
PS.10.01. Performance Indicator: Manage irrigation of established lawn.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.10.01.01.a. Identify irrigation methods for lawns.	**PS.10.01.01b.** Determine when and how long to irrigate an established lawn.	**PS.10.01.01.c.** Irrigate an established lawn.
PS.10.02. Performance Indicator: Execute a fertilizer plan for an established lawn.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.10.02.01.a. List how plant nutrients needs for turf grass is different than for other crops.	**PS.10.02.01.b.** Using a soil analysis, develop a fertilization plan for an established lawn.	**PS.10.02.01.c.** Fertilize an established lawn.
PS.10.03. Performance Indicator: Perform mechanical maintenance of established lawns.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.10.03.01.a. Explain the need to mow, aerate and thatch control lawns.	**PS.10.03.01.b.** Develop a plan for mowing, thatching and aerating established lawns.	**PS.10.03.01.c.** Mow, thatch and aerate established lawns as needed.
PS.11.01 Examine basic sport turf and golf course maintenance practices.		
PS.11.01. Performance Indicator: Examine basic sports turf management practices.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.11.01.01.a. Identify the steps needed to properly plan and layout a sports turf field.	**PS.11.01.01.a.** Explain the maintenance requirements of a sports turf field.	**PS.11.01.01.a.** Plan, develop and plant a sports turf field.
PS.11.02. Performance Indicator: Examine basic golf course industry.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.11.02.01.a. Describe the scope and development of the golf course industry.	**PS.11.02.01.a.** Compare the career opportunities and skills needed in golf course management.	**PS.11.02.01.a.** Conduct a supervised agriculture experience related to the golf course industry.

PS.11.03. Performance Indicator: Examine basic golf course industry.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PS.11.03.01.a. Describe the various areas of a golf course, including tees, fairways, putting greens, roughs, bunkers, and hazards.	**PS.11.03.01.b.** Determine the practices and benefits of mowing, fertilizing, irrigating, cultivating, and regulating golf courses.	**PS.11.03.01.c.** Maintain a golf course.



POWER, STRUCTURAL AND TECHNICAL SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks

Power, Structural and Technical Systems Career Pathway Content Frameworks

PURPOSE: The career pathway content standards outline technical knowledge and skills required for future success within this discipline. The content frameworks are intended to provide state agricultural education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the frameworks as a basis for the development of well-planned curriculum and assessments for Agriculture, Food and Natural Resource (AFNR)-related Career and Technical Education (CTE) programs. If this pathway is part of a school's curriculum, then the adoption and use of these frameworks is required. Local Education Agencies are encouraged to adapt sample measurements to meet local needs.

SCOPE: The Power, Structural and Technical Systems (PST) Career Pathway encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in AFNR settings.

SAMPLE CAREERS: Diesel Mechanic, Machine Operators, Agricultural Engineers, Heavy Equipment Maintenance Technicians, Equipment and Parts Managers, Welders, Machinists, GPS Technicians, Remote Sensing Specialist

DEFINITIONS: Within each pathway, the frameworks are organized as follows:

- ***Common Career Technical Core (CCTC) Frameworks*** – These are the frameworks for Power, Structural and Technical Systems (AG-PST) from the 2012 version of the Common Career and Technical Core Frameworks, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.
- ***Sample Measurements*** – The statements are ***sample*** measureable activities that students might carry out to indicate attainment of each performance indicator at three levels of proficiency – awareness (a), intermediate (b), and advanced (c). This is not intended to be an all-encompassing list; the sample measurements are provided as examples to demonstrate a logical progression of knowledge and skill development pertaining to one or more content areas related to the performance indicator. State and local entities may determine the most appropriate timing for attainment of each level of proficiency based upon local CTE program structures.

CONNECTIONS TO OTHER PATHWAYS:
For additional content frameworks on the topic of precision technologies, specifically Geographic Information Systems, see Environmental Service Systems ESS.05 and Natural Resource Systems ESS.03.

PST.01. CCTC Framework: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.		
PST.01.01. Performance Indicator: Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.01.01.01.a. Research and identify renewable and nonrenewable energy sources used in AFNR.	**PST.01.01.01.b.** Assess the environmental impacts of renewable and nonrenewable energy sources used in AFNR.	**PST.01.01.01.c.** Design and implement methods to evaluate the efficiency of renewable and nonrenewable energy sources used in AFNR.
PST.01.01.02.a. Compare and contrast the pathways of delivery for renewable and nonrenewable energy sources in an AFNR enterprise or business.	**PST.01.01.02.b.** Calculate the costs of using renewable and nonrenewable energy sources in an AFNR enterprise or business.	**PST.01.01.02.c.** Devise a strategy to incorporate the use of selected energy sources in an ANFR enterprise or business.
PST.01.01.03.a. Summarize methods and compare and contrast units used to benchmark energy use of AFNR structures (e.g., EUIs, BTUs, etc.).	**PST.01.01.03.b.** Convert energy utilized in an AFNR structure to an energy utilization index (e.g., convert CCF, KWH, etc. to Btu consumption per square foot, etc.).	**PST.01.01.03.c.** Apply energy benchmarking data to examine and select methods to conserve energy in AFNR structures.
PST.01.02. Performance Indicator: Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.01.02.01.a Compare and contrast applications of simple machines in AFNR related mechanical systems.	**PST.01.02.01.b** Perform mathematical calculations to determine the mechanical advantage of simple machines in AFNR related mechanical systems.	**PST.01.02.01.c.** Apply devise strategies to improve the efficiency of operation of AFNR related mechanical systems.
PST.01.02.02.a. Identify and explain the uses of the following woodworking tools used in agricultural construction: circular saw, drill press, jig/sabre saw, reciprocating saw, table saw, orbital sander, belt sander, router, portable drill, and miter saw.	**PST.01.02.02.b.** Calculate the maintenance and purchase cost of tools, machines and equipment used in AFNR including explaining the difference of and applications for corded and cordless tools.	**PST.01.02.02.c.** Devise and document processes to safely implement and evaluate the safe use of AFNR related tools, machinery and equipment.
PST.01.02.03.a. Examine owner's manuals to classify the types of safety hazards associated with different mechanical systems used in AFNR (e.g., caution, warning, danger, etc.).	**PST.01.02.03.b.** Select, maintain and demonstrate the proper use of tools, machines and equipment used in different AFNR related mechanical systems.	**PST.01.02.03.c.** Conduct a safety inspection of tools, machines and equipment used in different AFNR related mechanical systems.

PST.01.03. Performance Indicator: Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Gas Tungsten Arc Welding (GTAW), fuel-oxygen and plasma arc torch, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.01.03.01.a. Compare and contrast the principles and procedures of different welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).	**PST.01.03.01.b.** Analyze the situation and determine the best welding and cutting process to be used in metal fabrication.	**PST.01.03.01.c.** Evaluate the quality of metal fabrication procedures (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
PST.01.03.02.a. Identify personal protection equipment (PPE) used in welding.	**PST.01.03.02.b.** Demonstrate how to safely setup, use, and turn off oxy-acetylene welding equipment.	**PST.01.03.02.c.** Construct and/or repair metal structures and equipment using oxy acetylene welding equipment.
PST.01.03.03.a. Use the five-digit AWS classification system for selecting electrodes used in shielded metal arc welding (SMAW).	**PST.01.03.02.b.** Demonstrate how to safely set up, use, and turn off shielded metal arc welding (SMAW) equipment.	**PST.01.03.02.c.** Construct and/or repair metal structures and equipment using shielded metal arc welding (SMAW) equipment.
PST.01.03.04.a Compare and contrast the properties of different metals used in AFNR power, structural and technical systems (e.g., malleability, conductivity, optical properties, chemical composition, etc.).	**PST.01.03.04.b.** Demonstrate how to safely set up, use, and turn off a gas metal arc welding system (GMAW).	**PST.01.03.04.c.** Construct and/or repair metal structures and equipment using gas metal arc welding system (GMAW).
PST.02. CCTC Framework: Operate and maintain AFNR mechanical equipment and power systems.		
PST.02.01. Performance Indicator: Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power, structural and technical systems to assure proper functionality.	**PST.02.01.01.b.** Develop a preventative maintenance schedule for equipment, machinery and power units used in AFNR power, structural and technical systems.	**PST.02.01.01.c.** Devise a strategy to communicate to different audiences, preventative maintenance and service schedule for equipment, machinery and power units used in AFNR power, structural and technical systems.
PST.02.01.02.a. Identify the safety and operational procedures and service intervals based on a tractor or equipment operator's manual.	**PST.02.01.02.b.** Follow the operator's manual to maintain tractors and skid steers.	**PST.02.01.02.c.** Assess and adjust equipment (e.g., belts and drives, chains, sprockets, etc.) and maintain fluid conveyance components (e.g., hoses, lines, nozzles, etc.) to ensure proper functioning.

PST.02.02. Performance Indicator: Operate machinery and equipment while observing all safety precautions in AFNR settings.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.02.02.01.a. Research and summarize the use of equipment, machinery and power units for AFNR power, structural and technical systems.	**PST.02.02.01.b.** Analyze and calculate the cost of using equipment, machinery, and power units for AFNR power, structural and technical systems.	**PST.02.02.01.c.** Perform pre-operation inspections, start-up & shut-down procedures on equipment, machinery and power units as specified in owner's manuals.
PST.02.02.02.a. Examine and identify safety hazards associated with equipment, machinery and power units used in AFNR power, structural, and technical systems (e.g., caution, warning, danger, etc.).	**PST.02.02.02.b.** Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.	**PST.02.02.02.c.** Adjust equipment, machinery and power units for safe and efficient operation in AFNR power, structural and technical systems.
PST.03. CCTC Framework: Service and repair AFNR mechanical equipment and power systems.		
PST.03.01. Performance Indicator: Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.03.01.01.a. Identify and classify components of internal combustion engines used in AFNR power, structural and technical systems.	**PST.03.01.01.b.** Analyze and explain how the components of internal combustion engines interrelate during operation.	**PST.03.01.01.c.** Evaluate service and repair needs for internal combustion engines using a variety of performance tests (e.g., manuals, computer-based diagnostics, etc.).
PST.03.01.02.a. Distinguish the characteristics of spark-and-compression internal combustion engines used in AFNR power, structural and technical systems.	**PST.03.01.02.b.** Utilize technical manuals and diagnostic tools to determine service and repair needs of spark-and-compression internal combustion engines used in AFNR power, structural and technical systems.	**PST.03.01.02.c.** Inspect, analyze and repair spark-and-compression internal combustion engines used in AFNR power, structural and technical systems.
PST.03.01.03.a. Compare and contrast two-stroke and four stroke engines.	**PST.03.01.03.b.** Utilize a Briggs and Stratton repair manual to find engine specifications.	**PST.03.01.03.c.** Order parts for Briggs and Stratton engines.

PST.03.02. Performance Indicator: Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.03.02.01.a Compare and contrast basic units of electricity (e.g., volts, amps, watts, and ohms) and the principles that describe their relationship (e.g., Ohm's Law, Power Law, etc.).	**PST.03.02.01.b.** Assess the tools used to measure the basic units of electrical circuits in AFNR power, structural and technical systems, and perform the measurements.	**PST.03.02.01.c.** Analyze and design electrical circuits for AFNR power, structural and technical systems using knowledge of the basic units of electricity.
PST.03.02.02.a. Compare and contrast the characteristics of electronic components used in AFNR power, structural and technical systems (e.g., battery, resistor, diode, transistor, capacitor, etc.).	**PST.03.02.02.b.** Analyze and interpret electrical system symbols and diagrams.	**PST.03.02.02.c.** Conduct testing procedures to evaluate and repair malfunctioning electrical components and systems used in AFNR power, structural and technical systems.
PST.03.02.03.a. Classify the uses of electrical sensors and controls in AFNR power, structural and technical systems.	**PST.03.02.03.b.** Distinguish and select materials and tools used in electrical control circuit installation.	**PST.03.02.03.c.** Plan and install electrical control circuits and/or circuit boards to assure proper operation within AFNR power, structural and technical systems.
PST.03.03. Performance Indicator: Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	**PST.03.03.01.b.** Analyze and interpret hydraulic and pneumatic system symbols and diagrams used in AFNR power, structural and technical systems.	**PST.03.03.01.c.** Inspect, analyze and repair hydraulic and pneumatic system components used in AFNR power, structural and technical systems.
PST.03.03.02.a. Compare and contrast operation principles and features of mechanical transmission systems used in AFNR power, structural and technical systems (e.g., belts, chains, gears, bearings, seals, universals, drive shafts, etc.).	**PST.03.03.02.b.** Utilize speed, torque and power measurements to calculate efficiency in power transmission systems used in AFNR power, structural and technical systems.	**PST.03.03.02.c**. Inspect, analyze and repair the components of power transmission systems used in AFNR power, structural and technical systems.
PST.03.03.03.a. Identify and examine the components of suspension and steering systems used in AFNR power, structural and technical systems.	**PST.03.03.03.b.** Assess and analyze vehicle and machinery performance related to suspension and steering systems used in AFNR power, structural and technical systems.	**PST.03.03.03.c.** Inspect, analyze and repair vehicle suspension and steering systems used in AFNR power, structural and technical systems.

PST.04. CCTC Framework: Plan, build and maintain AFNR structures.		
PST.04.01. Performance Indicator: Create sketches and plans for AFNR structures.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.04.01.01.a. Interpret and explain the meaning of symbols used in sketches of agricultural structures.	**PST.04.01.01.b.** Apply scale measurement and dimension to develop sketches of agricultural structures.	**PST.04.01.01.c.** Create sketches of an agricultural structure by applying principles of design.
PST.04.01.02.a. Read and interpret the parts and/or views of plans for agricultural structures**.**	**PST.04.04.02.b.** Construct plans for agricultural structures using current technology (e.g., drafting software, computer-aided design, etc.).	**PST.04.01.02.c.** Evaluate, plan and design functional and efficient facilities for use in AFNR power, structural and technical systems.
PST.04.02. Performance Indicator: Determine structural requirements, specifications and estimate costs for AFNR structures		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.04.02.01.a. Summarize and categorize the information needed to complete a bill of materials and cost estimate for an AFNR structure.	**PST.04.02.01.b.** Analyze a project plan to prepare a bill of materials and an estimate of material costs.	**PST.04.02.01.c.** Create a project cost estimate, including materials, labor and management for an AFNR structure.
PST.04.02.02.a. Research and summarize sources of industry construction and materials standards and their importance (e.g., American National Standards Institute, ANSI, Underwriters' Laboratories, UL, etc.).	**PST.04.02.02.b.** Assess and analyze local building code requirements for agriculture structures.	**PST.04.02.02.c.** Design and conduct a building functionality and safety assessment on an agricultural structure using knowledge of industry standards and local code requirements.
PST.04.03. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.04.03.01.a. Examine the criteria in selecting materials for constructing, maintaining, and/or repairing AFNR structures.	**PST.04.03.01.b.** Analyze and assess samples of materials or products for quality and efficiency of workmanship.	**PST.04.03.01.c.** Select materials for a project based upon an analysis of the project and the quality of the materials.
PST.04.03.02.a. Summarize the characteristics needed for an ideal building site.	**PST.04.03.02.b.** Complete a building site analysis checklist to select an ideal building site.	**PST.04.03.02.c.** Assess site characteristics, identify adjustments, and demonstrate procedures for preparing a building site.
PST.04.03.03.a. Compare and contrast the characteristics of wood and/or metal products used in AFNR structures.	**PST.04.04.03.b.** Calculate costs associated with the repair and replacement of wood and/or metal components an AFNR structure.	**PST.04.03.03.c.** Construct AFNR structures using wood and/or metal materials.

PST.04.03.04.a. Compare and contrast the characteristics of materials used in plumbing and water systems (e.g., copper, PVC, PEX, etc.).	**PST.04.03.04.b.** Calculate the cost of a water system in an AFNR structure (e.g., copper, PVC, etc.).	**PST.04.03.04.c.** Install and/or repair pipes and plumbing equipment and fixtures in AFNR structures.
PST.04.03.05.a. Compare and contrast the characteristics of fencing materials, including government regulations and applicable installation codes.	**PST.04.03.05.b.** Measure and calculate the cost of fencing materials.	**PST.04.03.05.c.** Construct, maintain, and/or repair fencing, including wood, static wire, electrical wire and other fencing materials.
PST.04.03.06.a. Summarize the characteristics of the components found in concrete.	**PST.04.03.06.b.** Calculate volume for concrete projects.	**PST.04.03.06.c.** Construct, maintain and/or repair AFNR structures with concrete, brick, stone or masonry.
PST.04.03.07.a. Differentiate between types of insulation materials used in AFNR structures.	**PST.04.03.07.b.** Calculate BTU loss in an AFNR structure.	**PST.04.03.07.c.** Insulate a structure and estimate reduced BTU loss.
PST.04.04. Performance Indicator: Apply electrical wiring principles in AFNR structures.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.04.04.01.a. Define and measure amps, volts, and watts.	**PST.04.04.01.b.** Assess and analyze the electrical requirements of an AFNR structure.	**PST.04.04.01.c.** Install the following electrical circuits: duplex receptacle, single pole switch with light, and three-way switch with light.
PST.04.04.02.a. Distinguish electrical circuits and the components of each.	**PST.04.04.02.b.** Calculate the cost of operating an electrical motor.	**PST.04.04.02.c.** Plan and wire electrical circuits (i.e., single pole switch, three-way switch, duplex outlet, etc.).
PST.05. CCTC Framework: Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.		
PST.05.01. Performance Indicator: Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.05.01.01.a. Research and categorize computer technologies used to solve problems and increase efficiency in AFNR systems.	**PST.05.01.01.b.** Analyze data using computer programs and other current technologies used in AFNR systems.	**PST.05.01.01.c.** Solve problems and calculate changes in efficiency using computer technologies for AFNR systems.

PST.05.03.02.a. Examine and summarize the specific intent of technologies used to solve problems and increase the efficiency of AFNR systems (e.g., robotics, UAS, CNC, etc.).	**PST.05.03.02.b.** Calculate the change in efficiency after using technologies in AFNR systems.	**PST.05.03.02.c.** Solve problems and evaluate changes in efficiency and create recommendations for the use of technologies in AFNR systems.
PST.05.02. Performance Indicator: Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR settings.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.05.02.01.a. Examine and categorize electrical control system components used in AFNR systems (e.g., transistors, relays, HVAC, logic controllers, etc.).	**PST.05.02.01.b.** Analyze schematic drawings for electrical control systems used in AFNR systems.	**PST.05.02.01.c.** Design schematic drawings for electrical control systems used in AFNR systems.
PST.05.02.02.a. Differentiate between the purpose of electrical sensors and controls used in AFNR power, structural and technical systems.	**PST.05.02.02.b.** Interpret maintenance schedules for electrical control systems used in AFNR power, structural and technical systems.	**PST.05.02.02.c.** Troubleshoot electrical control system performance problems found in AFNR power, structural and technical systems.
PST.05.02.03.a. Research and summarize the importance of AFNR power, structural and technical control systems using programmable logic controllers (PLC) and/or other computer-based systems.	**PST.05.02.03.b.** Assess the functions of AFNR power, structural and technical control systems using programmable logic controllers (PLC) in agricultural production and manufacturing.	**PST.05.02.03.c.** Develop and implement AFNR power, structural and technical control systems using programmable logic controllers (PLC) and/or other computer-based systems.
PST.05.03. Performance Indicator: Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.		
Sample Measurement: The following sample measurement strands are provided to guide the development of measurable activities (at different levels of proficiency) to assess students' attainment of knowledge and skills related to the above performance indicator. The topics represented by each strand are not all-encompassing.		
PST.05.03.01.a. Research and summarize the impact of utilizing geospatial technologies (i.e., GPS, GIS, remote sensing, telematics, etc.) in AFNR systems.	**PST.05.03.01.b.** Analyze and interpret trends in data collected utilizing geospatial technologies.	**PST.05.03.01.c.** Collect data and create maps utilizing geospatial technologies.
PST.05.03.02.a. Examine the components of precision technologies used in AFNR systems.	**PST.05.03.02.b.** Analyze and calculate the economic impact of utilizing precision technologies (e.g., GPS/GIS) in AFNR systems.	**PST.05.03.02.c.** Install, maintain and service instrumentation and equipment used for precision technologies (i.e., GPS receivers, yield monitors, remote sensors, etc.) used in AFNR systems.

NATIONAL FFA PRECEPTS

The FFA Mission and Precepts

FFA Mission:

FFA makes a positive difference in the lives of students by developing their potential for premier leadership, personal growth and career success through agricultural education.

To accomplish this mission, FFA:

- Develops competent and assertive agricultural leadership.
- Increases awareness of the global and technological importance of agriculture and its contribution to our well-being.
- Strengthens agriculture students' confidence in themselves and their work.
- Promotes the intelligent choice and establishment of an agricultural career.
- Encourages achievement in supervised agricultural experience (SAE) programs.
- Encourages wise management of the community's economic, environmental and human resources.
- Develops interpersonal skills in teamwork, communication, human relations and social interaction.
- Builds character and promotes citizenship, volunteerism and patriotism.
- Promotes cooperation and cooperative attitudes among all people.
- Promotes healthy lifestyles.
- Encourages excellence in scholarship.

The National FFA Precepts are the standards that are utilized to accomplish the FFA mission.

National FFA Organization

Precepts for Leadership, Personal Growth and Career Success

PREMIER LEADERSHIP

Definition: Leadership is influence.

- A - Action
  - A1. Work independently and in groups to get things done
  - A2. Focus on results
  - A3. Plan effectively
  - A4. Identify and use resources
  - A5. Communicate effectively with others
  - A6. Take risks to get the job done
  - A7. Invest in others by enabling and empowering them
  - A8. Evaluate and reflect on actions taken and make appropriate modifications
- B - Relationships
  - B1. Practice human relations skills including compassion, empathy, unselfishness, trustworthiness, reliability and listening
  - B2. Interact and work with others
  - B3. Develop others
  - B4. Eliminate barriers in building relationships
  - B5. Participate effectively as a team member
- C - Vision
  - C1. Contemplate the future
  - C2. Conceptualize ideas
  - C3. Demonstrate courage to take risks
  - C4. Adapt to opportunities and obstacles
  - C5. Persuade others to commit
- D - Character
  - D1. Live with integrity
  - D2. Accurately assess my values
  - D3. Accept responsibility for personal actions
  - D4. Respect others
  - D5. Practice self-discipline
  - D6. Value service to others
- E - Awareness
  - E1. Address issues important to the community
  - E2. Perform leadership tasks associated with citizenship
  - E3. Participate in activities that promote appreciation of diversity

F - Continuous Improvement

F1. Implement a leadership and personal growth plan
F2. Seek mentoring from others
F3. Use innovative problem solving strategies
F4. Adapt to emerging technologies
F5. Acquire new knowledge

PERSONAL GROWTH

Definition: Personal growth is the positive evolution of the whole person.

G - Physical Growth

G1. Practice healthy eating habits
G2. Respect one's body
G3. Participate in a fitness program
G4. Set goals for long term health

H - Social Growth

H1. Acknowledge that differences exist among people
H2. Present self appropriately in various settings
H3. Develop, maintain, and grow healthy relationships

I - Professional Growth

I1. Plan and implement professional goals and priorities
I2. Make clear decisions in my professional life
I3. Demonstrate professional ethics
I4. Balance personal and professional responsibilities
I5. Demonstrate exemplary employability skills

J - Mental Growth

J1. Think critically
J2. Think creatively
J3. Practice sound decision-making
J4. Solve problems
J5. Commit to life long learning
J6. Persuade others
J7. Practice sound study skills

K - Emotional Growth

K1. Cope with life's trials
K2. Live a compassionate and selfless life
K3. Develop self-assurance and confidence
K4. Embrace the emotional development process
K5. Establish emotional well-being
K6. Seek appropriate counsel
K7. Practice healthy expressions of love

L - Spiritual Growth

L1. Nurture a spiritual belief system

L2. Respect and be sensitive to others' beliefs

CAREER SUCCESS

Definition: Career success is continuously demonstrating those qualities, attributes and skills necessary to succeed in or further prepare for a chosen profession while effectively contributing to society.

M - Communications

M1. Demonstrate technical and business writing skills

M2. Demonstrate professional job seeking skills

M3. Makes effective business presentations

M4. Communicates appropriately with co-workers and supervisors

M5. Operates effectively in the workplace

N - Decision Making

N1. Demonstrate the decision making process

N2. Demonstrate problem-solving skills

N3. Make ethical decisions

N4. Choose a career based on passion, abilities, and aptitudes

O - Flexibility and Adaptability

O1. Embraces emerging technology in the workplace

O2. Manages change

O3. Reacts with openness to feedback and professional growth opportunities

O4. Experiments and takes risks

APPENDICES

APPENDIX A: NATIONAL REVISION METHODOLOGY

The process for revising the standards was designed to ensure input and guidance from a diverse set of educators, business and industry representatives, and the public. The process consisted of 6 phases:

- ***Phase 1: Appointment of a Revision Governing Committee (April – June 2014)***
  - During this phase The National Council for Agricultural Education appointed a 9-member committee to advise the revision process.
  - Members of the committee represent a diverse group of post-secondary technical area instructors, agriculture teacher educators, and state leaders of agricultural education.
  - The governing committee hired Vivayic, Inc., to facilitate the process and support the revision of the content standards.
- ***Phase 2: Open Comment Period on the 2009 Version of the AFNR Career Cluster Content Standards (July – August 2014)***
  - During this phase stakeholders were invited to share feedback on the strengths and weaknesses of the previous AFNR Career Cluster Content Standards through an electronic survey open to the public.
  - The electronic survey was open for six weeks and a total of 126 responses were collected from stakeholders such as secondary and post-secondary educators, state leaders of agricultural education, CTE administrators, and business and industry representatives.
  - Survey responses were analyzed and synthesized to identify priorities for the revision process and document opportunities to encourage adoption and use of the content standards.
    - One key need that emerged from the open comment period was the need to benchmark the content standards against other standards, particularly the Common Career and Technical Core (CCTC) published by the National Association of State Directors of Career and Technical Education Consortium (NASDCTEc).
- ***Phase 3: Subject Matter Expert Input on the 2009 Version of the AFNR Career Cluster Content Standards (September – October 2014)***
  - During this phase a diverse group of 262 volunteers representing business and industry, including for-profit corporations, non-for-profits, and government (federal and state), as well as education, including both secondary and post-secondary, were recruited to participate in a detailed review of the existing content standards.
  - 94% of the volunteers returned surveys; the average number of responses for each pathway was 27 with 25% representing business and industry and 75% representing education; respondent demographics were also monitored to ensure geographic representation from across the United States and its territories.
  - Input from the Subject Matter Experts was compiled and analyzed by Vivayic and the Revision Governing Committee.
    - Two kinds of revisions were identified: 1) universal changes to improve the consistency and quality of the content standards across all pathways and 2) specific content changes to improve and update the content standards within each pathway.

- ***Phase 4: Revision of AFNR Career Cluster Content Standards (November 2014 – January 2015)***
  - During this phase a small group of six qualified technical writers with experience in education and industry were assembled to implement the revisions identified in the previous phases.
  - The revisions included aligning the AFNR Career Cluster Content Standards to the AFNR benchmarks outlined in the CCTC as well as a number of other edits to improve the overall quality and consistency of the standards.
  - The revisions were completed under the direction of Vivayic, Inc. along with review and input from the Revision Governing Committee.
  - The technical writers were also encouraged to benchmark the revised content standards against relevant industry standards as well as educational standards for English Language Arts, Science, Mathematics, Personal Finance, etc.
  - Each pathway underwent at least four iterations before being approved by the Revision Governing Committee for this validation survey.
- ***Phase 5: Validation of the revised AFNR Career Cluster Content Standards by Subject Matter Experts (January – February 2015)***
  - During this phase a diverse group of 247 volunteers representing education and business and industry reviewed the revised content standards to validate that they meet the objectives set forth for this body of work by the Revision Governing Committee using an electronic survey.
    - Many of the respondents also provided detailed feedback in Phase 2; however, new educators and business and industry partners were recruited to broaden the audience invited to validate the revised product.
  - 95% of the volunteers returned surveys; the average number of responses for each pathway was 27 with 31% representing business and industry and 69% representing education; respondent demographics were also monitored to ensure geographic representation from across the United States and its territories.
  - No pathway had less than 82% of the respondents indicate agreement that the revised standards met each of the goals established at the beginning of the project; in fact, on average, 93% of the respondents either agreed or strongly agreed that the revised standards met the stated goals.
  - Results were compiled and reviewed by the Revision Governing Committee to identify any final, mission-critical, changes to make before finalizing and publishing the content standards for use by the field. These changes did not alter the original intent of the statements and included:
    - Improving the specificity and measurability of sample measurements
    - Adding additional examples to improve the clarity of terms used in the sample measurements
    - Minor wording changes to improve sentence flow and readability of performance indicators and sample measurements
- ***Phase 6: Finalization, Approval and Publication (March – April 2015)***
  - During this phase the Revision Governing Committee advised on the implementation of any high-priority edits identified in the previous phase.
  - The final, revised AFNR Career Cluster Content Standards were presented to The Council for final review and approval.
  - The Council approved the revised AFNR Career Cluster Content Standards on March 31, 2015.

APPENDIX B: NATIONAL SUBJECT MATTER EXPERT ACKNOWLEDGEMENTS

The revision process relied upon input from volunteers representing education and industry provided input and subject matter expertise to shape the revision process. Their input was fundamental to achieving the project goals. Below is a list of individuals that participated in the review and revision process. 5 reviewers respectfully declined to have their name and organization printed in the list. The National Council for Agricultural Education thanks all individuals who provided input during this process.

Name	Organization	Title
Daniel Welch	Charles H. Dyson School of Applied Economics and Management, Cornell University	Extension Support Specialist
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Danny Bartlett	South Region Agricultural Education	Forestry Area Teacher
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Matt Preston	Roxton ISD	Agriculture Instructor
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Lynn Barber	State Ag Ed Staff	South Region Ag Education Director
Rhonda Morga	Pearland ISD	AgScience Teacher
Barry Norris	Georgia Agrirculture Education	Central Region Forestry Teacher
Kahyon Freeman	Pittsburg FFA	Agricultural Science Teacher
Jose A. Bernal	PIMA JTED FFA	Instructor
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Michael Pate	Utah State University	Assistant Professor of Agricultural Systems Technology
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Jerry Taylor	Georgia Agricultural Education	Area Forestry Teacher
T.J. Brown	Springfield High School	High School Ag Instructor
Shannon Layman	Celina High School	Agricultural Science Teacher
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Kim Dieter	Herlong High School	Agriculture Science Teacher/FFA Advisor
David Howell	Cotton Center FFA	Ag Science Teacher
Marshall A. Baker	Oklahoma State University	Assistant Professor
Michael w. Harrington	Maryland Agricutlural Teachers Association	President - elect
Jamie Philen	Klein Oak FFA	Ag teacher
Bonnie Walters	University of Wisconsin - River Falls	Professor of Animal and Food Science
Amy Hartman	Schulenburg ISD	Ag science teacher
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Barbara Volk-Tunnell	Bryan High School	Agriculture Science Teacher
Kristyn Harms	Norris High School	Teacher
Tommy Waldrop	Ga. Ag Education	Area Animal Science Teacher

Name	Organization	Title
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Heather Singmaster	Asia Society	Assistant Director
Dale Gruis	Iowa Dept. of Education	Ag Ed Consultant
Ronald C. Daughtrey	Lakeland high School	Teacher - Age Ed
Jennifer Vandeburg	Ivy Tech Community College	Agriculture Program Chair
Bob Broeckelman	FCC Services (Part of the Farm Credit System	Vice President - Recruiting & Selection
Shannon Miller	R.L Turner High School	Agriculture Science Teacher
Chad Bontrager	Kansas Dept of Agriculture	Deputy Sectetary
Elizabeth Waters	Valley Agricultural Education and FFA	Agriculture/ Horticulture Instructor and FFA Advisor
Joe Ryan	Smoky Hill Education Service Center	CTE Coordinator
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Matt Jakubik	Whittemore-Prescott High School	Agriscience and Natural Resource Instructor
Tim Heeg	School District of Marshfield	Agriculture Teacher and FFA Advisor
Matthew Eddy	Southeast Polk CSD	Agriculture Instructor
Craig Kohn	Waterford Union High School	Instructor
Michael Everett	Michigan State University	Academic Specialist
William (Buddy) Deimler	Utah State Office of Education	Specialist Agricultural Education
Rhonda Knapp	Waunakee High School	Agriculture Instructor
J.P. Hancock	Texas A&M University	Assistant Lecturer
Justin Suttles	Fulton County Schools	Agriculture Teacher
Robert Bollier	Lexington Technology Center FFA	Agriscience Instructor
Todd N. Thomas	Caliche Ag-Ed/FFA and CVATA	Ag-Ed Instructor
Mary Kate Berardi	The Pennsylvania State University	Program Director
Heather Pray	Garden Spot High School	Agricultural Educator / FFA Advisor
Ron Biondo		Educational Consultant
Tammy Glascock	Pilot Point FFA	Agricultural Science Instructor
Cassandra Palsgrove	Ohio FFA/Office of Career Technical Education (Ohio Department of Education)	Education Program Specialist - Agriculture and Environmental Systems
Rebecca Carter	National FFA	Team Leader
OP McCubbins	Iowa State University	Instructor for Farm Management and Operation and current graduate student
Tracy Cofield	Turner High School	Agriculture Science Teacher
Josh Allen	Georgia Agriculture Education	Area Horticulture Teacher

Name	Organization	Title
Jennifer Mason	Othello High School	Agriculture Instructor
Rodney Peugh	Santo ISD	Agricultural Science Teacher
Tracey Cortez	Lanier Agriculture Dept	AST
Jen Cushman	Glastonbury High School	Head Agriscience Teacher
Kymberly Edds	Garrison High School	Ag Teacher/Coach
Lorie Kempen	East Central High School (FFA)	AgriScience Instructor of Floral Design
Tim Buttles	Univ. of Wisconsin - River Falls	Professor of Agricultural Education
Emily Picard	Lyman Hall High School Agricultural Science and Technology	Agri Science Teacher
James Hunter	State Ag Ed	South Region Ag Mecjanics Teacher
Steven Boot Chumbley	Eastern New Mexico University	Assistant Professor
Kevin Keith	National Team Ag Ed/National FFA Organization	LPS Team Leader
Jerry K. Alldredge	Nutrients For Life Foundation	Colorado Regional Representative
Patrick Hazen	Highland School District	Agriculture Science and Technology Instructor
Matt Wolters	SureFire Ag Systems	Sales and Marketing Lead
Kellie Claflin	Gillett Secondary School	Agriscience Teacher
Nancy Zenger-Beneda	Cloud County Community College	Dean of Sciences and Mathematics
Joel Larsen	Minnesota Department of Education	Program Specialist AFNR Education
Lucinda T Pease	Fleming County High School	Teacher
Travis Scherer	Tri-County Schools	Agriculture Teacher
Kate Skirvin	North Putnam High School/FFA	Agriculture Teacher
Jack Wiley	Trinidad State Junior College	Associate Dean for CTE programs
P. Troy White	University of Idaho	Graduate Research Assistant
Travis Park	North Carolina State University	Associate Professor
Matthew Farris	Oakland High School	Agriculture Educator
Roger King	School District of Holmen	Agriscience Instructor
David Laney	Denton ISD/FFA	Agriscience Instructor
Karen Buechman	Plano ISD	Former Ag Teacher/ Current CTE Coordinator
Jenna Genson	National FFA	Education Specialist
Jenna Hovermale	National FFA Organization	Education Specialist
Adam Tyler	Riverton Parke HS	Agriculture Teacher
Rick Parker	National Agricultural Institute	President
Jack Winterrowd	Leander ISD	Agriculture Science Teacher
Kurt Murray	OK Dept of Career and Technology Education	Program Specialist - Agricultural Education

Name	Organization	Title
Zane Sheehan	California FFA Association	Leadership Development Coordinator
Kristin Powers	Timpson ISD	Agricultural Education Teacher
Dr. Allison J. L. Touchstone	University of Idaho	Assistant Professor
Hugh Mooney	California Department of Education	North Coast Region Supervisor, Ag Ed
Rick Ahrens	Hernando High School	Agriscience Teacher
Harold Mackin	Connecticut State Department of Education	Agricultural Science Education Consultant
James D. Howe	Agriculture Teacher/Penn State University	Agricultural Sciences Teacher (Retired)
Chris Thomas	LaRue County High School	Ag Teacher
Steve Inman	Kankakee Valley High School	Agriculture Teacher
Matt Spindler	Department of Agricultural, Leadership, and Community Education, Virginia Tech	Assistant Professor
Christa Steinkamp	Georgia Agriculture Education	Curriculum & Technology Director
Lynn Martindale	UC Davis	Teacher Supervisor / Lecturer
Johnny Hackett	Alief ISD	Instructor
Kevin Williams	Ohio Department of Education	Program Specialist - Agricultural & Environmental Systems Career Field
Alexander J. Hess	Davis Senior High	Agriculture Teacher
Catherine Shoulders	University of Arkansas	Assistant Professor
Dale Crabtree	National FFA Organiztion	Director of Convention, Awards, Recognition, Events and Service division
Marc Beitia	American Falls School District	Agricultural Science and natural Resource Instructor
Leah Amstutz	Ohio Department of Education	Assistant Director
Blake Simmons	Blevins FFA	Agriculture teacher
Annette Weeks	Battle Ground High School	Teacher
Steven Gass	Tennessee Department of Education	Agriculture, Food and Natural Resources Career Cluster Consultant
Chris Weller	PA Dept. of Ed	State Advisor Ag Ed
Harmony	AFBF YF&R National Committee - Kane County Farm Bureau - DHC Agriculture	Member - President - Owner
Haley Hampton	National FFA Organization	Senior Educational Consultant
Holly partridge	Genesee Valley Educational Partnership	Animal science instructor
Margo D. Bruce	Webster County High School	Agriculture Teacher/FFA Advisor
Briana Hargett	Appoquinimink School District	Teacher of Secondary Agriculture
Mark Forbush	Corunna High School	Agriscience Educator and FFA Advisor

Name	Organization	Title
Bill Kluth	Tagawa Greenhouse Enterprises, LLC	General Manager - Golden
Tracy Probst	Ag. Education	Teacher
Cory Epler	Nebraska Department of Education	Deputy State Director, Career Education
Janella Miller	Pulaski County High School	Agriculture teacher & FFA Advisor
Brandon K Davis	Kentucky Department of Education	State Supervisor of Agricultural Education
Dan Chabot	National FFA Organization	Education Specialist- SAE Based Awards
Rob Calvin	Troy Agricultural Education Dept. / Troy FFA Chapter	Agricultural Education Teacher / FFA Advisor
Jeffrey Perry	Cornell University	Lecturer
Will Currey	Lake Forest High School	Agriscience Teacher
Keith Schiebel	NYAAE -- New York Association of Agriculture Educators	Past President
Vincent Newman	McArthur High School, Hollywood, Florida	Agriscience Educator
Amanda Levzow Seichter	Wisconsin Dells High School	Agri-Science Instructor
Bruce watkins	Arizona Department of Education	State Supervisor of Agriculture
Ray Daugherty	Front Range Community College	Horticulture Faculty & Program Lead
Scott Robison	Wake County Public Schools	Biotechnology Teacher
Roger Hanagriff	Texas A&M University & The AET	Professor of Educational Outreach
Barb Lemmer	Linn-Mar High School	Agricultural Science Education Teacher
Jay Williams	Meridian District CUSD #223 and Stillman Valley FFA Chapter	Agriculture Instructor
Nadja Payok	Oakland Schools	Instructor
Ambra Tennery	National FFA Organization	Team Leader-Educational Development
Johnny M. Jessup	Hobbton High School - North Carolina	Agriculture Teacher/FFA Advisor
Amanda Mullins	Benton Central Junior Senior High School	Agriculture Teacher
Sherry Heishman	Central High School FFA	Agricultural Education Teacher
Jacob Hunter	The World Food Prize Foundation	Director of Iowa Education Programs
Donna Westfll-Rudd	Virginia Tech	Assoc Professor
Levi Reese	Hillsboro High School	Agriculture Education instructor
Joe Barbour	Texas Farm Bureau	Field Representative
Joshua Rusk	National FFA Organization	Partner Development Specialist - Alumni
Dr. Nina Crutchfield	National FFA Organization	LPS Specialist
Dustin L. Cox	American Farm Bureau	Young farmer and rancher committee 2013 to 2015
Amber Keller	Union Bank & Trust Company	Vice President

Name	Organization	Title
Andrea Nthole	Humboldt High School	Agriculture Teacher
Robyn Rudisill	Tyson Foods, Inc.	Director, Talent Management
George Lyman	Regional School District #14, Nonnewaug High School	Teacher of Natural Resources
Julian Smith	Chatham Central High School	Retired VoAgriculture Instructor
Brandy VanDeWalle	UNL	Nebraska Extension Educator
Keith Westervelt	Blueville Nursery	CEO/President
John Allen Bailey	Georgia Young Farmers	Executive Secretary
George R. Vahoviak	Penn State University	Affiliate Assistant Professor
Richard Naha	Circle Fresh Farms	CEO
Jake Wenger	Wenger Ranch Inc.	Vice President
Edward Franklin	The University of Arizona, Tucson	Associate Professor, Agricultural Education
Brandie Disberger	Kansas State	Instructor
Carla Travis	Northeast Metro 916	Instructor
Michael Gunderson	Purdue University	Associate Professor
Jake Worcester	Kansas Department of Agriculture	Assistant Secretary
Kevin Koelewyn	Tulare Joint Union High School District Agriculture Department	Teacher and FFA Advisor
Scott Grumbles	Klein Smoked Meats dba Hudson Meat Company	General Manager
Tim B. Gibbons	All Phase Landscape	Senior Account Manager, Landscape Horticulturist
Emily Lehning	Kansas State University	Associate Vice President for Student Life/Director, New Student Services
Mary R Kane	Kansas FFA Association	Executive Secretary
Joe Curran	Girard Agricultural Education	Agricultural Education Instructor
DanMcGinnis	Hummert International	Outside sales rep
Dalton Henry	Kansas Wheat	Director of Govt Affairs
Stan Brown	Associated Landscape Contractors of Colorado	Past President
Riley Pagett	U.S. Senator James Lankford (OK)	Legislative Assistant
Laura lee laFlamme	agriscience	director/ teacher
Matthew Lohr	Farm Credit of the Virginias	Director, Knowledge Center
Jim Barbee	Nevada Department of Agriculture	Director
Rod Hagman	Kuhn Krause Inc	Director of Engineering
John Zinner	Western Hills High School	Agriculture Educator
Brandi Buzzard Frobose	National Cattlemen's Beef Association	Manager, Issues Communication

Name	Organization	Title
Dr. Steven R. Harbstreit	Kansas State University	Associate Professor
Gary Aycock	Albertville High School	Agriculture Teacher
Robert Parrish	South Warren High School	Agriculture Instructor/ FFA advisor
Russ Hovey	University California, Davis	Professor of Animal Science
Tom Walter	Tasty Catering	Chief Culture Officer
Stacey Grant	Keystone Foods	Sr. Quality Systems Manager
Grace Berryhill	University of California, Davis	PhD Candidate in Animal Biology
Tessa Porter	Ferrara Candy Company	R&D Manager, Food Scientist
Delores Lomberk	USDA	support scientist
Carrie Preston	Branch Area Careers Center	Agriscience Educator
Brian Matchett	MSU Institute of Agricultural Technology	Program Coordinator - Applied Plant Science and Viticulture Programs
Scott Smalley	SDSU	Assistant Professor
Justin T. Benz	Hodgson Vo-Tech	Environmental Technology Instructor
Michael Bone	Denver Botanic Gardens	Curator of Steppe Collections/ Propagator
Doug Robertson	Maine Department of Education	Agriculture & Natural Resources Education Spec.
Chad Bontrager	Kansas Department of Agriculture	Deputy Secretary
James L Gibson	Minnesota Agricultural Interpretive Center-Farmamerica	Executive Director
Christine White	National FFA Organization	Director - Leadership, Education, Assessment and Development Division
Kirk Swortzel	Mississippi State University	Professor
Tracy Dendinger	Ohio Department of Education - Career Tech	Agriculture Education Program Specialist
Mike Hafner	Field of Hope	
Adam Wollenburg	Syngenta	District Manager
Deb Seibert	PA Association of Agricultural Educators	Ag Instuctor
Norm Lownds	Michigan State University	Associate Professor
Tom Lane	PA Department of Education	Consultant
William B. Peter	St.Croix Central High School	Agriculture Teacher
Beau Williamson	Elanco Animal Health	Sales Consultant
Chris Johnson	City of Westminster - Westminster, Colorado	City Park Superintendent
Hermilo Garcia	Troy Isd	Agriculture educator
Anne Clark	Locust Trace Agriscience Center	Principal
Tyler Ruoff	Blackbeard Island National Wildlife Refuge	Volunteer Supervisory Biotech

Name	Organization	Title
Mary Ellen Kraus	Madison Area Technical College	Program Director and Instructor
Cecelia Muller	USDA/ARS	Biological Science Laboratory Technician
Emily G. Adams	The Ohio State University	OSU Extension Educator, Agriculture & Natural Resources
Amber Scherer	Grassland Dairy Products, Inc.	Dairy Ingredients Sales Manager
Daniel Lynch	Pennsylvania Game Commission	Wildlife Education Specialist
Eric Schilling	Elanco	
Walter Chomentowski	Michigan State University	Academic Advisor
Rachel Anderson	Greenville Central School District	Agriculture Teacher
Raymond Ward	Ward Laboratories, INC	President
Linda Singletary	Dow AgroSciences	Biotech Technician
Kelly F. Lechtenberg	Midwest Veterinary Servcies, Inc.	President and CEO
Kyle Malter	Boehringer Ingelheim Vetmedica	Veterinarian
Shawna Embrey	Dow AgroSciences	Lead Biochemist/Pharmacy and Biology Support Leader
Chris Kalkowski	First National Bank of Omaha	Vice President
Brandy Chaffer	Field of Hope	Co-Founder
John Demerly	Dow AgroSciences	Northern Crops Sales Leaders
Shari Freyermuth, Ph.D.	University of Missouri	Associate Teaching Professor, Biochemistry
Theresa Alberici	PA Game Commission	Project WILD Coordinator, Wildlife Education Specialist
Erik Ingerslew	Cargill Inc.	Utilities Superintendent
Andrew Mothershead	Missouri Department of Conservation	Conservation Agent
Jamie Adam	Cargill Meat Solutions	Training Manager
Sangeeta Chopra	School of Packaging	Visiting Research Scholar
Harold D. Brown	United Agronomy, LLC.	Agronomist
Shawn Linder	Grand Rapids High School	AFNR Instructor and FFA Advisor
Quentin Rund	PAQ Interactive	CEO
Reed S. Nelsen	Central Valley Ag Cooperative	SVP Marketing
Tracy Dicken	Chapel Hill Independent School District	Agricultural Science Instructor
Brian Pinchart	Wrightstown FFA	Agricultural Education Instructor
Joe Kelsay	Government Affairs, DOW AgroSciences	Partner, Kelsay Farms
Louis Mills	Texas Tech University	Associate Professor
Stephen E. Koenig	Poultry Science Association	Executive Director

Name	Organization	Title
Jennifer Jackson	Frisco Centennial FFA/VATAT	AST
Todd Armstrong	Elanco	Sr Director, Beef Operations
Kurt Winters	Johnson County Wastewater	Director of Operations & Maintenance (O&M) Division
Dee McKenna	Nutrients For Life Foundation	
Jeff Hicken	Wisconsin Department of Public Instruction	Ag & Nat Res Consultant
Benjamin R Keefer, Ph.D.	Colorado Mesa University/WCCC	Assistant Professor
Aaron Caswell	Bristol County Agricultural High School	Natural Resource Management Teacher
Meghan Wulster-Radcliffe	American Society of Animal Science	CEO

APPENDIX C: EXAMPLE CROSSWALKS

A goal of the 2015 revision of the Agriculture, Food and Natural Resource Career Cluster Content Standards was to identify strategies for encouraging the adoption and use of this body of work. In addition to the revisions to update the technical content and improve clarity and consistency, the AFNR content standards were also cross-walked with several key frameworks to assist with state and local implementation.

Standards in the following key frameworks were cross-walked to the performance indicators in the AFNR Career Cluster Content Standards:

Common Core English Language Arts & Literacy

English Language Arts Standards. (2010, June 2). Retrieved February 25, 2015, from http://www.corestandards.org/ELA-Literacy/.

Common Core Mathematics

Mathematics Standards. (2010, June 2). Retrieved February 25, 2015, from http://www.corestandards.org/Math/.

Next Generation Science Standards

DCI Arrangements of Standards | Next Generation Science Standards. (2013, November). Retrieved February 25, 2015, from http://www.nextgenscience.org/search-standards-dci.

Green/Sustainability Knowledge and Skill Statements

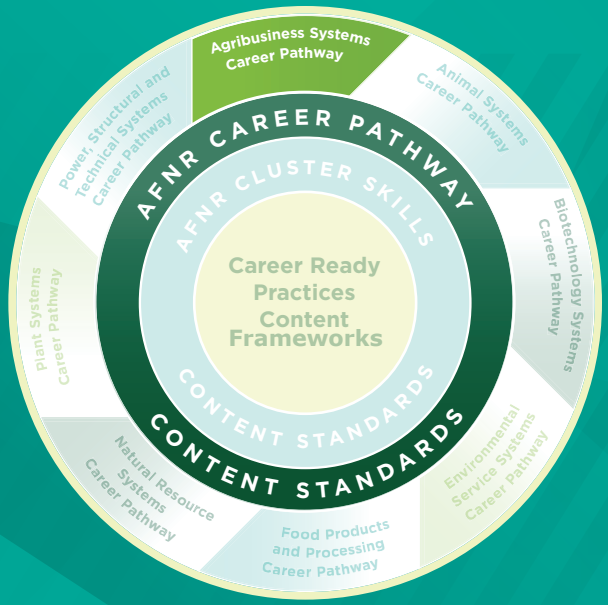
Proposed Green/Sustainability Knowledge And Skill Statements. Version 2. 2012. Web. 25 Feb. 2015.

National Standards For Financial Literacy

National Standards For Financial Literacy. New York: Council for Economic Education, 2013. Web. 25 Feb. 2015.

In order for a crosswalk to be established, the content of the cross-walked standard must be ***explicitly*** taught in order to attain the related Performance Indicator in the AFNR Content Standards given the stated sample measurements. Educators in the field of science, math and language arts reviewed and provided formative feedback on all crosswalks to help confirm their face validity.

The crosswalks identified are not a finite list of all potential crosswalks. They are based upon the ***sample*** measurements identified for each of the performance indicators. If states or local educators edit or add to the stated sample measurements to meet local needs or emphasize specific academic content additional crosswalks may be identified.



AGRIBUSINESS SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Standards Example Crosswalks

Agribusiness Systems (ABS)

Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.		
ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.		
	ELA	• CCSS.ELA-Literacy.L.9-10.6 • CCSS.ELA-LITERACY.L.11-12.6 • CCSS.ELA-LITERACY.RST.9-10.4 • CCSS.ELA-LITERACY.RST.11-12.4
	MATH	• CCSS.MATH.CONTENT.HSS.ID.C.7 • CCSS.MATH.CONTENT.HSS.IC.B.6
	NSFL	• Financial Investing: Benchmarks: Grade 12, Statement 9
ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.		
	ELA	• CCSS.ELA-LITERACY.W.9-10.2 • CCSS.ELA-LITERACY.W.11-12.2 • CCSS.ELA-LITERACY.W.9-10.9 • CCSS.ELA-LITERACY.W.11-12.9 • CCSS.ELA-LITERACY.RI.9-10.4 • CCSS.ELA-LITERACY.RI.11-12.4
ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.		
	ELA	• CCSS.ELA-LITERACY.SL.9-10.6 • CCSS.ELA-LITERACY.SL.11-12.6 • CCSS.ELA-LITERACY.L.9-10.6 • CCSS.ELA-LITERACY.L.11-12.6

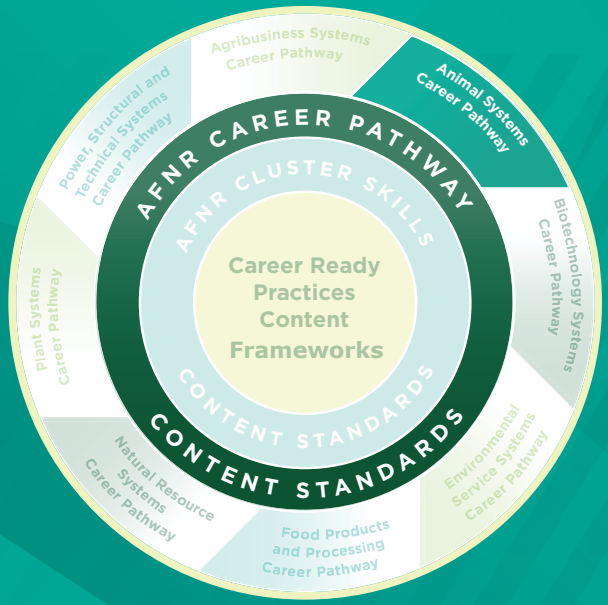
	• CCSS.ELA-LITERACY.RST.9-10.4 • CCSS.ELA-LITERACY.RST.11-12.4
ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.	
ELA	• CCSS.ELA-LITERACY.W.9-10.2 • CCSS.ELA-LITERACY.W.11-12.2 • CCSS.ELA-LITERACY.W.9-10.9 • CCSS.ELA-LITERACY.W.11-12.9 • CCSS.ELA-LITERACY.SL.9-10.6 • CCSS.ELA-LITERACY.SL.11-12.6 • CCSS.ELA-LITERACY.RI.9-10.4 • CCSS.ELA-LITERACYRI.11-12.4 • CCSS.ELA-LITERACY. L.9-10.6 • CCSS.ELA-LITERACY.L.11-12.6 • CCSS.ELA-LITERACY.RST.9-10.4 • CCSS.ELA-LITERACY.RST.11-12.4
NSFL	• Earning Income: Benchmarks: Grade 12, Statements 1 • Earning Income: Benchmarks: Grade 12, Statements 2 • Earning Income: Benchmarks: Grade 12, Statements 4 • Protecting and Insuring: Benchmarks: Grade 12, Statements 8 • Protecting and Insuring: Benchmarks: Grade 12, Statements 9 • Protecting and Insuring: Benchmarks: Grade 12, Statements 10 • Protecting and Insuring: Benchmarks: Grade 12, Statements 12
ABS.02. CCTC Framework: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.	
ABS.02.01. Performance Indicator: Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).	
MATH	• CCSS.MATH.CONTENT.HSS.IC.B.6 • CCSS.MATH.CONTENT.HSN.Q.A.1
NSFL	• Earning Income: Benchmarks: Grade 12, Statements 7

	• Earning Income: Benchmarks: Grade 12, Statements 8
ABS.02.02. Performance Indicator: Assemble, interpret and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).	
ELA	• CCSS.ELA-LITERACY.W.9-10.9 • CCSS.ELA-LITERACY.W.11-12.9 • CCSS.ELA-LITERACY.RH.9-10.7 • CCSS.ELA-LITERACY.RH.11-12.7
MATH	• CCSS.MATH.CONTENT.HSS.ID.C.7 • CCSS.MATH.CONTENT.HSS.IC.B.6 • CCSS.MATH.CONTENT.HSN.Q.A.1
NSFL	• Savings: Benchmarks: Grade 12, Statements 3 • Savings: Benchmarks: Grade 12, Statements 4 • Savings: Benchmarks: Grade 12, Statements 6 • Savings: Benchmarks: Grade 12, Statements 7 • Financial Investing: Benchmarks: Grade 12, Statement 2
ABS.03. CCTC Framework: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.	
ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.	
ELA	• CCSS.ELA-LITERACY.RH.9-10.7 • CCSS.ELA-LITERACY.RH.11-12.7 • CCSS.ELA- LITERACY.L.9-10.6 • CCSS.ELA-LITERACY. L.11-12.6 • CCSS.ELA- LITERACY.RST.9-10.4 • CCSS.ELA- LITERACY.RST.11-12.4
MATH	• CCSS.MATH.CONTENT.HSS.IC.B.6
ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.	
ELA	• CCSS.ELA-LITERACY.L.9-10.6 • CCSS.ELA-LITERACY.L.11-12.6 • CCSS.ELA-LITERACY.RST.9-10.4 • CCSS.ELA-LITERACY.RST.11-12.4
MATH	• CCSS.MATH.CONTENT.HSS.IC.B.6

NSFL	• Using Credit: Benchmarks: Grade 12, Statements 1 • Using Credit: Benchmarks: Grade 12, Statements 2 • Using Credit: Benchmarks: Grade 12, Statements 3 • Using Credit: Benchmarks: Grade 12, Statements 4 • Using Credit: Benchmarks: Grade 12, Statements 5 • Using Credit: Benchmarks: Grade 12, Statements 6 • Using Credit: Benchmarks: Grade 12, Statements 12 • Using Credit: Benchmarks: Grade 12, Statements 13 • Financial Investing: Benchmarks: Grade12, Statement 9
ABS.04. CCTC Framework: Develop a business plan for an AFNR business.	
ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.	
ELA	• CCSS.ELA-LITERACY.L.9-10.6 • CCSS.ELA-LITERACY.L.11-12.6 • CCSS.ELA-LITERACY.RST.9-10.4 • CCSS.ELA-LITERACY.RST.11-12.4 • CCSS.ELA-LITERACY.W.9-10.2 • CCSS.ELA-LITERACY.W.11-12.2 • CCSS.ELA-LITERACY.W.9-10.9 • CCSS.ELA-LITERACY.W.11-12.9
ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.	
KSS	• AFNR Career Cluster – Agribusiness Systems Pathway, Statement 3
ELA	• CCSS.ELA-LITERACY.ELA-W.9-10.2 • CCSS.ELA-LITERACY.W.11-12.2 • CCSS.ELA-LITERACY.L.9-10.6 • CCSS.ELA-LITERACY.L.11-12.6 • CCSS.ELA-LITERACY.RST.9-10.4 • CCSS.ELA-LITERACY.RST.11-12.4
ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.	
NSFL	• Financial Investing: Benchmarks: Grade 12, Statement 11

	• Protecting and Insuring: Benchmarks: Grade 12, Statements 2 • Protecting and Insuring: Benchmarks: Grade 12, Statements 3 • Protecting and Insuring: Benchmarks: Grade 12, Statements 4
ABS.05. CCTC Framework: Use sales and marketing principles to accomplish AFNR business objectives.	
ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.	
KSS	• AFNR Career Cluster, Statement 7 • AFNR Career Cluster – Agribusiness Systems Pathway, Statement 1
NSFL	• Financial Investing: Benchmarks: Grade 12, Statement 13
ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.	
ELA	• CCSS.ELA-LITERACY.SL.9-10.6 • CCSS.ELA-LITERACY.SL.11-12.6 • CCSS.ELA-LITERACY.RH.9-10.7 • CCSS.ELA-LITERACY.RH.11-12.7
NSFL	• Buying Goods & Services: Benchmarks: Grade 12, Statements 1 • Buying Goods & Services: Benchmarks: Grade 12, Statements 3 • Buying Goods & Services: Benchmarks: Grade 12, Statements 4 • Buying Goods & Services: Benchmarks: Grade 12, Statements 5
ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.	
KSS	• AFNR Career Cluster – Agribusiness Systems Pathway, Statement 4
ELA	• CCSS.ELA-LITERACY.L.9-10.6 • CCSS.ELA-LITERACY.L.11-12.6 • CCSS.ELA-LITERACY.RST.9-10.4 • CCSS.ELA-LITERACY.RST.11-12.4 • CCSS.ELA-LITERACY.W.9-10.2 • CCSS.ELA-LITERACY.W.11-12.2 • CCSS.ELA-LITERACY.RH.9-10.7 • CCSS.ELA-LITERACY.RH.11-12.7 • CCSS.ELA-LITERACY.SL.9-10.6 • CCSS.ELA-LITERACY.SL.11-12.6
NSFL	• Buying Goods & Services: Benchmarks: Grade 12, Statements 1 • Buying Goods & Services: Benchmarks: Grade 12, Statements 3

	• Buying Goods & Services: Benchmarks: Grade 12, Statements 4 • Buying Goods & Services: Benchmarks: Grade 12, Statements 7



ANIMAL SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Frameworks
Example Crosswalks

Animal Systems (AS)

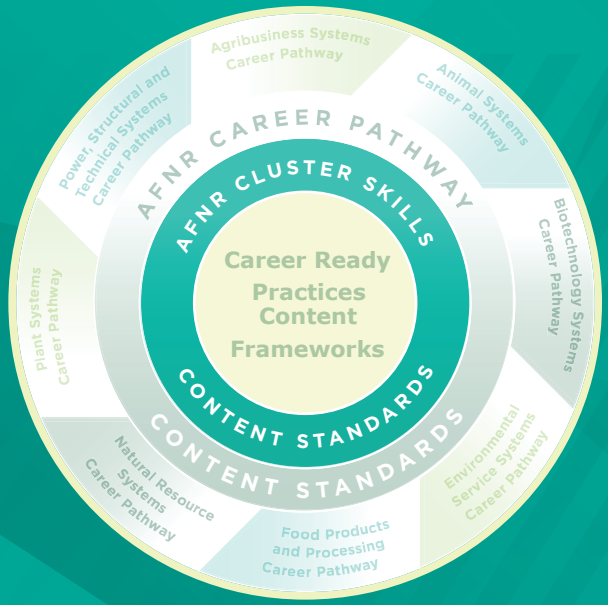
Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/ Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

AS.01. CCTC Framework: Analyze historic and current trends impacting the animal systems industry.		
AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution on production practices and the environment.		
	NGSS	• HS-LS4-3
AS.01.02. Performance Indicator: Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.		
	KSS	• AFNR Career Cluster, Statement 1 • AFNR Career Cluster – Animal Systems Pathway, Statement 3 • STEM Career Cluster, Statement 1
	NSFL	• Buying Goods and Services, Benchmarks: Grade 12, Statement 1 • Buying Goods and Services, Benchmarks: Grade 12, Statement 3
AS.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.		
	KSS	• AFNR Career Cluster, Statement 2 • AFNR Career Cluster – Animal Systems Pathway, Statement 1 • STEM Career Cluster, Statement 1, 4
	ELA	• CCSS.ELA-Literacy.W.9-10.9b • CCSS.ELA-Literacy.W.11-12.9b • CCSS.ELA-Literacy.RI.9-10.1 • CCSS.ELA-Literacy.RI.11-12.1
	NGSS	• HS-ETS1-1

AS.02. CCTC Framework: Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.		
AS.02.01. Performance Indicator: Demonstrate management techniques that ensure animal welfare.		
	NGSS	• HS-ETS1-2
AS.02.02. Performance Indicator: Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).		
	NGSS	• HS-ETS1-2
AS.03. CCTC Framework: Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.		
AS.03.01. Performance Indicator: Analyze the nutritional needs of animals.		
		•
AS.03.02 Performance Indicator: Analyze feed rations and assess if they meet the nutritional needs of animals.		
		•
AS.03.03 Performance Indicator: Utilize industry tools to make animal nutrition decisions.		
		•
AS.04. CCTC Framework: Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.		
AS.04.01. Performance Indicator: Evaluate animals for breeding readiness and soundness.		
		•
AS.04.02. Performance Indicator: Apply scientific principles to select and care for breeding animals.		
	MATH	• CCSS.MATH.CONTENT.HSS.MD.A.3
	NGSS	• HS-LS3-2 • HS-LS3-3
AS.04.03 Performance Indicator: Apply scientific principles to breed animals.		
		•

AS.05. CCTC Framework: Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.		
AS.05.01. Performance Indicator: Design animal housing, equipment and handling facilities for the major systems of animal production.		
	ELA	• AFNR Career Cluster – Animal Systems Pathway, Statement 2 • STEM Career Cluster, Statement 4 • STEM Career Cluster, Statement 5
AS.05.02. Performance Indicator: Comply with government regulations and safety frameworks for facilities used in animal production.		
	ELA	• CCSS.ELA-Literacy.W.9-10.9b • CCSS.ELA-Literacy.W.11-12.9b
AS.06. CCTC Framework: Classify, evaluate and select animals based on anatomical and physiological characteristics.		
AS.06.01. Performance Indicator: Classify animals according to taxonomic classification systems and use (e.g. agricultural, companion, etc.).		
		•
AS.06.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.		
	NGSS	• HS-LS1-2
AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.		
	KSS	• STEM Career Cluster, Statement 5
AS.07. CCTC Framework: Apply principles of effective animal health care.		
A**S.07.01. Performance Indicator:** Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.		
	MATH	• CCSS.MATH.CONTENT.HSN.Q.A.1 • CCSS.MATH.CONTENT.HSN.Q.A.2 • CCSS.MATH.CONTENT.HSN.Q.A.3

AS.07.02. Performance Indicator: Analyze biosecurity measures utilized to protect the welfare of animals on a local, state, national, and global level.		
		•
AS.08. CCTC Framework: Analyze environmental factors associated with animal production.		
AS.08.01. Performance Indicator: Design and implement methods to reduce the effects of animal production on the environment.		
	KSS	• AFNR Career Cluster – Environmental Service System Pathway, Statement 1
	NGSS	• HS-LS2-6 • HS-LS2-7
AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.		
	NGSS	• HS.LS4-6



AQUACULTURE SYSTEM CAREER PATHWAY

Agriculture, Food and Natural Resources Content Standards
Example Crosswalks

Aquaculture Systems (AQ)

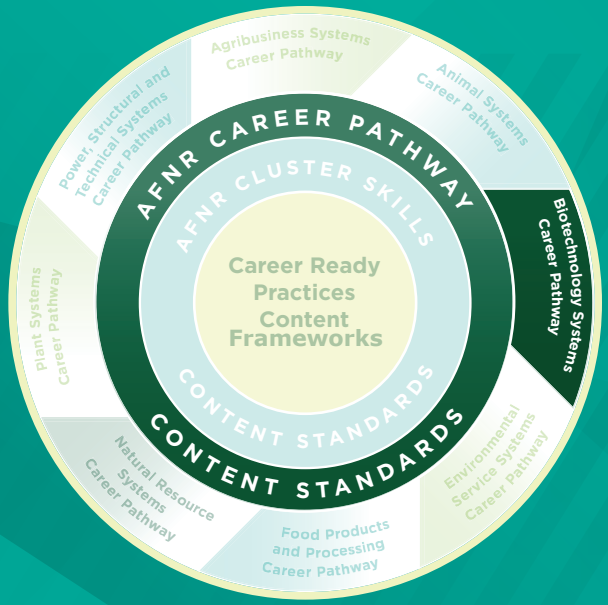
Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

AQ.01. CCTC Framework: Analyze historic and current trends impacting the aquaculture systems industry.		
AQ.01.01. Performance Indicator: Evaluate the development and implications of aquatic species origin and distribution on production practices and the environment.		
	NGSS	• HS-LS4-3
AQ.01.02. Performance Indicator: Devise and apply management and record keeping skills to organize and operate an aquaculture business in an efficient manner.		
	KSS	• All Career Clusters, Statement 2 • AFNR Career Cluster –Statement 4 • AFNR Career Cluster-Agribusiness Systems Pathway, Statement 1
AQ.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to aquaculture systems from a global perspective.		
	KSS	• AFNR Career Cluster, Statement 2 • AFNR Career Cluster – Animal Systems Pathway, Statement 1 • STEM Career Cluster, Statement 1, 4
	ELA	• CCSS.ELA-Literacy.W.9-10.9b • CCSS.ELA-Literacy.W.11-12.9b • CCSS.ELA-Literacy.RI.9-10.1 • CCSS.ELA-Literacy.RI.11-12.1
	NGSS	• HS-ETS1-1
AQ.02. CCTC Framework: Utilize best-practice protocols based upon aquatic animal behaviors and welfare.		
AS.02.01. Performance Indicator: Demonstrate management techniques that ensure aquatic animal welfare.		
	NGSS	• HS-ETS1-2

AQ.03. CCTC Framework: Classify aquatic species according to hierarchical taxonomy and use.		
AQ.03.01. Performance Indicator: Identify aquatic species by their hierarchical taxonomy and use.		
		•
AQ.04. CCTC Framework: Evaluate, select and manage aquatic organisms based on anatomical and physiological characteristics.		
AQ.04.01. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various aquatic species.		
		•
AQ.04.02. Performance Indicator: Select aquatic species for specific purposes and maximum performance based on anatomy and physiology.		
		•
AQ.05. CCTC Framework: Provide proper health care of aquaculture species.		
AQ.05.01. Performance Indicator: Prescribe and implement a prevention and treatment program for aquatic species diseases, parasites and other disorders.		
		•
AQ.05.02. Performance Indicator: Provide for the biosecurity of aquatic species and production facilities.		
	ELA	• CCSS.ELA-Literacy.W.9-10.9b • CCSS.ELA-Literacy.W.11-12.9b
AQ.06. CCTC Framework: Evaluate and select aquatic species based on scientific principles of animal and plant production.		
AQ.06.01. Performance Indicator: Evaluate the male and female reproductive systems in selecting aquatic species.		
		•
AQ.07. CCTC Framework: Analyze reproduction facilities and select aquatic stock for reproduction.		
AQ.07.01. Performance Indicator: Determine appropriate reproduction method for aquatic species.		
	MATH	• CCSS.MATH.CONTENT.HSN.Q.A.1 • CCSS.MATH.CONTENT.HSN.Q.A.2 • CCSS.MATH.CONTENT.HSN.Q.A.3
AQ.08. CCTC Framework: Apply Principles of hydrology to aquaculture.		
AQ.08.01. Performance Indicator: Manage water resources for aquaculture.		
	KSS	• AFNR Career Cluster – Environmental Service Systems Pathway, Statement 1

NGSS	• HS-LS2-6 • HS-LS2-7
AQ.08.02. Performance Indicator: Apply principles of wastewater treatment to manage wastewater disposal following rules and regulations.	
KSS	• All Career Clusters, Statement 1
AQ.09. CCTC Framework: Evaluate housing, equipment and handling facilities for the major aquaculture species.	
AQ.09.01. Performance Indicator: Design aquatic species housing, equipment and handling facilities.	
KSS	• AFNR Career Cluster – Environmental Service Systems Pathway, Statement 1
AQ.09.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in aquaculture production.	
	•
AQ.09.03. Performance Indicator: Manage hazardous materials to assure a safe facility and to comply with applicable regulations	
NGSS	• HS.LS4-6
AQ.10. CCTC Framework: Manage vehicles, equipment, and vessels for aquaculture production.	
AQ.10.01. Performance Indicator: Design vehicles, vessels and equipment for aquaculture production.	
NGSS	• HS.LS4-6
AQ.10.02. Performance Indicator: Demonstrate the ability to perform safely with aquaculture production vehicles, vessels, tools and equipment.	
	•
AQ.11. CCTC Framework: Apply principles of nutrition to ensure the proper growth, development, reproduction and economic production of aquatic species.	
AQ.11.01. Performance Indicator: Formulate feed rations to provide for the nutritional needs of aquatic species.	
KSS	• AFNR Career Cluster – Animal Systems Pathway, Statement 2
AQ.12. CCTC Framework: Processing and marketing aquatic crops.	
AQ.12.01. Performance Indicator: Process aquatic crops to produce high quality product.	
	•
AQ.13. CCTC Framework: Identify government and private organizations involved in the management of aquatic plants and animals and their environments.	
AQ.13.01. Performance Indicator: Discuss the need for government oversight and regulation for aquaculture.	
ELA	• CCSS.ELA-Literacy.W.9-10.9b

	• CCSS.ELA-Literacy.W.11-12.9b
AQ.14. CCTC Framework: Evaluate water resources and quality.	
AQ.14.01. Performance Indicator: Obtain water for aquaculture enterprises.	
	• All Career Clusters, Statement 1
AQ.14.02. Performance Indicator: Calculate water usage in aquaculture enterprises.	
MATH	• CCSS.MATH.CONTENT.HSN.Q.A.1 • CCSS.MATH.CONTENT.HSN.Q.A.2 • CCSS.MATH.CONTENT.HSN.Q.A.3
AQ.15. CCTC Framework: Integrate hydroponics within the management of aquaculture.	
AQ.15.01. Performance Indicator: Develop and implement sustainable aquaponics system.	
KSS	• All Career Clusters, Statement 1 • AFNR Career Cluster –Statement 6 • AFNR Career Cluster –Statement 8



BIOTECHNOLOGY SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Standards
Example Crosswalks

Biotechnology Systems (BS)

Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

BS.01. NCAE Farmework: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).

BS.01.01. Performance Indicator: Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).

ELA	• CCSS.ELA-Literacy.RI.9-10.1 • CCSS.ELA-Literacy.RI.11-12.1 • CCSS.ELA-Literacy.RI.9-10.6 • CCSS.ELA-Literacy.RI.11-12.6 • CCSS.ELA-Literacy.WI.9-10.2 • CCSS.ELA-Literacy.WI.11-12.2

BS.01.02. Performance Indicator: Evaluate the scope and implications of regulatory agencies on applications of biotechnology in agriculture and protection of public interests (e.g., health, safety, environmental issues, etc.).

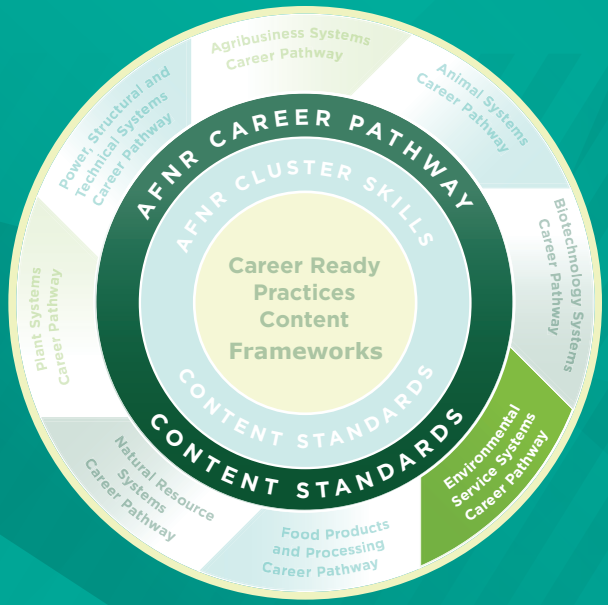
ELA	• CCSS.ELA-Literacy.RI.9-10.5 • CCSS.ELA-Literacy.RI.11-12.5 • CCSS.ELA-Literacy.RI.9-10.6 • CCSS.ELA-Literacy.RI.11-12.6

BS.01.03. Performance Indicator: Analyze the relationship and implications of bioethics, laws and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).

ELA	• CCSS.ELA-Literacy.RI.9-10.5 • CCSS.ELA-Literacy.RI.11-12.5 • CCSS.ELA-Literacy.RI.9-10.6 • CCSS.ELA-Literacy.RI.11-12.6 • CCSS.ELA-Literacy.WI.9-10.1

		• CCSS.ELA-Literacy.WI.11-12.1
BS.02. NCAE Framework: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance,		
BS.02.01. Performance Indicator: Read, document, evaluate and secure accurate laboratory records of experimental protocols, observations and results.		
	ELA	• CCSS.ELA-Literacy.RST.9-10.1 • CCSS.ELA-Literacy.RST.11-12.1 • CCSS.ELA-Literacy.RST.9-10.3 • CCSS.ELA-Literacy.RST.11-12.3
BS.02.02. Performance Indicator: Implement standard operating procedures for the proper maintenance, use and sterilization of equipment in a laboratory.		
		•
BS.02.03. Performance Indicator: Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.		
	NGSS	• HS-ETS1-2
BS.02.04. Performance Indicator: Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.		
	ELA	• CCSS.ELA-Literacy.RST.9-10.4 • CCSS.ELA-Literacy.RST.11-12.4
BS.02.05. Performance Indicator: Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.		
	ELA	• CCSS.ELA-Literacy.RST.9-10.3 • CCSS.ELA-Literacy.RST.11-12.3
	NGSS	• HS-LS3-1
BS.03. NCAE Framework: Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, etc.).		
BS.03.01. Performance Indicator: Apply biotechnology principles, techniques and processes to create transgenic species through genetic engineering.		
	NGSS	• HS-LS3-2

BS.03.02. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance the production of food through the use of microorganisms and enzymes.		
		•
BS.03.03. Performance Indicator: Apply biotechnology principles, techniques and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).		
		•
BS.03.04. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals, biodiversity, etc.).		
	NGSS	• HS-ETS1-2 • HS-LS4-6
BS.03.05. Performance Indicator: Apply biotechnology principles, techniques and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).		
	KSS	• AFNR Career Cluster, Statement 5
	ELA	• CCSS.ELA-Literacy.RI.9-10.1 • CCSS.ELA-Literacy.RI.11-12.1 • CCSS.ELA-Literacy.RST.9-10.3 • CCSS.ELA-Literacy.RST.11-12.3
BS.03.06. Performance Indicator: Apply biotechnology principles, techniques and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).		
		•



ENVIRONMENTAL SERVICE SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Standards Example Crosswalks

Environmental Service Systems (ESS)

Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

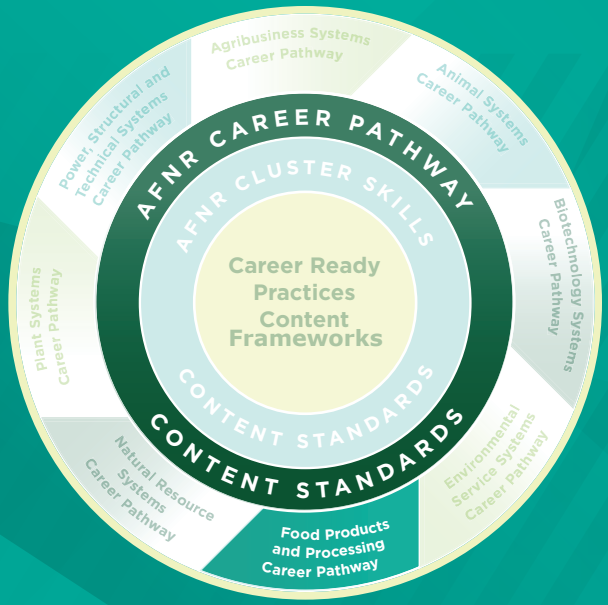
ESS.01. CCTC Framework: Use analytical procedures and instruments to manage environmental service systems.		
ESS.01.01. Performance Indicator: Analyze and interpret laboratory and field samples in environmental service systems.		
	ELA	• CCSS.ELA-LITERACY.SL.11-12.5 • CCSS.ELA-LITERACY.RST.11-12.9
	MATH	• CCSS.MATH.CONTENT.HSN.Q.A.1 • CCSS.MATH.CONTENT.HSN.Q.A.2 • CCSS.MATH.CONTENT.HSN.Q.A.3 • CCSS.MATH.CONTENT.HSS.ID.A.2 • CCSS.MATH.CONTENT.HSS.ID.B.5
	NGSS	• HS-ESS2-2
ESS.01.02. Performance Indicator: Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).		
		•
ESS.02. CCTC Standard: Evaluate the impact of public policies and regulations on environmental service system operations.		
ESS.02.01. Performance Indicator: Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.		
	KSS	• AFNR Career Cluster, Statement 2 • AFNR Career Cluster, Agribusiness Systems Pathway, Statement 1 • AFNR Career Cluster, Natural Resources Systems Pathway, Statement 2

		• STEM Career Cluster, Statement 3
ESS.02.02. Performance Indicator: Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).		
		•
ESS.02.03. Performance Indicator: Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.		
		•
ESS.03. CCTC Framework: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.		
ESS.03.01. Performance Indicator: Apply meteorology principles to environmental service systems.		
	ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.2 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.WHST.9-12.7
	MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3
	NGSS	• HS-ESS2-6 • HS-ESS3-5
ESS.03.02. Performance Indicator: Apply soil science and hydrology principles to environmental service systems.		
	ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.2 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.WHST.9-10.7 • CCSS.ELA-LITERACY.WHST.11-12.7

MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3
NGSS	• HS-ESS2-5 • HS-ESS2-6
ESS.03.03. Performance Indicator: Apply chemistry principles to environmental service systems.	
ELA	• CCSS.ELA-LITERACY.RST.9-10.7 • CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.2 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.5 • CCSS.ELA-LITERACY.WHST.11-12.5
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.3
NGSS	• HS-ESS2-6
ESS.03.04. Performance Indicator: Apply microbiology principles to environmental service systems.	
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.WHST.9-10.2 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.5 • CCSS.ELA-LITERACY.WHST.11-12.5 • CCSS.ELA-LITERACY.WHST.9-10.9 • CCSS.ELA-LITERACY.WHST.11-12.9
MATH	• CCSS.MATH.CONTENT.HSF.BF.A.1
NGSS	• HS-LS2-3 • HS-LS3-2 • HS-ET1-2
NGSS	
ELA	• CCSS.ELA-LITERACY.RST.9-10.8

	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.9-10.2 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.9 • CCSS.ELA-LITERACY.WHST.11-12.9
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3
NGSS	• HS-LS2-1 • HS-LS4-4
ESS.04. CCTC Framework: Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).	
ESS.04.01. Performance Indicator: Use pollution control measures to maintain a safe facility and environment.	
NGSS	• HS-ETS1-2
ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste in environmental service systems.	
NGSS	• HS-ETS1-2
ESS.04.03. Performance Indicator: Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.	
NGSS	• HS-ETS1-2 • HS-ETS1-4
ESS.04.04. Performance Indicator: Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.	
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.9-10.5

	• CCSS.ELA-LITERACY.WHST.11-12.5 • CCSS.ELA-LITERACY.WHST.9-10.7 • CCSS.ELA-LITERACY.WHST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.2 • CCSS.ELA-LITERACY.RST.11-12.9 • CCSS.ELA-LITERACY.WHST 11-12.9
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3
NGSS	• HS-ETS1-2 • HS-ETS1-4
ESS.05. CCTC Framework: Use tools, equipment, machinery and technology common to tasks in environmental service systems**.**	
ESS.05.01. Performance Indicator: Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.	
NGSS	• HS-ETS1-4
ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.	
NGSS	• HS-ETS1-4 • HS-ETS1-2



FOOD PRODUCTS AND PROCESSING SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Standards Example Crosswalks

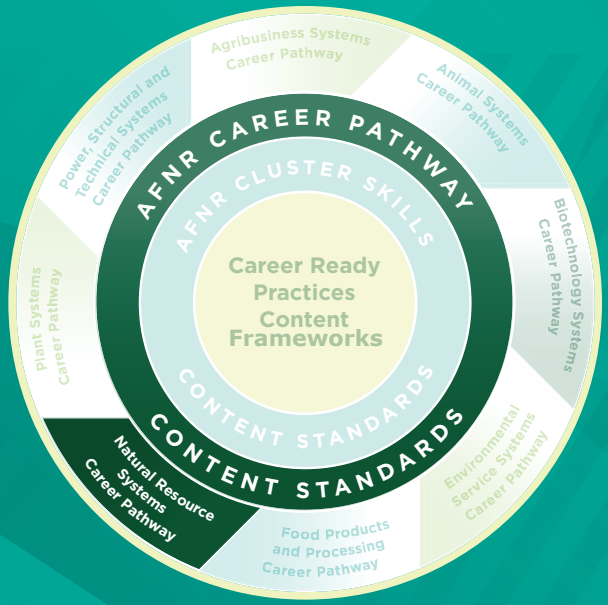
Food Product and Processing Systems (FPP)

Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

FPP.01. CCTC Framework: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.		
FPP.01.01. Performance Indicator: Analyze and manage operational and safety procedures in food products and processing facilities.		
	KSS	• AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 1 • AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 2 • AFNR Career Cluster, Statement 6 • Manufacturing Career Cluster – Maintenance, Installation and Repair Pathway Statement 2 • Manufacturing Career Cluster – Maintenance, Installation and Repair Pathway Statement 4 • Manufacturing Career Cluster – Production Pathway 2 • Manufacturing Career Cluster – Production Pathway 3
FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.		
	KSS	• AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 1 • AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 2
FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.		
		•
FPP.02. CCTC Framework: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.		
FPP.02.01. Performance Indicator: Apply principles of nutrition and biology to develop food products that provide a safe, wholesome and nutritious food supply for local and global food systems.		
		•

FPP.02.02. Performance Indicator: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.		
		•
FPP.02.03. Performance Indicator: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.		
		•
FPP.03. CCTC Framework: Select and process food products for storage, distribution and consumption.		
FPP.03.01. Performance Indicator: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.		
	KSS	• AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 1 • AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 2
	NSFL	• Buying Goods and Services, Benchmarks: Grade 12, Statement 7
FPP.03.02. Performance Indicator: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.		
	KSS	• AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 3
FPP.03.03. Performance Indicator: Create food distribution plans and procedures to ensure safe delivery of food products.		
	KSS	• AFNR Career Cluster, Statement 7 • AFNR Career Cluster – Food Products and Processing Pathway, Statement 3 • Manufacturing Career Cluster – Logistics and Inventory Control, Pathway 2 • Manufacturing Career Cluster – Manufacturing Product Process Development Pathway, Statement 1 • Manufacturing Career Cluster – Manufacturing Product Process Development Pathway, Statement 2 • Transportation, Distribution and Logistics Career Cluster, Statement 3
	ELA	• CCSS.ELA-Literacy.W.9-10.2 • CCSS.ELA-Literacy.W.11-12.2
	NGSS	• HS-ETS1-2

FPP.04. CCTC Framework: Explain the scope of the food industry and the historical and current developments of food product and processing.		
FPP.04.01. Performance Indicator: Examine the scope of the food industry by evaluating local and global policies, trends and customs for food production.		
	NGSS	• HS-ETS1-3
	NSFL	• Buying Goods and Services, Benchmarks: Grade 12, Statement 1 • Buying Goods and Services, Benchmarks: Grade 12, Statement 2
FPP.04.02. Performance Indicator: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.		
	NSFL	• Buying Goods and Services, Benchmarks: Grade 12, Statement 1
FPP.04.03. Performance Indicator: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence the local and global food systems.		
	KSS	• Transportation, Distribution and Logistics Career Cluster – Transportation Systems/Infrastructure Planning, Management and Regulation Pathway, Statement 4
	NSFL	• Buying Goods and Services, Benchmarks: Grade 12, Statement 7



NATURAL RESOURCE SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Standards Example Crosswalks

Natural Resource Systems (NRS)

Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

NRS.01. CCTC Framework: Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.		
NRS.01.01. Performance Indicator: Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.		
	KSS	• AFNR Career Cluster, Statement 1 • AFNR Career Cluster, Statement 2 • AFNR Career Cluster - Natural Resources Systems Pathway, Statement 3 • STEM Career Cluster, Statement 1
	ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.9-10.2 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.9 • CCSS.ELA-LITERACY.WHST.11-12.9
NRS.01.02. Performance Indicator: Classify different types of natural resources in order to enable protection, conservation, enhancement and management in a particular geographical region.		
	KSS	• AFNR Career Cluster - Natural Resources Systems Pathway, Statement 3
	ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.9-10.2 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.7

	• CCSS.ELA-LITERACY.WHST.11-12.7 • CCSS.ELA-LITERACY.WHST.9-10.9 • CCSS.ELA-LITERACY.WHST.11-12.9
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2
NGSS	• HS-ESS3-2
NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.	
KSS	• AFNR Career Cluster - Natural Resources Systems Pathway, Statement 3
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.8
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3 • CCSS.MATH.CONTENT.HSS-ID.A.1 • CCSS.MATH.CONTENT.HSS-IC.A.1 • CCSS.MATH.CONTENT.HSS-IC.B.6
NGSS	• HS-ESS2-4 • HS-ESS2-6 • HS-ESS3-4 • HS-ESS3-5
NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.	
KSS	• AFNR Career Cluster, Statement 1 • AFNR Career Cluster – Animal Systems Pathway, Statement 3 • AFNR Career Cluster – Natural Resources Systems Pathway, Statement 3
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.8

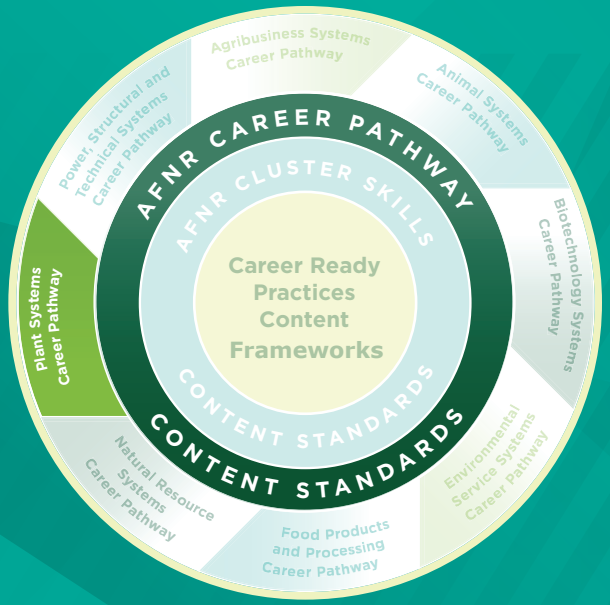
	• CCSS.ELA-LITERACY.WHST.9-10.7 • CCSS.ELA-LITERACY.WHST.11-12.7
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3 • CCSS.MATH.CONTENT.HSS-ID.A.1 • CCSS.MATH.CONTENT.HSS-IC.A.1 • CCSS.MATH.CONTENT.HSS-IC.B.6
NGSS	• HS-ESS3-6
NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.	
KSS	• AFNR Career Cluster, Statement 1 • AFNR Career Cluster – Animal Systems Pathway, Statement 3 • AFNR Career Cluster – Natural Resources Systems Pathway, Statement 3
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.8
MATH	• CCSS.MATH.CONTENT.HSS-ID.A.1 • CCSS.MATH.CONTENT.HSS-IC.A.1 • CCSS.MATH.CONTENT.HSS-IC.B.6
NGSS	• HS-ESS3-4 • HS-ESS3-2
NRS.01.06. Performance Indicator: Apply ecological concepts and principles to living organisms in natural resource systems.	
KSS	• AFNR Career Cluster, Statement 1 • AFNR Career Cluster – Animal Systems Pathway, Statement 3 • AFNR Career Cluster – Natural Resources Systems Pathway, Statement 3
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.9-10.2 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.5 • CCSS.ELA-LITERACY.WHST.11-12.5

	• CCSS.ELA-LITERACY.WHST.9-10.7 • CCSS.ELA-LITERACY.WHST.11-12.7 • CCSS.ELA-LITERACY.WHST.9-10.9 • CCSS.ELA-LITERACY.WHST.11-12.9
NGSS	• HS-LS4-4 • HS-LS4-6 • HS-ESS3-4
NRS.02.01. CCTC Framework: Analyze the interrelationships between natural resources and humans.	
NRS.02.01. Performance Indicator: Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).	
KSS	• AFNR Career Cluster, Statement 2 • AFNR Career Cluster – Agribusiness Systems Pathway, Statement 1 • AFNR Career Cluster – Natural Resources Systems Pathway, Statement 2 • STEM Career Cluster, Statement 3
NRS.02.02. Performance Indicator: Assess the impact of human activities on the availability of natural resources.	
KSS	• AFNR Career Cluster – Animal Systems Pathway, Statement 1 • STEM Career Cluster, Statement 2
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.2 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.9-10.2 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.9-10.7 • CCSS.ELA-LITERACY.WHST.11-12.7
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2

	• CCSS.MATH.CONTENT.HSN-Q.A.3
NGSS	• HS-LS2-7 • HS-ESS3-2 • HS-ESS3-3 • HS-ESS3-4 • HS-ESS3-5 • HS-ESS3-6
NRS.02.03. Performance Indicator: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.	
KSS	• AFNR Career Cluster, Statement 7
NRS.02.04. Performance Indicator: Examine and explain how economics affects the use of natural resources.	
KSS	• AFNR Career Cluster, Statement 4 • AFNR Career Cluster – Agribusiness Systems Pathway, Statement 4 • AFNR Career Cluster – Natural Resources Systems Pathway, Statement 4 • AFNR Career Cluster – Plant Systems Pathway, Statement 1
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.11-12.7 • CCSS.ELA-LITERACY.WHST.11-12.8 • CCSS.ELA-LITERACY.WHST.11-12.9 • CCSS.ELA-LITERACY.SL.11-12.4
NGSS	• HS-ESS3-2
NRS.02.05. Performance Indicator: Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.	
KSS	• AFNR Career Cluster, Statement 2 • AFNR Career Cluster, Statement 3 • STEM Career Cluster, Statement 2 • STEM Career Cluster, Statement 3

NRS.03. CCTC Framework Develop plans to ensure sustainable production and processing of natural resources.		
NRS.03.01. Performance Indicator: Sustainably produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).		
	KSS	• AFNR Career Cluster – Food Products and Processing Systems Pathway, Statement 1 • AFNR Career Cluster – Plant Systems Pathway, Statement 4
	ELA	• CCSS.ELA-LITERACY.RST.11-12.8
	NGSS	• HS-ESS3-2 • HS-ESS3-3
NRS.03.02. Performance Indicator: Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.		
		•
NRS.04. CCTC Framework: Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.		
NRS.04.01. Performance Indicator: Demonstrate natural resource protection, maintenance, enhancement and improvement techniques.		
	KSS	• AFNR Career Cluster – Environmental Service Systems Pathway, Statement 3 • AFNR Career Cluster – Environmental Service Systems Pathway, Statement 4 • AFNR Career Cluster – Natural Resources Systems Pathway, Statement 2 • AFNR Career Cluster – Natural Resources Systems Pathway, Statement 5 • AFNR Career Cluster – Plant Systems Pathway, Statement 2 • AFNR Career Cluster – Plant Systems Pathway, Statement 3
	ELA	• CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.SL.11-12.4
	NGSS	• HS-ESS3-2 • HS-ESS3-3 • HS-ESS3-4
NRS.04.02. Performance Indicator: Diagnose plant and wildlife diseases and follow protocols to prevent their spread.		
	ELA	• CCSS.ELA-LITERACY.RST.11-12.7

	• CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.11-12.2 • CCSS.ELA-LITERACY.WHST.11-12.7 • CCSS.ELA-LITERACY.WHST.11-12.8 • CCSS.ELA-LITERACY.WHST.11-12.9
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3
NGSS	• HS-LS2-7
NRS.04.03. Performance Indicator: Prevent or manage introduction of ecologically harmful species in a particular region.	
ELA	• CCSS.ELA-LITERACY.RST.11-12.1 • CCSS.ELA-LITERACY.RST.11-12.7 • CCSS.ELA-LITERACY.RST.11-12.8 • CCSS.ELA-LITERACY.WHST.9-10.5 • CCSS.ELA-LITERACY.WHST.11-12.5 • CCSS.ELA-LITERACY.WHST.9-10.7 • CCSS.ELA-LITERACY.WHST.11-12.7
MATH	• CCSS.MATH.CONTENT.HSN-Q.A.1 • CCSS.MATH.CONTENT.HSN-Q.A.2 • CCSS.MATH.CONTENT.HSN-Q.A.3 • CCSS.MATH.CONTENT.HSS-ID.A.1 • CCSS.MATH.CONTENT.HSS-IC.A.1 • CCSS.MATH.CONTENT.HSS-IC.B.6
NGSS	• HS-LS2-7 • HS-LS4-6
NRS.04.04. Performance Indicator: Manage fires in natural resource systems.	
	•



PLANT SYSTEMS CAREER PATHWAY

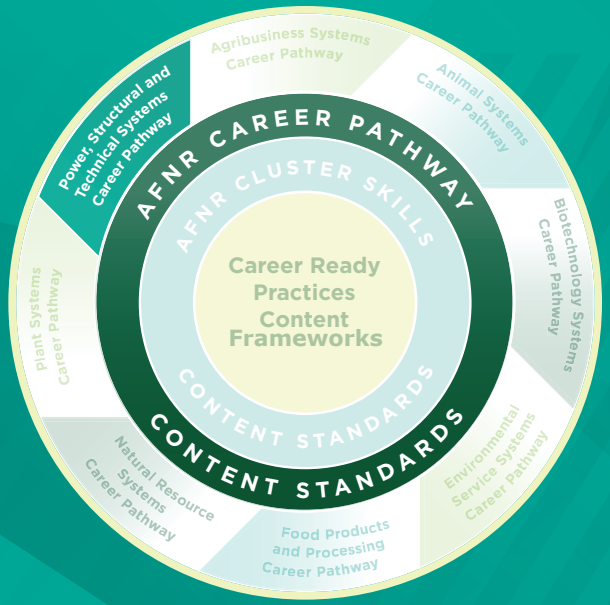
Agriculture, Food and Natural Resources Content Standards
Example Crosswalks

Plant Systems (PS)

Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)
PS.01. CCTC Framework: Develop and implement a crop management plan for a given production goal that accounts for environmental factors.					
PS.01.01. Performance Indicator: Determine the influence of environmental factors on plant growth.					
		•			
PS.01.02. Performance Indicator: Prepare and manage growing media for use in plant systems.					
		•			
PS.01.03. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.					
	MATH	• CCSS.MATH.CONTENT.HSN.Q.A.2 • CCSS.MATH.CONTENT.HSN.Q.A.3			
PS.02. CCTC Framework: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.					
PS.02.01. Performance Indicator: Classify plants according to taxonomic systems.					
		•			
PS.02.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.					
	NGSS	• HS-LS1-4			
PS.02.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.					
	NGSS	• HS-LS1-5			

PS.03. CCTC Framework: Propagate, culture and harvest plants and plant products based on current industry standards.		
PS.03.01. Performance Indicator: Demonstrate plant propagation techniques in plant system activities.		
		•
PS.03.02. Performance Indicator: Develop and implement a management plan for plant production.		
	ELA	• CCSS.ELA-Literacy.RI.9-10.1 • CCSS.ELA-Literacy.RI.9-10.8 • CCSS.ELA-Literacy.RST.9-10.3 • CCSS.ELA-Literacy.WHST.9-10.2 • CCSS.ELA-Literacy.WHST.9-10.4 • CCSS.ELA-Literacy.WHST.9-10.9
PS.03.03. Performance Indicator: Develop and implement a plan for integrated pest management for plant production.		
		•
PS.03.04. Performance Indicator: Apply principles and practices of sustainable agriculture to plant production.		
	KSS	• AFNR Career Cluster, Statement 2 • STEM Career Cluster, Statement 1 • STEM Career Cluster, Statement 4
	NGSS	• HS-ESS3-2
PS.03.05. Performance Indicator: Harvest, handle and store crops according to current industry standards.		
	ELA	• CCSS.ELA-Literacy.RST.9-10.3 • CCSS.ELA-Literacy.RST.9-10.4 • CCSS.ELA-Literacy.WHST.9-10.2a
PS.04. CCTC Framework: Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).		
PS.04.01. Performance Indicator: Evaluating, identifying and preparing plants to enhance an environment.		
		•

PS.04.02. Performance Indicator: Create designs using plants.	
KSS	• AFNR Career Cluster – Natural Resources Systems Pathway, Statement 3 • AFNR Career Cluster – Plant Systems Pathway, Statement 2 • STEM Career Cluster, Statement 4



POWER, STRUCTURAL AND TECHNICAL SYSTEMS CAREER PATHWAY

Agriculture, Food and Natural Resources Content Standards Example Crosswalks

Power, Structural and Technical Systems (PST)

Alignment Key	Green/Sustainability Knowledge and Skill Statements (KSS)	Common Core English Language Arts/Literacy Standards (ELA)	Common Core Mathematics Standards (MATH)	Next Generation Science Standards (NGSS)	National Standards for Financial Literacy (NSFL)

PST.01. CCTC Framework: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.		
PST.01.01. Performance Indicator: Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.		
	KSS	• AFNR Career Cluster, Statement 4 • AFNR Career Cluster, Statement 5
	NGSS	• HS-ESS3-3 • HS-PS3-3
PST.01.02. Performance Indicator: Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.		
	NGSS	• HS-PS3-1 • HS-PS3-3
PST.01.03. Performance Indicator: Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).		
		•
PST.02. CCTC Framework: Operate and maintain AFNR mechanical equipment and power systems.		
PST.02.01. Performance Indicator: Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.		
		•
PST.02.02. Performance Indicator: Operate machinery and equipment while observing all safety precautions in AFNR settings.		
		•

PST.03. CCTC Framework: Service and repair AFNR mechanical equipment and power systems.		
PST.03.01. Performance Indicator: Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.		
		•
PST.03.02. Performance Indicator: Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.		
		•
PST.03.03. Performance Indicator: Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).		
		•
PST.04. CCTC Framework: Plan, build and maintain AFNR structures.		
PST.04.01. Performance Indicator: Create sketches and plans for AFNR structures.		
		•
PST.04.02. Performance Indicator: Determine structural requirements, specifications and estimate costs for AFNR structures		
		•
PST.04.03. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).		
		•
PST.04.04. Performance Indicator: Apply electrical wiring principles in AFNR structures.		
	NGSS	• HS-PS3-5
PST.05. CCTC Framework: Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.		
PST.05.01. Performance Indicator: Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.		
	NGSS	• HS-ETS1-3 • HS-ESS3-2

PST.05.02. Performance Indicator: Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR settings.		
		•
PST.05.03. Performance Indicator: Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.		
	NGSS	• HS-ESS3-4 • HS-ETS1-3 • HS-ESS3-2

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