2018 Aquaculture Technology

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The Research and Curriculum Unit (RCU), located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Standards

Standards are superscripted in each unit and are referenced in the appendices. Standards in the Aquaculture Technology Curriculum Framework and Supporting Materials are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National Council for Agricultural Education (The Council) shapes and strengthens school-based agricultural education at all levels. The Council and the National AFNR Career Cluster Content Standards Committee have developed the career pathway content standards to outline technical knowledge and skills required for future success within Agriculture and Environmental Science and Technology. The content standards are intended to provide a forward-thinking guide for what students should know and be able to do after completing this program of study. Reprinted with permission, 2015. National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. 800.772.0939. https://www.ffa.org/thecouncil/afnr.

College and Career-Ready Standards

The College and Career-Ready Standards emphasize critical thinking, teamwork and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted College- and Career-Ready Standards (MCCRS) because they provide a consistent, clear understanding of what students are expected to learn so that teachers and parents know what they need to do to help them. Reprinted from http://www.mde.k12.ms.us/MCCRS

International Society for Technology in Education Standards (ISTE)

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21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st-century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and information and communication technology (ICT) literacy.

Preface

Secondary career and technical education programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and Every Student Succeeds Act 2015.).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers.

Curriculum, Assessment, Professional Learning, and other program resources can be found at The Research and Curriculum Unit's website: http://www.rcu.msstate.edu

Should you need additional instructions regarding these resources, please call 662.325.2510.

The National FFA Organization website has educator resources, student organization guidelines and program information, professional organization information and experiential learning guidelines. All Agricultural Education teachers have been given free access to these resources at www.ffa.org.

Executive Summary

Pathway Description

Aquaculture technology is an instructional program designed to prepare students to enter occupations related to the field. Upon completion of the two-year program, graduates may become employed at the entry level or further pursue the field through a postsecondary program. The concepts taught in this program include aquatic animals and plants, basic water management, hatchery and culture methods, and aquatic farm management. Industry standards were adapted from the *Career Cluster Resources for Agriculture, Food, and Natural Resources*, which is copyrighted by the National Association of State Directors of Career Technical Education.

Industry Certification

No national industry-recognized certifications are known to exist at this time in the field of agriscience. Competencies and suggested performance indicators in the aquaculture technology course have been correlated, however, to the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Assessment

The latest assessment blueprint for the curriculum can be found at http://www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx.

Student Prerequisites

In order for students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in math (last course taken, or the instructor can specify the math)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Applied Academic Credit

The latest academic credit information can be found at https://www.rcu.msstate.edu/MDE/PathwaystoSuccess.aspx.
Once there, click the Counselor Resources tab, then click Curriculum Enhancement List. Check this site often, as it is updated frequently.

Teacher Licensure

The latest teacher licensure information can be found at http://www.mde.k12.ms.us/educator-licensure.

Professional Learning

If you have specific questions about the content of any of training sessions provided, please contact the Research and Curriculum Unit at 662.325.2510.

Course Outlines

Option 1—Four One-Carnegie Unit Courses

This curriculum consists of four one-credit courses, which should be completed in the following sequence:

1. **Introduction to Aquaculture—Course Code: 991602**
2. **Basic Aquaculture—Course Code: 991603**
3. **Advanced Aquaculture—Course Code: 991604**
4. **Application of Aquaculture—Course Code: 991605**

Course Description: Introduction to Aquaculture
Introduction to Aquaculture covers the history and scope of the aquaculture industry in the United States and in Mississippi. Students will learn about the associated CTE student organization, how they can become involved in leadership and career development through the FFA, and begin planning for their personalized supervised agricultural experience (SAE) program. Further studies in aquaculture will focus on water chemistry, aquatic-species health management, and fish-hatchery maintenance and operation.

Course Description: Basic Aquaculture
The second course in the aquaculture series will take students on an in-depth journey to the various types of aquatic environments. They will explore the various crops grown in these diverse habitats, which are distinguished by water temperature and salinity levels. Students will also investigate aquatic plants, all while creating contained aquatic habitats for study and research.

Course Description: Advanced Aquaculture
In the Advanced Aquaculture course, students will learn advanced concepts and skills related to managing a controlled aquatic environment for fish and plant production. This hands-on, interactive course focuses on the maintenance and management of production systems with real-life aquaculture systems.

Course Description: Application of Aquaculture
In the Application of Aquaculture course, students will culminate the aquaculture program with independent study and research associated with aquatic plant or fish production. Students will apply practices, methods, and knowledge obtained throughout this course of study to effectively manage aquatic resources for the successful production of an aquatic crop.

Introduction to Aquaculture—Course Code: 991602

Unit	Unit Name	Hours
1	History and Overview of Aquaculture	20
2	Leadership and Experiential Learning	15
3	Basic Water Chemistry and Management	35
4	Aquatic Health Management	30
5	Aquatic Plants	35
Total		135

Basic Aquaculture—Course Code: 991603

Unit	Unit Name	Hours
6	Warm-Freshwater Aquaculture Crops	35
7	Cool-Freshwater Aquaculture Crops	35
8	Saltwater and Brackish Water Crops	35
9	Hatchery Maintenance and Operations	30
Total		135

Advanced Aquaculture—Course Code: 991604

Unit	Unit Name	Hours
10	The Aquaculture Industry	10
11	Leadership and Experiential Learning	15
12	Lab Safety, Biosecurity, and Basic Water Management	35
13	Advanced Culture Methods	30
14	Aquatic Health Management	30
15	Aquatic Farm Management	20
Total		140

Application of Aquaculture—Course Code: 991605

Unit	Unit Name	Hours
16	Application of General Practices of Aquaculture to Specific Species	30
17	Hatchery Management	25
18	Aquatic Resources Management	25
19	Independent Research Project for Aquaculture	40
Total		120

Option 2 – Two Two-Carnegie Unit Courses

This curriculum consists of two two-credit courses, which should be completed in the following sequence:

1. **Aquaculture I – Course Code: 991600**

2. **Aquaculture II – Course Code: 991601**

Course Description: Aquaculture I

The first year of the aquaculture program is designed to introduce basic concepts used in aquaculture farm production and maintenance. The material emphasizes a strong science background, which is taught through the application of concepts. These basic concepts provide an interesting background in the field of aquaculture (2-2.5 Carnegie Units, depending upon time spent in the course).

Course Description: Aquaculture II

Aquaculture II is an extension of Aquaculture I in that the course completes preparation for employment at the entry level or a continuation into the postsecondary program. This course extends the science background through the application of concepts. Units of study for this course provide a working knowledge of aquaculture farm production and maintenance and require independent performance of tasks (2-2.5 Carnegie Units. depending upon time spent in the course).

Aquaculture I – 991600

Unit	Unit Name	Hours
1	History and Overview of Aquaculture	20
2	Leadership and Experiential Learning	15
3	Basic Water Chemistry and Management	35
4	Aquatic Health Management	30
5	Aquatic Plants	35
6	Warm-Freshwater Aquaculture Crops	35
7	Cool-Freshwater Aquaculture Crops	35
8	Saltwater and Brackish Water Crops	35
9	Hatchery Maintenance and Operation	30
Total		270

Aquaculture II – 991601

Unit	Unit Name	Hours
10	The Aquaculture Industry	10
11	Leadership and Experiential Learning	15
12	Lab Safety, Biosecurity, and Basic Water Management	35
13	Advanced Culture Methods	30
14	Aquatic Health Management	30
15	Aquatic Farm Management	20
16	Application of General Practices of Aquaculture to Specific Species	30
17	Hatchery Management	25
18	Aquatic Resources Management	25
19	Independent Research Project for Aquaculture	40
Total		260

Research Synopsis

Introduction

Aquaculture textbooks, research articles, websites, and a marine-science course were considered and referenced during the development of the aquaculture technology courses, which targets skills and knowledge for careers at the professional and technical levels in aquaculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and four-year college levels in aquaculture, marine science, and fisheries management.

Needs of the Future Workforce

According to the USDA's National Institute of Food and Agriculture, the aquaculture industry is expected to produce two thirds of the fish consumed by the world population by 2030. Wild-fish harvesting is reaching a critical sustainability point; therefore, the need for controlled aquatic environments suitable for producing fish for human consumption is steadily increasing. Training a generation of students to produce healthy, highly nutritional crops in aquaculture; research new and improved production methods; reduce waste; and utilize existing natural resources is a huge challenge, but not out of reach. In order to meet the growing demands of the aquaculture industry, skilled and knowledgeable workers are needed.

Data for this synopsis were compiled from the Mississippi Department of Employment Security (2016). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

	Employment		Projected Growth 2012-2022		Average Wage 2016	
Occupation	Current (2012)	Projected (2022)	Number	Percent	Hourly	Annual
Animal Food Manufacturing	25,150	25,470	320	1.3	$21.92	$45,604
Animal Production and Aquaculture	3,510	3,480	-30	-0.9	$16.68	$34,730
Civil Engineers	2,190	2,280	90	4.1	$38.65	$80,380
Conservation Scientists	1,300	1,330	60	4.6	$26.00	$54,080
Environmental Engineers	910	970	60	6.6	$34.92	$72,640
Environmental Engineering Technicians	100	110	10	10.0	$17.53	$36,460
Environmental Scientists and Specialists, Including Health	940	1,110	70	7.4	$26.11	$54,310
Environmental Science and Protection Technicians, Including Health	30	40	10	33.3	$19.08	$39,690
Farmworkers, Farm, Ranch and Aquaculture Animals	450	470	20	4.4	$11.09	$23,070

First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	310	320	10	3.2	$22.15	$46,070
Seafood Product Preparation and Packaging, Support Activities	2,350	2,460	110	4.7	$12.17	$25,345
Zoologists and Wildlife Biologists	310	330	20	6.5	$32.66	$67,930

Source: Mississippi Department of Employment Security, www.mdes.ms.gov.

Perkins IV Requirements

The secondary aquaculture technology curriculum meets Perkins IV requirements for high-skill, high-wage, and/or high-demand occupations by introducing students to and preparing students for occupations within the field of aquaculture. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning course, that will prepare them for occupations in these fields. Additionally, the secondary aquaculture technology curriculum is integrated with academic standards. Lastly, the secondary aquaculture technology curriculum focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Curriculum Content

Summary of Standards

The standards included in the secondary aquaculture technology curriculum are based on the Mississippi College- and Career-Ready State Standards Initiative, 21st Century Skills, and the National Educational Technology Standards (NETS) for Students. Combining these standards to create this document will result in highly skilled, well-rounded students who are prepared to enter postsecondary education or the workforce.

Academic Infusion

The secondary aquaculture technology curriculum is aligned to the Mississippi College- and Career-Ready Standards. The curriculum provides multiple opportunities to enhance and reinforce these academic skills. Because students will be required to communicate effectively in the classroom and in the workforce, there is a considerable amount of writing in this curriculum. The academic content in the secondary aquaculture technology curriculum provides several opportunities for focuses on public speaking, personal finance, and money management as they relate to secondary aquaculture technology content. Overall, the secondary aquaculture technology content requires students to perform calculations, using strategic and critical-thinking skills to solve real-world problems. Appendix E includes the Mississippi College- and Career-Ready Standards for each unit.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website: http://www.mccb.edu/.

Best Practices

The premise of the success of all school-based, agricultural education programs is the three-circle model, which depicts the three major components of the program interlocked and working

together as one. The three components are classroom and laboratory instruction; experiential learning through SAE programs for individual students; and participation in the CTE student organization for agriculture education, the National FFA.

Classroom and Laboratory Instruction

The classroom and laboratory component of the school-based, agricultural-education, three-circle model is the foundation of the success of the other two components. Through contextual learning, students in agricultural education can learn the science, business, and technology of modern agriculture through innovative instructional technologies, differentiated instruction, and cooperative learning.

Innovative Instructional Technologies

Recognizing that today's students are digital learners, the classroom should be equipped with tools that will teach them in the way they need to learn. The aquaculture-technology teacher's goal should be to include teaching strategies that incorporate current technology. It is suggested that each classroom house a set of smart tablets and one teacher laptop. To make use of the latest online communication tools, such as wikis, blogs, and podcasts, the teacher is encouraged to use a learning-management system that introduces students to teaching and learning strategies in an online environment and places the responsibility of learning on the student.

Differentiated Instruction

All students are unique and possess an individualized learning style. Differentiated instruction is an approach to teaching that addresses the differences in learning styles by providing alternative teaching and assessment methods that reach across the spectrum of student needs in the classroom. By differentiating instruction in aquaculture technology, teachers can more effectively reach students and address their strengths and weaknesses, therefore increasing student success. The implementation of various forms of technology; use of alternative assessments, such as rubrics and problem-based assessment; and utilizing hands-on and work-based learning opportunities in the program of instruction truly enhance the quality of the curriculum presentation.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the aquaculture-technology curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The aquaculture-technology curriculum provides opportunities for students to work together and help each other complete complex tasks.

Experiential Learning (SAE)

The experiential learning (SAE) component has long been an integral part of the school-based, agricultural education, three-component model. Each student is encouraged to explore their career interests and plan an experiential, service, and/or work-based learning program to guide them to their career goals. This SAE program guides the student as they maintain a record-keeping system of the time and money invested, as well as the skills gained from their experiences. The experiential learning projects can be used in a variety of situations to reinforce and complement classroom theory and content. The experiential learning project consists of entrepreneurship, placement, research/experimentation, and exploratory discovery and spans the duration of program enrollment.

CTE Student Organizations

As the third part of the school-based, agricultural education program, the FFA component is the showcase, or focal point, of leadership, growth, and development for students. The FFA is the student organization for aquaculture technology curriculum. The FFA offers many opportunities for student success, such as leadership development, career development events, degrees of attainment, awards and scholarships, and community service. The FFA provides students with growth opportunities and competitive events. It also opens the doors to the world of agriculture and scholarship opportunities.

Conclusion

Secondary aquaculture technology is one of Mississippi's most contemporary and advanced agriculture curricula. Students that complete this program are well equipped for a variety of endeavors. Instructors are urged to encourage secondary aquaculture technology students to pursue educational opportunities at community colleges and universities in Mississippi.

Professional Organizations

Agricultural Education Division of the Association for Career and Technical Education. May be found online at http://www.acteonline.org/

American Association for Agricultural Education. May be found online at http://aaaeonline.org/

Mississippi ACTE. May be found online at http://www.mississippiacte.com/

Mississippi Association of Vocational Agriculture Teachers (MAVAT). May be found online at www.mississippiffa.org

National Association of Agricultural Educators. May be found online at http://www.naae.org/

National Association of Supervisors of Agricultural Education. May be found online at https://www.ffa.org/thecouncil/nasae/

National FFA Alumni Association. May be found online at https://www.ffa.org/getinvolved/alumni/

National FFA Foundation, Inc. May be found online at https://www.ffa.org/support/foundation/

National Farm and Ranch Business Management Education Association. May be found online at http://www.nfrbmea.org/

National Postsecondary Agricultural Student Organization. May be found online at http://www.nationalpas.org/

National Young Farmer Educational Association. May be found online at http://www.nyfea.org

Using This Document

Suggested Time on Task

This section indicates an estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

AFNR National Standards, 21st Century Skills, *College and Career Ready Standards* and International Society for Technology in Education (ISTE) Standards

This section crosswalks the Aquaculture Technology curriculum with the Agriculture, Forestry and Natural Resources National Standards, as well as identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877. The standards that are integrated into the content of the unit are aligned with the *College and Career Ready Standards* outlined in this document. Research-based teaching strategies also incorporate the 21st Century Skills and Information and Communication Technology Literacy skills.

Unit 1: History and Overview of Aquaculture

Competencies and Suggested Objectives
1. Investigate the origin and development of aquaculture to its current status. AS, CS a. Define aquaculture. b. Examine the relationship between fishing and aquaculture. c. Trace the history and development of aquaculture in the United States.
2. Compare and contrast the relationship between aquatic and terrestrial farm animals. AS
3. Assess the status of aquaculture production today and predict how it will look in the future. AS, CS a. Discuss the current status and practices in aquaculture in the United States. b. Discuss the current status and practices in aquaculture in other countries. c. Compare the differences between aquaculture in the United States and other parts of the world. d. Research periodicals, online sources, and other references to keep abreast of current aquaculture trends, practices, and developments. e. Explore future trends and advances that will impact the aquaculture industry in the future.
4. Describe the issues facing aquaculture as a global, national, and statewide industry. CRP, CS a. Discuss the environmental, political, and economic issues affecting the aquaculture industry. b. Examine the different career opportunities in aquaculture.
5. Investigate new and emerging technologies, practices, trends, and issues associated with aquaculture. AS, CRP, ESS, NRS a. Research and write a report on a new and emerging technology associated with aquaculture. b. Research and write a report on a current trend or issue associated with aquaculture.
6. Discuss safety procedures for the school and classroom. BS a. Demonstrate safety procedures as prescribed by the local school regulations.
7. Demonstrate proper procedures of first aid. BS.02 a. Perform first aid procedures properly.
8. Practice proper safety procedures for working in aquaculture facilities. CRP, CRP, BS a. Discuss general safety procedures. b. Demonstrate proper electrical safety procedures. c. Describe and discuss proper water safety. d. Describe and discuss proper mechanical safety procedures. e. Describe and discuss the proper safety procedures related to biological hazards. f. Describe and discuss the proper safety procedures related to chemical hazards. g. Describe and discuss the proper safety procedures related to the effects of weather, including sun, heat, and lightning.

Unit 2: Leadership and Experiential Learning

Competencies and Suggested Objectives

1. Explore the integral relationship between the FFA and agricultural education. CRP
   a. Examine historical events that shaped school-based agricultural education:
      - Smith-Hughes Act (1917)
      - Establishment of the National FFA organization (1928)
      - Mississippi FFA Association chartered (1934)
      - Establishment of the New Farmers of America (1935)
      - Public Law 740 (1950)
      - Merger of the FFA and the NFA (1965)
      - Female membership (1969)
      - Organizational name change (1988)
   b. Identify types of FFA membership:
      - Active
      - Collegiate
      - Alumni
      - Honorary
   c. Compare the degree levels of FFA membership and describe the requirements for each:
      - Discovery FFA degree
      - Greenhand FFA degree
      - Chapter FFA degree
      - State FFA degree
      - American FFA degree

2. Explore the role of the FFA in promoting leadership, personal growth, and career success through 21st Century Skills standards. CRP
   a. Explain the role of effective leadership.
   b. Have students self-evaluate their personal leadership traits and develop a plan for improvement.
   c. Identify and put into practice FFA activities that promote personal and career development, teamwork, and leadership skills.
      - Public speaking and communication skills
      - Career development events
      - Proficiency awards
      - Community service activities
      - Conventions and leadership conferences
   d. Demonstrate basic parliamentary procedures:
      - Conducting a meeting
      - Stating a main motion
      - Voting on a motion
      - Understanding the use of the gavel

e. Distinguish between the types of motions that are used in parliamentary procedure: main, subsidiary, incidental, and privileged.

3. Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration, such as: CRP
   - Leadership development competitions
   - Leadership retreats or conferences
   - Industry-related seminars, workshops, or conferences
   - Agriscience Fair

4. Describe the purposes and requirements of the SAE program. ABS,CRP
   a. Establish objectives for the SAE program:
      - Personal growth
      - Career development
      - Responsible citizenship
      - Practical application of work experience and/or skill attainment
   b. Determine the benefits of participation in an SAE program:
      - Assist with career and personal choices
      - Apply business practices, such as record keeping and money management
      - Nurture individual talents and develop a cooperative attitude
      - Build character and encourage citizenship and volunteerism
      - Provide an environment for practical learning
   c. Describe the types of SAE programs:
      - Exploratory
      - Research
        - Experimental
        - Analytical
        - Invention
      - Placement/internship
      - Entrepreneurship/ownership
      - School-based enterprise
      - Service learning
      - Improvement project

5. Develop a personal plan for a SAE program. ABS,CRP
   a. Determine the availability of time and money/resources to invest.
   b. Set short-range goals for the SAE program.
   c. Project long-range goals for the SAE program.
   d. Complete a training agreement for an SAE project.
   e. Establish requirements of student, parents, supervisor, and/or employer.

6. Develop a record-keeping system for an individual student's SAE program. ABS,CRP
    a. Determine types of records to keep:
        - Hours worked/spent on a project or enterprise
        - Inventory of assets
        - Expenses
        - Income
        - Skills attained during a project or enterprise
        - Leadership record
        - Community service record
        - Journal of experiences
    b. Maintain records using an electronic/computer-based system of record keeping for the SAE program.

Unit 3: Basic Water Chemistry and Management

Competencies and Suggested Objectives
1. Examine chemical and physical properties of water. ESS, NRS a. Define terms related to chemical and physical properties of water. b. Measure water-quality parameters using standard industry methods.
2. Investigate mechanical and biological recirculation and filtration devices and systems. AS, CRP, CS, BS, NRS, ESS a. Discuss and illustrate methods and equipment for maintaining water quality and correcting water-quality problems. b. Compare types of filtration systems, their function, and maintenance: • Mechanical filtration • Chemical filtration c. Compare types of aeration devices and systems, their function, and maintenance. d. Demonstrate methods of testing water quality: • Nitrates • Nitrites • Ammonia e. Discuss bacteria-borne illnesses and biohazards in aquaculture systems.
3. Prepare aquatic systems for fish and plants. AS, CRP, ESS, NRS a. Take inventory of aquatic system and begin building the system. b. Prepare water and begin filling tanks. c. Seed tanks and test water quality. d. Continue assessing water quality until tanks are within parameters for livestock. e. Demonstrate the procedure for cleaning and maintaining systems under fish loads.

Unit 4: Aquatic Health Management

Competencies and Suggested Objectives
1. Discuss aquatic health management practices. BS, CS, NRS a. Define and identify disease processes. b. Recognize the role of stress factors on fish production. c. Recognize signs of disease in aquatic crops. d. List symptoms and causes of selected major aquatic diseases.
2. Examine the role of nutrition in aquatic species. CRP a. Compare and contrast the major types of aquatic feed. b. Explore ingredients typically used in aquatic feed. c. Calculate feed rates and conversions for selected crops.

Unit 5: Aquatic Plants

Competencies and Suggested Objectives

1. Apply concepts of plant production in an aquatic or hydroponic growing system. CS, CRP, NRS, PS
    a. Explain the principles of aquatic plant production:
        - Aquaponics
        - Aquaponics and filtration
        - Nutrients
        - Nutrient deficiencies
        - Species selection
        - Seeding and precrop plant
        - Floating-table and growing-system design
        - Health and management of aquatic plants
    b. Discuss the culture of plants in freshwater environments.
    c. Describe the culture of plants in saltwater or brackish environments.
    d. Examine the types and impact of invasive plant species on the aquatic environment.
    e. Design and implement an aquatic or hydroponic plant-growing system.
    f. Produce plant crops in aquatic or hydroponic growing systems.
    g. Maintain plant growth logs with details regarding plant-growth patterns.

Unit 6: Warm- Freshwater Aquaculture Crops

Competencies and Suggested Objectives

1. Describe basic biological, environmental, and cultural requirements for warm-freshwater aquaculture species. AS, CRP, CS, ESS, NRS
   a. Discuss biological principles, including respiration and photosynthesis in warm-freshwater species.
   b. Discuss general environmental requirements for warm-freshwater aquaculture crops.
   c. Discuss the basic cultural requirements for warm-freshwater aquaculture crops:
      - Species selection
      - Available water
      - Nutritional requirements
      - Good health
      - Water management
      - Available market

2. Describe the requirements for producing catfish. AS, CRP, CS, ESS, CSS, NRS
   a. Identify specific characteristics of the species of catfish grown in controlled environments.
   b. Investigate the external and internal anatomy and physiology of a catfish through specimen dissection.
   c. Discuss environmental requirements for raising catfish.
   d. Explain how seed stock of catfish are obtained and managed for production.
   e. Apprise culture and stocking practices of catfish crops as related to the growing environment.
   f. Explain general feeding guidelines for catfish.
   g. Discuss the types of diseases that can affect catfish production.
   h. Describe how catfish are harvested and marketed.

3. Describe the requirements for producing tilapia. AS, CRP, CS, ESS, NRS
   a. Identify specific characteristics of the species of tilapia grown in controlled environments.
   b. Investigate the external and internal anatomy and physiology of a tilapia through specimen dissection.
   c. Discuss environmental requirements for raising tilapia.
   d. Explain how seed stock of tilapia are obtained and managed for production.
   e. Apprise culture and stocking practices of tilapia crops as related to the growing environment.
   f. Explain general feeding guidelines for tilapia.
   g. Discuss the types of diseases that can affect tilapia production.
   h. Describe how tilapia are harvested and marketed.

4. Describe the requirements for producing other types of fish in a warm-freshwater environment. AS, CRP, CS, ESS, NRS
   a. Identify specific characteristics of the species of fish grown in controlled environments, such as bass or sunfish.

b. Investigate the external and internal anatomy and physiology of other warm-freshwater fish through specimen dissection.
c. Discuss environmental requirements for raising other types of fish in a warm-freshwater environment.
d. Explain how seed stock of other types of fish are obtained and managed for production in a warm-freshwater environment.
e. Apprise culture and stocking practices of other types of fish crops as related to the warm-freshwater growing environment.
f. Explain general feeding guidelines for other fish.
g. Discuss the types of diseases that can affect other fish production.
h. Describe how other types of fish are harvested and marketed.

5. Describe the requirements for producing crawfish. AS, CRP, CS, ESS, NRS
a. Identify specific characteristics of the species of crawfish grown in controlled environments.
b. Investigate the external and internal anatomy and physiology of a crawfish through specimen dissection.
c. Discuss environmental requirements for raising crawfish.
d. Explain how seed stock of crawfish are obtained and managed for production.
e. Apprise culture and stocking practices of crawfish crops as related to the growing environment.
f. Explain general feeding guidelines for crawfish.
g. Discuss the types of diseases that can affect crawfish production.
h. Describe how crawfish are harvested and marketed.

6. Describe the requirements for producing freshwater prawns. AS, CRP, CS, ESS, NRS
a. Identify specific characteristics of the species of freshwater prawns grown in controlled environments.
b. Investigate the external and internal anatomy and physiology of a freshwater prawn through specimen dissection.
c. Discuss environmental requirements for raising freshwater prawns.
d. Explain how seed stock of freshwater prawns are obtained and managed for production.
e. Apprise culture and stocking practices of freshwater-prawn crops as related to the growing environment.
f. Explain general feeding guidelines for freshwater prawns.
g. Discuss the types of diseases that can affect freshwater-prawn production.
h. Describe how freshwater prawns are harvested and marketed.

7. Describe the requirements for producing baitfish. AS, CRP, CS, ESS, NRS
a. Identify specific characteristics of the species of baitfish grown in controlled environments.
b. Investigate the external and internal anatomy and physiology of a baitfish through specimen dissection.
c. Discuss environmental requirements for raising baitfish.

d. Explain how seed stock of baitfish are obtained and managed for production.
e. Apprise culture and stocking practices of baitfish as related to the growing environment.
f. Explain general feeding guidelines for baitfish.
g. Discuss the types of diseases that can affect baitfish production.
h. Describe how baitfish are harvested and marketed.

Unit 7: Cool-Freshwater Aquaculture Crops

Competencies and Suggested Objectives

1. Describe basic biological, environmental, and cultural requirements for cool-freshwater aquaculture species. AS, CRP, CS, ESS, NRS
   a. Discuss biological principles of cool-freshwater fish production, including respiration and photosynthesis.
   b. Discuss general environmental requirements for cool-freshwater aquaculture crops.
   c. Discuss the basic cultural requirements for cool-freshwater aquaculture crops:
      - Species selection
      - Available water
      - Nutritional requirements
      - Good health
      - Water management
      - Available market

2. Describe the requirements for producing trout. AS, CRP, CS, ESS, NRS
   a. Identify specific characteristics of the species of trout grown in controlled environments.
   b. Investigate the external and internal anatomy and physiology of a trout through specimen dissection.
   c. Discuss environmental requirements for raising trout.
   d. Explain how seed stock of freshwater trout are obtained and managed for production.
   e. Apprise culture and stocking practices of trout crops as related to the growing environment.
   f. Explain general feeding guidelines for trout.
   g. Discuss the types of diseases that can affect trout production.
   h. Describe how trout are harvested and marketed.

3. Describe the requirements for producing sturgeon. AS, CRP, CS, ESS, NRS
   a. Identify specific characteristics of the species of sturgeon grown in controlled environments.
   b. Investigate the external and internal anatomy and physiology of a sturgeon through specimen dissection.
   c. Discuss environmental requirements for raising sturgeon.
   d. Explain how seed stock of sturgeon are obtained and managed for production.
   e. Apprise culture and stocking practices of sturgeon crops as related to the growing environment.
   f. Explain general feeding guidelines for sturgeon.
   g. Discuss the types of diseases that can affect sturgeon production.
   h. Describe how sturgeon are harvested and marketed.

Unit 8: Saltwater and Brackish-Water Crops

Competencies and Suggested Objectives
1. Describe basic fundamentals of saltwater and brackish-water aquaculture production. AS, CRP, CS, ESS, NRS a. Describe salinity and chlorinity and how they are measured in saltwater and brackish-water aquaculture. b. Discuss the basic cultural requirements for saltwater and brackish-water aquaculture crops: • Species selection • Available water/location • Nutritional requirements • Good health • Water-quality management • Available market • Regulations
2. Describe the requirements for producing shrimp. AS, CRP, CS, ESS, NRS a. Identify specific characteristics of the species of shrimp grown in controlled environments. b. Investigate the external and internal anatomy and physiology of shrimp through specimen dissection. c. Discuss environmental requirements for raising shrimp. d. Explain how seed stock of shrimp are obtained and managed for production. e. Apprise culture and stocking practices of shrimp as related to the growing environment. f. Explain general feeding guidelines for shrimp. g. Discuss the types of diseases that can affect shrimp production. h. Describe how shrimp are harvested and marketed.
3. Describe the requirements for producing salmon. AS, CRP, CS, ESS, NRS a. Identify specific characteristics of the species of salmon grown in controlled environments. b. Investigate the external and internal anatomy and physiology of salmon through specimen dissection. c. Discuss environmental requirements for raising salmon. d. Explain how seed stock of salmon are obtained and managed for production. e. Apprise culture and stocking practices of salmon as related to the growing environment. f. Explain general feeding guidelines for salmon. g. Discuss the types of diseases that can affect salmon production. h. Describe how salmon are harvested and marketed.

4. Describe the requirements for producing mollusks. AS, CRP, CS, ESS,NRS
   a. Identify specific characteristics of the species of mollusks grown in controlled environments.
   b. Investigate the external and internal anatomy and physiology of a mollusk through specimen dissection.
   c. Discuss environmental requirements for raising mollusks.
   d. Explain how seed stock of mollusks are obtained and managed for production.
   e. Apprise culture and stocking practices of mollusks as related to the growing environment.
   f. Explain general feeding guidelines for mollusks.
   g. Discuss the types of diseases that can affect mollusk production.
   h. Describe how mollusks are harvested and marketed.

5. Describe the requirements for producing other crustaceans, such as lobster and crab. AS, CRP, CS, ESS, NRS
   a. Identify specific characteristics of the species of other crustaceans, such as lobster and crab, grown in controlled environments.
   b. Investigate the external and internal anatomy and physiology of other crustaceans, such as lobster and crab, through specimen dissection.
   c. Discuss environmental requirements for raising other crustaceans, such as lobster and crab.
   d. Explain how seed stock of other crustaceans, such as lobster and crab, are obtained and managed for production.
   e. Apprise culture and stocking practices of other crustaceans, such as lobster and crab, as related to the growing environment.
   f. Explain general feeding guidelines for other crustaceans, such as lobster and crab.
   g. Discuss the types of diseases that can affect production of other crustaceans, such as lobster and crab.
   h. Describe how other crustaceans, such as lobster and crab, are harvested and marketed.

6. Describe the requirements for producing other finfish. AS, CRP, CS, ESS, NRS
   a. Identify specific characteristics of the species of other finfish grown in controlled environments.
   b. Investigate the external and internal anatomy and physiology of other finfish through specimen dissection.
   c. Discuss environmental requirements for raising other finfish.
   d. Explain how seed stock of other finfish are obtained and managed for production.
   e. Apprise culture and stocking practices of other finfish as related to the growing environment.
   f. Explain general feeding guidelines for other finfish.
   g. Discuss the types of diseases that can affect production of other finfish.
   h. Describe how other finfish are harvested and marketed.

7. Describe the requirements for producing baitfish. AS, CRP, CS, ESS, NRS
    a. Identify specific characteristics of the species of baitfish grown in controlled environments.
    b. Investigate the external and internal anatomy and physiology of a baitfish through specimen dissection.
    c. Discuss environmental requirements for raising baitfish.
    d. Explain how seed stock of baitfish are obtained and managed for production.
    e. Apprise culture and stocking practices of baitfish as related to the growing environment.
    f. Explain general feeding guidelines for baitfish.
    g. Discuss the types of diseases that can affect baitfish production.
    h. Describe how baitfish are harvested and marketed.

Unit 9: Hatchery Maintenance and Operation

Competencies and Suggested Objectives
1. Apply aquaculture management skills to the maintenance and operation of a fish hatchery. AS, BS, CS, CRP, ESS, NRS a. Describe the sexual reproduction process in fish, crustaceans, and mollusks. b. Describe and operate typical hatchery equipment used in producing eggs, larvae, and juveniles of all aquatic livestock. c. Produce and raise live-food organisms, such as artemia, mosquito fish, and minnows. d. Raise aquatic livestock juveniles to stocking size. e. Manage and maintain aquatic livestock brood stock. f. Prepare, enumerate, and acclimate aquatic livestock juveniles for stocking into grow-out systems. g. Calculate fish stocking rates and feed conversions required during the growth cycle.

Unit 10: The Aquaculture Industry

Competencies and Suggested Objectives
1. Examine the environmental impact of the aquaculture industry on our state, nation, and world. AS, CRP, ESS, NRS a. Research and assess the environmental impact of the aquaculture industry as a global food source. b. Explain the concept of sustainable fisheries as it applies to aquaculture production. c. Compare and contrast the costs and rewards of saltwater aquaculture versus freshwater aquaculture.
2. Examine trends and changes related to aquaculture and global economic factors. AS, CRP, CS, ESS, NRS a. Define and discuss the concept of global economics and competition. b. Describe global economic factors and competition as related to aquaculture. c. Research and use geographic and economic data of various countries or regions to address food insecurity or hunger issues. d. Identify public policies and laws that impact aquaculture production, such as labeling and import/export regulations.

Unit 11: Leadership and Experiential Learning (SAE)

Competencies and Suggested Objectives

1. Demonstrate career and leadership skills required for employment in the aquaculture industry. CRP, CS
   a. Write and present a speech on a topic related to aquaculture:
      - Research a topic related to aquaculture.
      - Write a 2-3 minute speech on the chosen topic.
      - Present a 2-3 minute speech on the chosen topic.
   b. Demonstrate skill in advanced parliamentary procedure and public speaking:
      - Participate in a discussion demonstrating five procedures of parliamentary law.
      - Lead a minimum of 15 minutes of group discussion.
   c. Participate in a minimum of 10 hours of community service activity.
   d. Build a personal résumé for the purpose of applying for jobs.

2. Assess personal career and leadership skills required for employment in the aquaculture industry. AS, CRP, CS, ESS, NRS
   a. Self-evaluate workplace soft skills and discuss how they apply to real work situations:
      - Complete a personality or strengths assessment.
      - Discuss workplace ethics.
      - Investigate time-management techniques.
   b. Practice human relations skills (e.g., team participation, client/customer service, leadership, negotiation, working with culturally diverse groups) related to aquaculture.
   c. Research work ethics and employer expectations of employees in aquaculture.
   d. Participate in five leadership activities through FFA above the local level.
   e. Investigate involvement opportunities in professional associations and other aquaculture-related organizations.
   f. Participate in a minimum of 25 hours in at least two different community service activities.
   g. Identify potential college and career opportunities in aquaculture:
      - Research colleges and universities that offer studies in plant agriculture or a related field.
      - Complete an application for college admission and scholarships.
      - Revise a personal résumé for the purpose of applying for a specific job.
      - Complete a job application for employment.
   h. Participate in a mock or real interview for employment.

3. Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration, such as: CRP, CS
   - Leadership development competitions
   - Leadership retreats or conferences
   - Industry-related seminars, workshops, or conferences
   - Agriscience Fair
   - World Food Prize

4. Review individual plans for student SAE programs. CRP, CS
    a. Assess goal attainment in SAE from previous year.
    b. Review and update short- and long-range goals pertaining to SAE program.

5. Maintain agricultural records for an SAE. ABS, CRP, CS
    a. Redefine and adjust requirements of student, parents, supervisor, and/or employer.
    b. Utilize an electronic/computer-based system of record keeping.
    c. Update SAE records to include:
        - SAE program goals
        - Student inventory related to SAE program
        - Expense records
        - Income/gift and scholarship records
        - Skill-attainment records
        - Leadership-activity records
        - Community service hours
    d. Complete degree and proficiency award applications as they apply to SAE.

Unit 12: Lab Safety, Biosecurity, and Basic Water Management

Competencies and Suggested Objectives
1. Make observations related to the chemical and physical properties of water. CRP, ESS, NRS a. Review terms related to the chemical and physical properties of water. b. Measure water-quality parameters using standard industry methods, determine effects of various factors on quality, and recommend corrective measures for poor quality. c. Discuss the effects of weather, biomass, soil, chemicals, and feeding on water quality. d. Maintain accurate records on water quality parameters in all types of production systems. e. Apply principles of maintaining a saltwater system, if applicable.
2. Review the operation of mechanical and biological systems designed for water recirculation and filtration devices. CRP, ESS, NRS a. Select appropriate methods and equipment for maintaining, monitoring, and correcting water quality in aquatic systems. b. Review the types and functions of aeration devices and systems. c. Conduct routine maintenance on existing recirculation and filtration systems.
3. Review safety procedures for the school, aquaculture classroom, and laboratory. BS, CRP, ESS, NRS a. Demonstrate the safety procedures prescribed by school regulations. b. Discuss the concept of biosecurity when working in the aquaculture industry. c. Describe biosecurity guidelines in aquaculture.
4. Demonstrate proper procedures of first aid. BS, CRP a. Perform first aid procedures properly.
5. Describe proper safety procedures for aquaculture. BS, CS CRP, ESS, NRS a. Discuss general safety procedures. b. Demonstrate proper electrical safety procedures. c. Describe and discuss proper water safety. d. Describe and discuss proper mechanical safety procedures. e. Describe and discuss the proper safety procedures related to biological hazards. f. Describe and discuss the proper safety procedures related to chemical hazards. g. Describe and discuss the proper safety procedures related to the effects of weather, including sun, heat, and lightning.

Unit 13: Advanced Culture Methods

Competencies and Suggested Objectives
1. Assess and operate aquatic-culture methods currently in use. AS, CRP, ESS, NRS a. Describe aquatic-culture methods. b. Discuss advantages and disadvantages of various aquatic-culture methods. c. Review selection criteria for appropriate culture methods based on aquatic species and locale. d. Construct aquaculture-culture systems. e. Stock, manage, sample, feed, and harvest appropriate species from a culture system. f. Stock, manage, sample, feed, and harvest various species of aquatic livestock from ponds and raceways. g. Review and discuss minor culture systems. h. Analyze the role of biofiltration in aeration in aquaculture.

Unit 14: Aquatic Health Management

Competencies and Suggested Objectives
1. Review aquatic health management practices. AS, CRP, ESS,NRS a. Review types and descriptions of aquatic diseases. b. Review the role of stress factors on crop health in aquatic environments. c. List and identify signs, symptoms, and causes of selected major aquatic diseases. d. Review treatment options for selected aquatic diseases. e. Calculate and administer treatment for various levels of disease stages.
2. Examine the role of nutrition in aquatic species. AS, CRP, ESS, NRS a. Review definitions and identify parts of the digestive system of selected aquatic species. b. Explore the role of proteins, carbohydrates, fats, vitamins, and minerals in aquatic species development. c. Review the major types of aquatic feed. d. Explore and analyze ingredients typically used in aquatic feed. e. Review the steps in calculating feeding rates and feed conversions. f. Conduct a scientific nutrition study on cultured fish using student-formulated feed.

Unit 15: Aquatic Farm Management

Competencies and Suggested Objectives
1. Demonstrate the principles of sound aquaculture farm management. AS, CRP, ESS, FPP, NRS, PST a. Explain obstacles in aquatic management other than those related to water quality or fish disease. b. Observe and perform the processing, storage, and packaging of a final aquaculture product (pond-to-table). c. Describe transportation methods for aquaculture crops. d. Maintain equipment and aquaculture production facilities. e. Utilize parts, tools, and plumbing methods for PVC plumbing structures in aquaculture production systems. f. Simulate various marketing strategies for aquaculture products. g. Relate the importance of maintaining aquaculture production records to a successful aquaculture production facility. h. Identify sources of informational assistance in aquaculture production. i. Interpret regulations and permits required in aquaculture production. j. Prepare a species profile on a chosen or assigned aquaculture species. k. Describe and design a recreational aquaculture facility.

Unit 16: Application of General Practices of Aquaculture to Specific Species

Competencies and Suggested Objectives
1. Apply culture and management requirements specific to individual aquatic species. AS, CRP, ESS, NRS a. Investigate the characteristics related specifically, but not limited to, the culture of catfish, crawfish, trout, tilapia, hybrid bass, baitfish, prawns, tropical fish, ornamental fish, oysters, sturgeons, paddlefish, flounder, clams, redfish, bluegills, largemouth bass, and flounder. b. Discuss the production characteristics of minor aquaculture crops. c. Apply aquaculture technology practices to grow, manage, and maintain representative living specimens of as many aquaculture species as possible.

Unit 17: Hatchery Management

Competencies and Suggested Objectives
1. Maintain and operate a hatchery. AS, CRP, ESS, NRS, PST a. Review the sexual reproduction process in fish, crustaceans, and mollusks. b. Operate typical hatchery equipment used in producing eggs, larvae, and juveniles of catfish, shrimp, bass, and tilapia. c. Produce and raise artemia and other live food sources. d. Raise catfish, shrimp, bass, and tilapia juveniles to stocking size. e. Manage and maintain brood stock of catfish, shrimp, crawfish, bass, oyster, etc. f. Prepare, enumerate, and acclimate catfish, shrimp, bass, tilapia, crawfish, ornamentals, and oyster juveniles for stocking into grow-out systems. g. Hatch and attempt to rear fry and juveniles of one ornamental fish, one bait fish, and one marine species. h. Maintain, clean, and repair hatchery equipment.

Unit 18: Aquatic Resources Management

Competencies and Suggested Objectives
1. Discuss principles of fish and wildlife ecology. AS, CRP, ESS, NRS a. Examine how fish and wildlife relate to each other and to their nonliving environment. b. Identify endangered species, the causes for endangerment, and the role of the aquaculture industry in preserving those species.
2. Trace the history of natural-resource management as related to aquaculture. AS, CRP, ESS, NRS a. Examine the history and basic principles of natural-resource management. b. Explore issues and techniques involved in management of aquatic resources. c. Comprehend the role of aquaculture in natural-resource management.
3. Examine the basic principles of pond and lake management. AS, CRP, ESS,NRS a. List and discuss requirements for maintaining good sportfishing conditions in ponds and lakes. b. Sample a pond and make specific management recommendations to the owner for maintenance or improvement of sportfishing.
4. Classify freshwater and saltwater fish species in Mississippi. AS, CRP, ESS,NRS a. Recognize all major fish families in Mississippi.
5. Practice farm-pond management. AS, CRP, ESS, NRS a. Discuss farm-pond management practices. b. Perform appropriate sampling techniques. c. Evaluate results of sampling. d. Make farm-pond management recommendations to improve production outcomes.
6. Explore the opportunities for aquaculturalists in the design, construction, and maintenance of ornamental fish ponds. AS, CRP, CS, ESS,NRS a. Investigate and critique existing ornamental fish ponds. b. Design an ornamental fish pond.

~~Unit 19: Independent Research Project for Aquaculture~~

~~Competencies and Suggested Objectives~~
~~1. Propose, conduct, and report on a basic aquaculture research project.~~ ~~AS, CS, CRP, ESS,NRS~~ ~~a. Identify an aquaculture research project for approval.~~ ~~b. Conduct the approved project utilizing appropriate research procedures.~~ ~~c. Present results of the project as an oral report.~~

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: History and Overview of Aquaculture		
	1.	Investigate the origin and development of aquaculture to its current status.
	2.	Compare and contrast the relationship between aquatic and terrestrial farm animals.
	3.	Assess the status of aquaculture production today and predict how it will look in the future.
	4.	Describe the issues facing aquaculture as a global, national, and statewide industry.
	5.	Investigate new and emerging technologies, practices, trends, and issues associated with aquaculture.
	6.	Discuss safety procedures for the school and classroom.
	7.	Demonstrate proper procedures of first aid.
	8.	Practice proper safety procedures for working in aquaculture facilities.
Unit 2: Leadership and Experiential Learning		
	1.	Explore the integral relationship between the FFA and agricultural education.
	2.	Explore the role of the FFA in promoting leadership, personal growth, and career success through 21st Century Skills standards.
	3.	Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration, such as:
	4.	Describe the purposes and requirements of the SAE program.
	5.	Develop a personal plan for a SAE program.
	6.	Develop a record keeping system for an individual student's SAE program.
Unit 3: Basic Water Chemistry and Management		
	1.	Examine chemical and physical properties of water.
	2.	Investigate mechanical and biological recirculation and filtration devices and systems.
	3.	Prepare aquatic systems for fish and plants.
Unit 4: Aquatic Health Management		
	1.	Discuss aquatic health management practices.
	2.	Examine the role of nutrition in aquatic species.
Unit 5: Aquatic Plants		

	1.	Apply concepts of plant production in an aquatic or hydroponic growing system.
Unit 6: Warm-Freshwater Aquaculture Crops		
	1.	Describe basic biological, environmental, and cultural requirements for warm-freshwater aquaculture species.
	2.	Describe the requirements for producing catfish.
	3.	Describe the requirements for producing tilapia.
	4.	Describe the requirements for producing other types of fish in a warm-freshwater environment.
	5.	Describe the requirements for producing crawfish.
	6.	Describe the requirements for producing freshwater prawns.
	7.	Describe the requirements for producing baitfish.
Unit 7: Cool-Freshwater Aquaculture Crops		
	1.	Describe basic biological, environmental, and cultural requirements for cool-freshwater aquaculture species.
	2.	Describe the requirements for producing trout.
	3.	Describe the requirements for producing sturgeon.
Unit 8: Saltwater and Brackish-Water Crops		
	1.	Describe basic fundamentals of saltwater and brackish-water aquaculture production.
	2.	Describe the requirements for producing shrimp.
	3.	Describe the requirements for producing salmon.
	4.	Describe the requirements for producing mollusks.
	5.	Describe the requirements for producing other crustaceans, such as lobster and crab.
	6.	Describe the requirements for producing other finfish.
	7	Describe the requirements for producing baitfish.
Unit 9: Hatchery Maintenance and Operation		
	1.	Apply aquaculture-management skills to the maintenance and operation of a fish hatchery.
Unit 10: The Aquaculture Industry		
	1.	Examine the environmental impact of the aquaculture industry on our state, nation, and world.
	2.	Examine trends and changes related to aquaculture and global economic factors.
Unit 11: Leadership and Experiential Learning (SAE)		
	1.	Demonstrate career and leadership skills required for employment in the aquaculture industry.
	2.	Assess personal career and leadership skills required for employment in the aquaculture industry.
	3.	Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration, such as:
	4.	Review individual plans for student SAE programs.

	5.	~~Maintain agricultural records for an SAE.~~
~~Unit 12: Lab Safety, Biosecurity, and Basic Water Management~~		
	1.	~~Make observations related to the chemical and physical properties of water.~~
	2.	~~Review the operation of mechanical and biological systems designed for water recirculation and filtration devices.~~
	3.	~~Review safety procedures for the school, aquaculture classroom, and laboratory.~~
	4.	~~Demonstrate proper procedures of first aid.~~
	5	~~Describe proper safety procedures for aquaculture.~~
~~Unit 13: Advanced Culture Methods~~		
	1.	~~Assess and operate aquatic culture methods currently in use.~~
~~Unit 14: Aquatic Health Management~~		
	1.	~~Review aquatic health management practices.~~
	2.	~~Examine the role of nutrition in aquatic species.~~
~~Unit 15: Aquatic Farm Management~~		
	1.	~~Demonstrate the principles of sound aquaculture farm management.~~
~~Unit 16: Application of General Practices of Aquaculture to Specific Species~~		
	1.	~~Apply culture and management requirements specific to individual aquatic species.~~
~~Unit 17: Hatchery Management~~		
	1.	~~Maintain and operate a hatchery.~~
~~Unit 18: Aquatic Resources Management~~		
	1.	~~Discuss principles of fish and wildlife ecology.~~
	2.	~~Trace the history of natural resource management as related to aquaculture.~~
	3.	~~Examine the basic principles of pond and lake management.~~
	4.	~~Classify freshwater and saltwater fish species in Mississippi.~~
	5.	~~Practice farm pond management.~~
	6.	~~Explore the opportunities for aquaculturalists in the design, construction, and maintenance of ornamental fish ponds.~~
~~Unit 19: Independent Research Project for Aquaculture~~		
	1.	~~Propose, conduct, and report on a basic aquaculture research project.~~

AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

Crosswalk for Aquaculture Technology										
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
AFNR										
ABS - AGRIBUSINESS SYSTEMS		X								
AS - ANIMAL SYSTEMS	X		X	X		X	X	X	X	X
BS - BIOTECHNOLOGY		X	X			XX	X	X	X	
CRP - CAREER READY PRACTICES	X	X	X	X	X	X	X	X	X	X
CS – AGRICULTURE, FOOD AND NATURAL RESOURCES CLUSTER SKILL	X	X	X	X	X	X	X	X	X	X
ES - ENVIRONMENTAL SERVICE SYSTEMS		X	X			X	X	X	X	X
NRS - NATURAL RESOURCE SYSTEMS		X	X	X		X	X	X	X	X
PS - PLANT SYSTEMS					X					

	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19
AFNR									
AS - ANIMAL SYSTEMS	X	X	X	X	X	X	X	X	X
BS - BIOTECHNOLOGY	X								
CRP - CAREER READY PRACTICES	X	X	X	X	X	X	X	X	X
CS – AGRICULTURE, FOOD AND NATURAL RESOURCES CLUSTER SKILL	X	X	X	X	X	X	X	X	X
ES - ENVIRONMENTAL SERVICE SYSTEMS	X	X	X	X	X	X	X	X	X
FPP - FOOD PRODUCTS AND PROCESSING SYSTEMS					X				
NRS - NATURAL RESOURCE SYSTEMS	X	X	X	X	X	X	X	X	X
PST - POWER, STRUCTURAL, AND TECHNICAL SYSTEMS					X		X		

ABS – AGRIBUSINESS SYSTEMS
AS – ANIMAL SYSTEMS
BS – BIOTECHNOLOGY

CRP – CAREER READY PRACTICES
CS – AGRICULTURE FOOD AND NATURAL RESOURCES CLUSTER SKILL
ES – ENVIRONMENTAL SERVICE SYSTEMS
FPP – FOOD PRODUCTS AND PROCESSING SYSTEMS
NRS – NATURAL RESOURCE SYSTEMS
PS – PLANT SYSTEMS
PST – POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

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Agribusiness Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agribusiness Systems (AG-ABS) 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.

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.

ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.

ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.

ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.

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.).

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.).

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.

ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business 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.

ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.

ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.

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.

ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Animal Systems Career Pathway Content Standards

The Animal Systems (AS) Career Pathway encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, and 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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Animal Systems (AG-AS) 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.

AS.01. CCTC Standard: 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.

AS.01.02. Performance Indicator: Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.

AS.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.

AS. CCTC Standard: 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.

AS.02.02. Performance Indicator: Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).

AS.03. CCTC Standard: 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 Standard: 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.

AS.04.03 Performance Indicator: Apply scientific principles to breed animals.

AS.05. CCTC Standard: 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.

AS.05.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in animal production.

AS.06. CCTC Standard: 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.

AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.

AS.07. CCTC Standard: Apply principles of effective animal health care.

AS.07.01. Performance Indicator: Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.

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 Standard: 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.

AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.

Common Career Technical Core Career Ready Practices Content Standards

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 standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for CRPs 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 CTE program of study.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.

CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.

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.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.

CRP.02. CCTC Standard: Apply appropriate academic and technical skills.

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.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

CRP.03. CCTC Standard: Attend to personal health and financial well-being.

CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.

CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.

CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.

CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.

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.

CRP.06. CCTC Standard: Demonstrate creativity and innovation.

CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

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.

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.

CRP.07. CCTC Standard: Employ valid and reliable research strategies.

CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

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.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.

CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.

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.).

CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

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.).

CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.

CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match 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.

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.

CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. CCTC Standard: Use technology to enhance productivity.

CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity 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.

CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence.

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.

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.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) 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.

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.

CS.01.02. Performance Indicator: Examine technologies and analyze their impact on AFNR systems.

CS.01.03. Performance Indicator: Identify public policies and examine their impact on 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.

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.

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.

CS.03.02. Performance Indicator: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.

CS.03.03. Performance Indicator: Apply health and safety practices to AFNR workplaces.

CS.03.04. Performance Indicator: Use appropriate protective equipment and demonstrate safe and proper use of 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.

CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that 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.).

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.

CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

Biotechnology Systems Career Pathway Content Standards

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.

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.

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.).
- **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.).
- **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).

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.
- **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.
- **BS.02.04. Performance Indicator:** Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.
- **BS.02.05. Performance Indicator:** Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.

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.
- **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.).
- **BS.03.05. Performance Indicator:** Apply biotechnology principles, techniques and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).
- **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 Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards 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.

ESS.01. CCTC Standard: 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.
- **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.
- **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 Standard: 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.
- **ESS.03.02. Performance Indicator:** Apply soil science and hydrology principles to environmental service systems.
- **ESS.03.03. Performance Indicator:** Apply chemistry principles to environmental service systems.
- **ESS.03.04. Performance Indicator:** Apply microbiology principles to environmental service systems.
- **ESS.03.05. Performance Indicator:** Apply ecology principles to environmental service systems.

ESS.04. CCTC Standard: 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.
- **ESS.04.02. Performance Indicator:** Manage safe disposal of all categories of solid waste in environmental service systems.
- **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.
- **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.

ESS.05. CCTC Standard: 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.

ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.

Food Products and Processing Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Food Products and Processing Systems (AG-FPP) 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.

FPP.01. CCTC Standard: 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.

FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.

FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.

FPP.02. CCTC Standard: 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 Standard: 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.

FPP.03.02. Performance Indicator: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

FPP.03.03. Performance Indicator: Create food distribution plans and procedures to ensure safe delivery of food products.

FPP.04. CCTC Standard: 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.

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.

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.

Natural Resource Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Natural Resource Systems (AG-NRS) 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.

NRS.01. CCTC Standard: 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.

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.

NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.

NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.01.06. Performance Indicator: Apply ecological concepts and principles to living organisms in natural resource systems.

NRS.02. CCTC Standard: 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.).

NRS.02.02. Performance Indicator: Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Performance Indicator: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.

NRS.02.04. Performance Indicator: Examine and explain how economics affects the use of natural resources.

NRS.02.05. Performance Indicator: Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

NRS.03. CCTC Standard: 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.).

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 Standard: 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.

NRS.04.02. Performance Indicator: Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

NRS.04.03. Performance Indicator: Prevent or manage introduction of ecologically harmful species in a particular region.

NRS.04.04. Performance Indicator: Manage fires in natural resource systems.

Plant Science Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Plant Systems (AG-PS) 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.

PS.01. CCTC Standard: 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.

PS.02. CCTC Standard: 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.

PS.02.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.

PS.03. CCTC Standard: 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.

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.

PS.03.05. Performance Indicator: Harvest, handle and store crops according to current industry standards.

PS.04. CCTC Standard: 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.

Power, Structural and Technical Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Power, Structural and Technical Systems (AG-PST) 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.

PST.01. CCTC Standard: 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.
- **PST.01.02. Performance Indicator:** Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.
- **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 Standard: 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 Standard: 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 Standard: 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.

PST.05. CCTC Standard: 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.
- **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.

Appendix B: 21st Century Skills [1]

21st Century Crosswalk for Aquaculture Technology											
	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
21st Century Standards											
CS1		X	X								
CS2		X	X	X	X	X	X	X	X	X	X
CS3			X								
CS5		X	X	X	X	X	X	X	X	X	X
CS6		X	X	X	X	X	X	X	X	X	X
CS7		X	X	X	X	X	X	X	X	X	X
CS8		X	X	X	X	X	X	X	X	X	X
CS9		X	X	X	X	X	X	X	X	X	X
CS10		X	X	X	X	X	X	X	X	X	X
CS11		X	X	X	X	X	X	X	X	X	X
CS12		X	X	X	X	X	X	X	X	X	X
CS13		X	X	X	X	X	X	X	X	X	X
CS14		X	X	X	X	X	X	X	X	X	X
CS15		X	X	X	X	X	X	X	X	X	X
CS16		X	X	X	X	X	X	X	X	X	X
		Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19	
CS1									X	X	
CS2		X	X	X	X	X	X	X	X	X	
CS3		X									
CS5		X	X	X	X	X	X	X	X	X	
CS6		X	X	X	X	X	X	X	X	X	
CS7		X	X	X	X	X	X	X	X	X	
CS8		X	X	X	X	X	X	X	X	X	
CS9		X	X	X	X	X	X	X	X	X	
CS10		X	X	X	X	X	X	X	X	X	
CS11		X	X	X	X	X	X	X	X	X	
CS12		X	X	X	X	X	X	X	X	X	
CS13		X	X	X	X	X	X	X	X	X	
CS14		X	X	X	X	X	X	X	X	X	
CS15		X	X	X	X	X	X	X	X	X	
CS16		X	X	X	X	X	X	X	X	X	

CSS1-21st Century Themes

CS1 – Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 – Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 – Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes

[1] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.
4. Take individual and collective action toward addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

CSS2 Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3 Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4 Life and Career Skills

~~CS12 Flexibility and Adaptability~~

1. ~~Adapt to change~~
2. ~~Be Flexible~~

~~CS13 Initiative and Self-Direction~~

1. ~~Manage Goals and Time~~
2. ~~Work Independently~~
3. ~~Be Self-directed Learners~~

~~CS14 Social and Cross-Cultural Skills~~

1. ~~Interact Effectively with others~~
2. ~~Work Effectively in Diverse Teams~~

~~CS15 Productivity and Accountability~~

1. ~~Manage Projects~~
2. ~~Produce Results~~

~~CS16 Leadership and Responsibility~~

1. ~~Guide and Lead Others~~
2. ~~Be Responsible to Others~~

Appendix C: College and Career Ready Standards

English Standards											
	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
W.9.1		X	X								
W.9.2		X									
W.9.3		X									
W.9.4		X									
W.9.5		X									
W.9.6		X									
W.9.7		X									
W.9.8		X									
W.9.9		X									
W.9.10		X	X								
SL.9.1		X	X	X	X	X	X	X	X	X	X
SL.9.2		X		X	X	X	X	X	X	X	X
SL.9.3		X		X	X	X	X	X	X	X	X
SL.9.4				X	X	X	X	X	X	X	X
SL.9.5		X		X	X	X	X	X	X	X	X
SL.9.6		X		X	X	X	X	X	X	X	X
L.9.1			X	X	X	X	X	X	X	X	X
L.9.2			X	X	X	X	X	X	X	X	X
L.9.3				X	X	X	X	X	X	X	X
L.9.4		X		X	X	X	X	X	X	X	X
L.9.5		X		X	X	X	X	X	X	X	X
L.9.6		X		X	X	X	X	X	X	X	X
RST.9-10.1		X	X	X	X	X	X	X	X	X	X
RST.9-10.2		X	X	X	X	X	X	X	X	X	X
RST.9-10.3		X	X	X	X	X	X	X	X	X	X
RST.9-10.4		X	X	X	X	X	X	X	X	X	X
RST.9-10.5		X	X	X	X	X	X	X	X	X	X
RST.9-10.6		X	X	X	X	X	X	X	X	X	X
RST.9-10.7		X	X	X	X	X	X	X	X	X	X
RST.9-10.8		X	X	X	X	X	X	X	X	X	X
RST.9-10.9		X	X	X	X	X	X	X	X	X	X
RST.9-10.10		X	X	X	X	X	X	X	X	X	X
WHST.9-10.1		X	X	X	X	X	X	X	X	X	X
WHST.9-10.2		X	X	X	X	X	X	X	X	X	X
WHST.9-10.3		X	X	X	X	X	X	X	X	X	X
WHST.9-10.4		X	X	X	X	X	X	X	X	X	X
WHST.9-10.5		X	X	X	X	X	X	X	X	X	X
WHST.9-10.6		X	X	X	X	X	X	X	X	X	X
WHST.9-10.7		X	X	X	X	X	X	X	X	X	X
WHST.9-10.8		X	X	X	X	X	X	X	X	X	X
WHST.9-10.9		X	X	X	X	X	X	X	X	X	X
WHST.9-10.10		X	X	X	X	X	X	X	X	X	X
W.11.1		X									
W.11.2		X									
W.11.3		X									
W.11.4		X									
SL.11.1		X	X	X	X	X	X	X	X	X	X
SL.11.2		X	X	X	X	X	X	X	X	X	X
L.11.1		X		X	X	X	X	X	X	X	X
L.11.2		X		X	X	X	X	X	X	X	X
L.11.3		X		X	X	X	X	X	X	X	X
L.11.4		X		X	X	X	X	X	X	X	X
RL.12.10					X	X	X	X	X	X	X
RST.11-12.1		X			X	X	X	X	X	X	X
RST.11-12.2		X			X	X	X	X	X	X	X
RST.11-12.3		X			X	X	X	X	X	X	X
RST.11-12.4		X			X	X	X	X	X	X	X
RST.11-12.5		X			X	X	X	X	X	X	X

~~RST.11-12.6~~		~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~RST.11-12.7~~		~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~RST.11-12.8~~					~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~RST.11-12.9~~					~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
~~RST.11-12.10~~					~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~

English Standards

	Units	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19	
W.9.1			X							X	
W.9.2			X							X	
W.9.3			X							X	
W.9.4			X							X	
W.9.5			X							X	
W.9.6			X							X	
W.9.7			X							X	
W.9.8			X							X	
W.9.9			X							X	
W.9.10			X							X	
SL.9.1		X	X	X	X	X	X	X	X	X	
SL.9.2		X	X	X	X	X	X	X	X	X	
SL.9.3		X	X	X	X	X	X	X	X	X	
SL.9.4		X	X	X	X	X	X	X	X	X	
SL.9.5		X	X	X	X	X	X	X	X	X	
SL.9.6		X	X	X	X	X	X	X	X	X	
L.9.1		X	X	X	X	X	X	X	X	X	
L.9.2		X	X	X	X	X	X	X	X	X	
L.9.3		X	X	X	X	X	X	X	X	X	
L.9.4		X	X	X	X	X	X	X	X	X	
L.9.5		X	X	X	X	X	X	X	X	X	
L.9.6		X	X	X	X	X	X	X	X	X	
RST.9-10.1		X		X	X	X	X	X	X		
RST.9-10.2		X		X	X	X	X	X	X		
RST.9-10.3		X		X	X	X	X	X	X		
RST.9-10.4		X		X	X	X	X	X	X		
RST.9-10.5		X		X	X	X	X	X	X		
RST.9-10.6		X		X	X	X	X	X	X		
RST.9-10.7		X		X	X	X	X	X	X		
RST.9-10.8		X		X	X	X	X	X	X		
RST.9-10.9		X		X	X	X	X	X	X		
RST.9-10.10		X		X	X	X	X	X	X		
WHST.9-10.1		X	X	X	X	X	X	X	X	X	
WHST.9-10.2		X	X	X	X	X	X	X	X	X	
WHST.9-10.3		X	X							X	
WHST.9-10.4		X	X							X	
WHST.9-10.5		X	X							X	
WHST.9-10.6		X	X							X	
WHST.9-10.7		X	X							X	
WHST.9-10.8		X	X							X	
WHST.9-10.9		X	X							X	
WHST.9-10.10		X	X							X	
W.11.1			X							X	
W.11.2			X							X	
W.11.3			X							X	
W.11.4			X							X	
W.11.5			X							X	
W.11.6			X							X	
W.11.7			X							X	
W.11.8			X							X	
W.11.9			X							X	
W.11.10			X							X	
SL.11.1		X	X	X	X	X	X	X	X	X	
SL.11.2		X	X	X	X	X	X	X	X	X	
SL.11.3			X	X	X	X	X	X	X	X	
SL.11.4			X	X	X	X	X	X	X	X	
SL.11.5			X	X	X	X	X	X	X	X	
SL.11.6			X	X	X	X	X	X	X	X	

L.11.1		X	X	X	X	X	X	X	X	X	
L.11.2		X	X	X	X	X	X	X	X	X	
L.11.3		X	X	X	X	X	X	X	X	X	
L.11.4		X	X	X	X	X	X	X	X	X	
RL.12.10		X		X	X	X	X	X	X		
RST.11-12.1		X		X	X	X	X	X	X		
RST.11-12.2		X		X	X	X	X	X	X		
RST.11-12.3		X		X	X	X	X	X	X		
RST.11-12.4		X		X	X	X	X	X	X		
RST.11-12.5		X		X	X	X	X	X	X		
RST.11-12.6		X		X	X	X	X	X	X		
RST.11-12.7		X		X	X	X	X	X	X		
RST.11-12.8		X		X	X	X	X	X	X		
RST.11-12.9		X		X	X	X	X	X	X		
RST.11-12.10		X		X	X	X	X	X	X		
WHST.11-12.1			X							X	
WHST.11-12.2			X							X	
WHST.11-12.6			X							X	
WHST.11-12.8			X							X	

College and Career Ready English I

Reading Literature Key Ideas and Details

RL.9.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

RL.9.2 Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.

RL.9.3 Analyze how complex characters (e.g., those with multiple or conflicting motivations) develop over the course of a text, interact with other characters, and advance the plot or develop the theme.

Craft and Structure

RL.9.4 Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language evokes a sense of time and place; how it sets a formal or informal tone).

RL.9.5 Analyze how an author's choices concerning how to structure a text, order events within it (e.g., parallel plots), and manipulate time (e.g., pacing, flashbacks) create such effects as mystery, tension, or surprise.

RL.9.6 Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.

Integration of Knowledge and Ideas

RL.9.7 Analyze the representation of a subject or a key scene in two different artistic mediums, including what is emphasized or absent in each treatment (e.g., Auden's "Musée des Beaux Arts" and Breughel's Landscape with the Fall of Icarus).

RL.9.8 Not applicable to literature.

College and Career Ready English I

RL.9.9 Analyze how an author draws on and transforms source material in a specific work (e.g., how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare).

Range of Reading and Level of Text Complexity

RL.9.10 By the end of grade 9, read and comprehend literature, including stories, dramas, and poems, in the grades 9-10 text complexity band proficiently, with scaffolding as needed at the high end of the range.

College and Career Ready English I

Reading Informational Text Key Ideas and Details

RI.9.3 Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.

Craft and Structure

RI.9.5 Analyze in detail how an author's ideas or claims are developed and refined by particular sentences, paragraphs, or larger portions of a text (e.g., a section or chapter).

RI.9.6 Determine an author's point of view or purpose in a text and analyze how an author uses rhetoric to advance that point of view or purpose.

Integration of Knowledge and Ideas

RI.9.7 Analyze various accounts of a subject told in different mediums (e.g., a person's life story in both print and multimedia), determining which details are emphasized in each account.

RI.9.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.

RI.9.9 Analyze seminal U.S. documents of historical and literary significance (e.g., Washington's Farewell Address, the Gettysburg Address, Roosevelt's Four Freedoms speech, King's "Letter from Birmingham Jail"), including how they address related themes and concepts.

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Writing Text Types and Purposes

W.9.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

W.9.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.

W.9.1b Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.

W.9.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

W.9.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.9.1 e Provide a concluding statement or section that follows from and supports the argument presented.

W.9.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

W.9.2a Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

W.9.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

W.9.2c Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

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W.9.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic.

W.9.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.9.2 f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

W.9.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

W.9.3a Engage and orient the reader by setting out a problem, situation, or observation, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

W.9.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.

W.9.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole.

W.9.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.

W.9.3 e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.9.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

W.9.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 9–10.)

W.9.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

W.9.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

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W.9.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

W.9.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

W.9.9a Apply grades 9–10 Reading standards to literature (e.g., "Analyze how an author draws on and transforms source material in a specific work [e.g., how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare]").

W.9.9 b Apply grades 9–10 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning").

Range of Writing

W.9.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audience.

College and Career Ready English I

SL.9.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

SL.9.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

SL.9.1b Work with peers to set rules for collegial discussions and decision making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.

SL.9.1c Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

SL.9.1d Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
SL.9.2 Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
SL.9.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.

Presentation of Knowledge and Ideas

SL.9.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

College and Career Ready English I

SL.9.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
SL.9.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grades 9–10 Language standards 1 and 3 for specific expectations.)

College and Career Ready English I
Language
Conventions of Standard English

L.9.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
L.9.1a Use parallel structure.*
L.9.1 b Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
L.9.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
L.9.2a Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
L.9.2 b Use a colon to introduce a list or quotation.
L.9.2c Spell correctly

Knowledge of Language

L.9.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening
L.9.3 a Write and edit work so that it conforms to the guidelines in a style manual (e.g., MLA Handbook, Turabian's Manual for Writers) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

L.9.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.
L.9.4a Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
L.9.4b Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy).

College and Career Ready English I

L.9.4c Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology.
L.9.4 d Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).
L.9.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
L.9.5a Interpret figures of speech (e.g., euphemism, oxymoron) in context and analyze their role in the text.

L.9.5 b Analyze nuances in the meaning of words with similar denotations.
L.9.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

College and Career Ready English II
Range of Reading and Level of Text Complexity
RL.10.10 By the end of grade 10, read and comprehend literature, including stories, dramas, and poems, at the high end of the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Literacy in History/SS
Reading in History/Social Studies Key Ideas and Details
RH.9-10.1 Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
RH.9-10.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary of how key events or ideas develop over the course of the text.
RH.9-10.3 Analyze in detail a series of events described in a text; determine whether earlier events caused later ones or simply preceded them.

Craft and Structure
RH.9-10.4 Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history/social science.
RH.9-10.5 Analyze how a text uses structure to emphasize key points or advance an explanation or analysis.
RH.9-10.6 Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and emphasize in their respective accounts.

Integration of Knowledge and Ideas
RH.9-10.7 Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text.
RH.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claims.
RH.9-10.9 Compare and contrast treatments of the same topic in several primary and secondary sources.

Range of Reading and Level of Text Complexity
RH.9-10.10 By the end of grade 10, read and comprehend history/social studies texts in the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Literacy in Science and Technical Subjects
Reading in Science and Technical Subjects Key Ideas and Details
RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure
RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas
RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts

Range of Reading and Level of Text Complexity
RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Writing in History/SS, Science, and Technical Subjects
Writing Text Types and Purposes
WHST.9-10.1 Write arguments focused on discipline-specific content.
WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.
WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

Grades 9-10
Writing in History/SS, Science, and Technical Subjects
WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
WHST.9-10.3 Not Applicable

Production and Distribution of Writing
WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

WHST.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

Grades 9-10

Writing in History/SS, Science, and Technical Subjects

Range of Writing

WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

English III

Reading Literature Key Ideas and Details

RL.11.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.11.2 Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

RL.11.3 Analyze the impact of the author's choices regarding how to develop and relate elements of a story or drama (e.g., where a story is set, how the action is ordered, how the characters are introduced and developed).

Craft and Structure

RL.11.4 Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including words with multiple meanings or language that is particularly fresh, engaging, or beautiful. (Include Shakespeare as well as other authors.)

RL.11.5 Analyze how an author's choices concerning how to structure specific parts of a text (e.g., the choice of where to begin or end a story, the choice to provide a comedic or tragic resolution) contribute to its overall structure and meaning as well as its aesthetic impact.

RL.11.6 Analyze a case in which grasping a point of view requires distinguishing what is directly stated in a text from what is really meant (e.g., satire, sarcasm, irony, or understatement).

Integration of Knowledge and Ideas

RL.11.7 Analyze multiple interpretations of a story, drama, or poem (e.g., recorded or live production of a play or recorded novel or poetry), evaluating how each version interprets the source text. (Include at least one play by Shakespeare and one play by an American dramatist.)

RL.11.8 Not applicable to literature.

RL.11.9 Demonstrate knowledge of eighteenth , nineteenth and early twentieth century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics.

Range of Reading and Level of Text Complexity

RL.11.10 By the end of grade 11, read and comprehend literature, including stories, dramas, and poems, in the grades 11 CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.

English III

Reading Informational Text Key Ideas and Details

Rl.11.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.

Craft and Structure

Rl.11.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).

Rl.11.5 Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging.

Rl.11.6 Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness or beauty of the text.

Integration of Knowledge and Ideas

Rl.11.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

Rl.11.8 Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning (e.g., in U.S. Supreme Court majority opinions and dissents) and the premises, purposes, and arguments in works of public advocacy (e.g., The Federalist, presidential addresses).

Rl.11.9 Analyze seventeenth , eighteenth , and nineteenth century foundational U.S. documents of historical and literary significance (including Them Declaration of Independence, the Preamble to the Constitution, the Bill of Rights, and Lincoln's Second Inaugural Address) for their themes, purposes, and rhetorical features.

Range of Reading and Level of Text Complexity

Rl.11.10 By the end of grade 11, read and comprehend literary nonfiction in the grades 11 CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.

English III

Writing

W.11.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

W.11.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.

W.11.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.

W.11.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

W.11.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11.1 e Provide a concluding statement or section that follows from and supports the argument presented.
W.11.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
W.11.2a Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

English III

W.11.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
W.11.2c Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
W.11.2d Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic.
W.11.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
W.11.2 f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
W.11.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
W.11.3a Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.
W.11.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.
W.11.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).
W.11.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.
W.11.3 e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.11.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

English III

W.11.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 11–12.)
W.11.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

W.11.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
W.11.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
W.11.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
W.11.9a Apply grades 11–12 Reading standards to literature (e.g., "Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics").

W.11.9 b Apply grades 11–12 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning [e.g., in U.S. Supreme Court Case majority opinions and dissents] and the premises, purposes, and arguments in works of public advocacy [e.g., The Federalist, presidential addresses]").

Range of Writing

W.11.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

English III

Speaking and Listening Comprehension and Collaboration

SL.11.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

SL11.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

SL.11.1b Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.

SL.11.1c Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.

SL.11.1d Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.

SL.11.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SL.11.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

Presentation of Knowledge and Ideas

SL.11.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

English III

SL11.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

SL.11.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (See grades 11–12 Language standards 1 and 3 for specific expectations.)

English III

Language

Conventions of Standard English

L.11.1a Apply the understanding that usage is a matter of convention, can change over time, and is sometimes contested.

L.11.1 b Resolve issues of complex or contested usage, consulting references (e.g., Merriam-Webster's Dictionary of English Usage, Garner's Modern American Usage) as needed.

L.11.2 a Observe hyphenation conventions.

L.11.3 a Vary syntax for effect, consulting references (e.g., Tufte's Artful Sentences) for guidance as needed; apply an understanding of syntax to the study of complex texts when reading.

Vocabulary Acquisition and Use

L.11.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies.

L.11.4b Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable).

English IV

Range of Reading and Level of Text Complexity

RL.12.10 By the end of grade 12, read and comprehend literature, including stories, dramas, and poems, at the high end of the grades 11–CCR text complexity band independently and proficiently.

Grades 11–12: Literacy in History/SS

Reading in History/Social Studies Key Ideas and Details

RH.11–12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.

RH.11–12.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

RH.11–12.3 Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain. Craft and Structure

RH.11–12.4 Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines faction in Federalist No. 10).

RH.11–12.5 Analyze in detail how a complex primary source is structured, including how key sentences, paragraphs, and larger portions of the text contribute to the whole.

RH.11–12.6 Evaluate authors' differing points of view on the same historical event or issue by assessing the authors' claims, reasoning, and evidence. Integration of Knowledge and Ideas

Rh.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

RH.11–12.8 Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.

RH.11–12.9 Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources. Range of Reading and Level of Text Complexity

RH.11-12.10 By the end of grade 12, read and comprehend history/social studies texts in the grades 11–CCR text complexity band independently and proficiently.

Grades 11–12: Literacy in Science and Technical Subjects

Reading in Science and Technical Subjects Key Ideas and Details

RST. 11–12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

RST.11–12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

RST.11–12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Range of Reading and Level of Text Complexity

RST.11-12.10 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Grades 11-12: Writing I History/SS, Science and Technical Subjects
Writing
Text Types and Purposes

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

Grades 11-12: Writing I History/SS, Science and Technical Subjects

WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.

Production and Distribution of Writing

WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

Mathematics Standards											
	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
N-Q.1			X	X	X	X	X	X	X	X	
N-Q.2			X	X	X	X	X	X	X	X	
N-Q.3			X	X	X	X	X	X	X	X	
G-GMD.1											
G-GMD.3											
G-MG.1			X	X	X	X	X	X	X	X	
G-MG.2			X	X	X	X	X	X	X	X	
G-MG.3			X	X	X	X	X	X	X	X	
S-IC.1											
S-IC.2											
S-IC.3											
S-IC.4											
S-IC.5											
S-IC.6					X	X	X	X	X	X	
S-CP.1											
S-CP.2											
S-CP.3											
S-CP.4											
S-CP.5											
S-CP.6											
S-CP.7											
S-CP.8											
S-CP.9											
S-MD.5											
S-MD.6											
S-MD.7											

Mathematics Standards											
	Units	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19	
N-Q.1		X	X	X	X	X	X	X	X	X	
N-Q.2		X	X	X	X	X	X	X	X	X	
N-Q.3		X	X	X	X	X	X	X	X	X	
G-GMD.1					X	X	X		X	X	
G-GMD.3					X	X	X		X	X	
G-MG.1					X	X	X		X	X	
G-MG.2					X	X	X		X	X	
G-MG.3					X	X	X		X	X	
S-IC.1						X	X		X	X	
S-IC.2						X	X		X	X	
S-IC.3						X	X		X	X	
S-IC.4						X	X		X	X	
S-IC.5						X	X		X	X	
S-IC.6						X	X		X	X	
S-CP.1						X	X		X	X	
S-CP.2						X	X		X	X	
S-CP.3						X	X		X	X	
S-CP.4						X	X		X	X	
S-CP.5						X	X		X	X	
S-CP.6						X	X		X	X	
S-CP.7						X	X		X	X	
S-CP.8						X	X		X	X	
S-CP.9						X	X		X	X	
S-MD.5									X	X	
S-MD.6									X	X	
S-MD.7									X	X	

Number and Quantity

Reason quantitatively and use unites to solve problems

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

Algebra II

Understand and evaluate random processes underlying statistical experiments

S-IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*

S-IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

S-IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*

S-IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*

S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*

S-IC.6 Evaluate reports based on data.*

Understand independence and conditional probability and use them to interpret data

S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").*

S-CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*

S-CP.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.*

S-CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*

Use the rules of probability to compute probabilities of compound events in a uniform probability model

S-CP.6 Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.*

S-CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.*

Integrated Mathematics
Number and Quantity
Reason quantitatively and use units to solve problems

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

Explain volume formulas and use them to solve problems

G-GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.

G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*

Integrated Mathematics III
Number and Quantity
Reason quantitatively and use units to solve problems

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

Apply geometric concepts in modeling situations

G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

G-MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*

G-MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*

Understand and evaluate random processes underlying statistical experiments

S-IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Integrated Mathematics III

S-IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

S-IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*

S-IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*

S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*

S-IC.6 Evaluate reports based on data.*

Advanced Mathematics Plus

Use probability to evaluate outcomes of decisions

S-MD.5 Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. *

a. Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.

b. Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*

S-MD.6 Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).*

S-MD.7 Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).*

Appendix D: International Society for Technology in Education Standards (ISTE)

ISTE Crosswalk for Aquaculture Technology											
	Course	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
ISTE Standards											
T1		X	X	X	X	X	X	X	X	X	X
T2		X	X	X	X	X	X	X	X	X	X
T3		X	X	X	X	X	X	X	X	X	X
T4		X	X	X	X	X	X	X	X	X	X
T5		X	X	X	X	X	X	X	X	X	X
T6		X	X	X	X	X	X	X	X	X	X

	Course	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19
ISTE Standards										
T1		X	X	X	X	X	X	X	X	X
T2		X	X	X	X	X	X	X	X	X
T3		X	X	X	X	X	X	X	X	X
T4		X	X	X	X	X	X	X	X	X
T5		X	X	X	X	X	X	X	X	X

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T5 Digital Citizenship
T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.
b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.
d. Transfer current knowledge to learning of new technologies.

2023 Aquaculture

Program CIP: 01.0303 — Aquaculture

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Mississippi State, MS 39762

The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Mr. Glen East, vice chair
Dr. Karen Elam
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Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE aquaculture technology is aligned to the following standards:

National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards
The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in Grades 9-12 and two-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. The National AFNR Career Cluster Content Standards are copyrighted by the National Council for Agricultural Education and are used with permission.
thecouncil.ffa.org/afnr

International Society for Technology in Education Standards (ISTE)
Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE.
iste.org

College- and Career-Ready Standards
College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities required by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn so teachers and parents know what they need to do to help them.
mdek12.org/oae/college-and-career-readiness-standards

Framework for 21st Century Learning
In defining 21st-century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, technology skills; and life and career skills. 21 *Framework Definitions* (2019).
battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510.

Executive Summary

Pathway Description
Aquaculture is an instructional program designed to prepare students to enter occupations related to the field. Upon completion of the two-year program, graduates may become employed at the entry level or further pursue the field in a postsecondary program. The concepts taught in this program include aquatic animal and plant husbandries, basic water management, hatchery and culture methods, and aquatic farm management.

College, Career, and Certifications
No national industry-recognized certifications are known to exist at this time in the field of agriscience. Competencies and suggested performance indicators in the aquaculture technology course have been correlated, however, to the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Grade Level and Class Size Recommendations
It is recommended that students enter this program as 10th graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class with only one class with the teacher at a time.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum/curriculumdownload.

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/ese/approved-course-for-the-secondary-schools.

Teacher Licensure
The latest teacher licensure information can be found at

mdek12.org/oel/apply-for-an-educator-license.

Professional Learning
If you have specific questions about the content of any of training sessions provided, please contact the RCU at 662.325.2510.

Course Outlines

Option 1—Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses, which should be completed in the following sequence:

1. **Introduction to Aquaculture—Course Code: 991602**
2. **Basic Aquaculture—Course Code: 991603**
3. **Advanced Aquaculture—Course Code: 991604**
4. **Application of Aquaculture—Course 991605**

Course Description: Introduction to Aquaculture
Introduction to Aquaculture covers the history and scope of the aquaculture industry in the United States and Mississippi. Students will learn about the associated CTE student organization, how they can become involved in leadership and career development through the FFA and begin planning for their personalized supervised agricultural experience (SAE) program. Further studies in aquaculture will focus on water chemistry, aquatic-species health management, and fish-hatchery maintenance and operation.

Course Description: Basic Aquaculture
This course will take students on an in-depth journey into various aquatic environments. Students will explore the various organisms grown in these diverse environments, which are distinguished by the operating system, water temperature, and salinity levels. Students will also investigate aquatic plants while creating contained and controlled aquatic habitats for study and research.

Course Description: Advanced Aquaculture
In the Advanced Aquaculture course, students will learn advanced concepts and skills related to managing a controlled aquatic environment for animal and plant production. This hands-on, interactive course focuses on the maintenance and management of production systems with real-life aquaculture systems.

Course Description: Application of Aquaculture
In the Application of Aquaculture course, students will culminate the aquaculture program with independent study and research associated with aquatic plant or fish production. Students will apply practices, methods, and knowledge obtained throughout this course of study to produce a crop from an aquaculture system to effectively manage aquatic resources for the successful production of an aquatic crop.

Introduction to Aquaculture—Course Code: 991602

Unit	Unit Name	Hours
1	History and Overview of Aquaculture	30
2	Safety and Biosecurity	45
3	Professional and Student Organizations	20
4	Supervised Agriculture Experience (SAE)for All	45
Total		140

Basic Aquaculture—Course Code: 991603

Unit	Unit Name	Hours
5	Basic Water Chemistry and Management	45
6	Major and Minor Crops With Applications	40
7	Aquatic Resources Management	25
8	The Aquaculture Industry	30
Total		140

Advanced Aquaculture—Course Code: 991604

Unit	Unit Name	Hours
9	Hatchery Management and Operation	45
10	Aquatic Health Management	50
11	Immersion Into FFA and Supervised Agricultural Experience (SAE) for All	45
Total		140

Application of Aquaculture—Course Code: 991605

Unit	Unit Name	Hours
12	Aquaculture Wastes and Remediation	40
13	Advanced Culture Methods	45
14	Pond Aquaculture	35
15	Independent Research Project for Aquaculture	20
Total		140

Option 2—Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses, which should be completed in the following sequence:

1. **Aquaculture Concepts—Course Code: 991600**
2. **Aquaculture Application-Course Code:991601**

Course Description: Aquaculture Concepts
Agriculture Concepts is designed to introduce basic concepts used in aquaculture farm production and maintenance. The material emphasizes a strong science background, which is taught through the application of concepts. These basic concepts provide an interesting background in the field of aquaculture (2-2.5 Carnegie Units, depending upon time spent in the course).

Course Description: Aquaculture Application
Aquaculture Application is an extension of Aquaculture Concepts in that the course completes preparation for entry-level employment or continuation into a postsecondary program. This course extends the science background through the application of concepts. Units of study for this course provide a working knowledge of aquaculture-farm production and maintenance and require independent performance of tasks (2-2.5 Carnegie Units. depending upon time spent in the course).

Aquaculture Concepts—991600

Unit	Unit Name	Hours
1	History and Overview of Aquaculture	30
2	Safety and Biosecurity	45
3	Professional and Student Organizations	20
4	Supervised Agriculture Experience (SAE) for All	40
5	Basic Water Chemistry and Management	45
6	Major and Minor Crops with Applications	45
7	Aquatic Resources Management	25
8	The Aquaculture Industry	30
Total		280

Aquaculture Application—991601

Unit	Unit Name	Hours
9	Hatchery Management and Operation	40
10	Aquatic Health Management	50
11	Immersion Into FFA and Supervised Agricultural Experience (SAE) for All	30
12	Aquaculture Wastes and Remediation	45
13	Advanced Culture Methods	50
14	Pond Aquaculture	40
15	Independent Research Project for Aquaculture	25
Total		280

Career Pathway Outlook

Overview
According to the USDA's National Institute of Food and Agriculture (NIFA), the aquaculture industry is expected to produce two-thirds of the fish consumed by the world population by 2030. Wild fish harvesting is reaching a critical sustainability point; therefore, the need for controlled aquatic environments suitable for producing fish for human consumption is steadily increasing. Training a generation of students to produce healthy, highly nutritional crops in aquaculture; research new and improved production methods; reduce waste; and utilize existing natural resources is a considerable challenge, but not out of reach. Skilled and knowledgeable workers are needed to meet the growing demands of the aquaculture industry.

Aquaculture will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and four-year college levels.

Needs of the Future Workforce
Data for this synopsis were compiled from the Mississippi Department of Employment Security (2022). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Occupation	Employment		Projected Growth 2018-2028		Average Wage 2021	
	Current (2018)	Projected (2028)	Number	Percent	Hourly	Annual
Animal Food Manufacturing	25,150	25,470	320	1.3%	$21.92	$45,604
Animal Production and Aquaculture	3,510	3,480	-30	-0.9%	$16.68	$34,730
Civil Engineers	1,590	1,670	90	4.1%	$42.84	$89,120
Conservation Scientists	880	1,330	60	4.6%	$27.21	$56,590
Environmental Engineers	450	470	20	4.4%	$38.92	$80,940
Environmental Engineering Technicians	70	70	0	0%	$19.41	$40,360
Environmental Scientists and Specialists, Including Health	540	570	30	5.6%	$24.45	$50,860
Farmworkers, Farm, Ranch and Aquaculture Animals	6,120	6,120	0	0%	$16.02	$33,320
Farming, Fishing, and Forestry Workers	12,600	12,270	-330	-2.6%	$18.20	$37,860
First-Line Supervisors of Farming, Fishing and Forestry Workers	830	830	0	0%	$26.11	$54,300

Meat, Poultry, and Fish Cutters and Trimmers	6,650	6,730	80	1.2%	$14.37	$29,880
Seafood Product Preparation and Packaging, Support Activities	2,350	2,460	110	4.7%	$12.17	$25,345
Zoologists and Wildlife Biologists	420	440	20	4.8%	$35.10	$73,010

Source: Mississippi Department of Employment Security; mdes.ms.gov (2022).

Perkins V Requirements and Academic Infusion

The Aquaculture curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in aquaculture fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for aquaculture careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers and relationships with industry.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The aquaculture educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunity to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. There are several here in Mississippi that will foster the types of learning expected from the Aquaculture curriculum. FFA is an example of a student organization outlet for aquaculture students. Student organizations provide participants and members with growth opportunities and competitive events. They also open the doors to the world of agriculture careers and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the Aquaculture curriculum for group work. Students need to be able to work collaboratively with others and solve problems without excessive conflict to function in today's workforce. The Aquaculture curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the Aquaculture curriculum that will allow and encourage collaboration with professionals currently in the aquaculture field.

Work-Based Learning

Work-based learning (WBL) is an extension of understanding competencies taught in the aquaculture classroom. This program may require students to obtain a minimum of 35 clinical-type hours, which may include but are not limited to clinicals/worksite field experiences, entrepreneurships, internships, pre-apprenticeships, school-based enterprises, job placements, and simulated worksites. These real-world connections and applications provide a link to all types of students regarding knowledge, skills, and professional dispositions. Thus, supervised collaboration and immersion into the agricultural industry are keys to students' success, knowledge, and skills development. For more information on embedded WBL, visit the Mississippi Work-Based Learning Manual on the RCU website, rcu.msstate.edu.

Professional Organizations

Agricultural Education Division of the Association for Career and Technical Education
acteonline.org

American Association for Agricultural Education
aaaeonline.org

Mississippi ACTE
mississippiacte.com

Mississippi Association of Agricultural Educators (MSAAE)
mississippiffa.org

National Association of Agricultural Educators
naae.org

National Association of Supervisors of Agricultural Education
ffa.org/thecouncil/nasae

National FFA Alumni Association
ffa.org/getinvolved/alumni

National FFA Foundation, Inc.
ffa.org/support/foundation

National Farm and Ranch Business Management Education Association
nfrbmea.org

National Postsecondary Agricultural Student Organization
nationalpas.org

National Young Farmer Educational Association
nyfea.org

U.S. Aquaculture Society
usaquaculture.org

World Aquaculture Society
was.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students are expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level. Teachers are welcome to teach the competencies in other ways than the listed objectives if it allows for mastery of the competencies. Teachers are also allowed to teach the units and competencies in the order they prefer, as long as they teach the necessary material allotted for the specific course or credit they are teaching at the time.

Teacher Resources
All teachers should request to be added to the Canvas Resource Guide for their course. For questions or to added to the guide send a help desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences for students. If the aquaculture program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: History and Overview of Aquaculture

Competencies and Suggested Objectives
1. Investigate the origin and development of aquaculture. DOK3 a. Define aquaculture. b. Define aqua crop. c. Trace the history and development of aquaculture in the United States. • Brown trout eggs from Germany (late 1800s). • Pond aquaculture in the South (the 1950s). • Development of bivalve culture on coastlines.
2. Compare and contrast the relationship between aquatic and terrestrial farm animals (e.g., feed efficiency and feed conversion ratio, fighting gravity vs. drag, cold vs. warm-blooded. DOK3
3. Discuss the current status and practices in the aquaculture industry. DOK1 a. Compare the differences between aquaculture in the United States and other parts of the world. • Explore the availability of United States seafood (i.e., import vs. export). • Gulf of Thailand shrimp vs. Gulf of Mexico shrimp • Global food security b. Discuss the environmental, political, and economic issues affecting the aquaculture industry. c. Explore current aquaculture practices (i.e., intensive and extensive). • Pond • Cage • Integrated multi-trophic aquaculture (IMTA) • Aquaponics • Recirculating aquaculture systems (RAS) • Flow-through or single-pass d. Investigate new and emerging technologies, practices, trends, and issues associated with aquaculture.
4. Examine the different career opportunities in aquaculture and related fields. DOK2

Unit 2: Safety and Biosecurity

Competencies and Suggested Objectives
1. Review safety procedures for the school, aquaculture classroom, and laboratory. DOK 1 a. Demonstrate the safety procedures prescribed by school regulations. b. Discuss the concept of safety when working in the aquaculture industry.
2. Implement biosecurity measures and standard operating procedures. DOK 3 a. Review potential fomites (e.g., nets, tubes, pumps, etc.). b. Discuss disinfection techniques.
3. Demonstrate proper first aid procedures. DOK 3 a. Perform first aid procedures properly.
4. Describe proper safety procedures for aquaculture. DOK 1 a. Discuss general safety procedures. b. Demonstrate proper electrical safety procedures. c. Describe and discuss proper water safety. d. Describe and discuss proper mechanical safety procedures. e. Describe and discuss the proper safety procedures related to biological hazards. f. Describe and discuss the proper safety procedures related to chemical hazards. g. Describe and discuss the proper safety procedures related to the effects of weather (e.g., sun, heat, lightning, etc.).
5. Demonstrate proper tool safety procedures. DOK 3

Unit 3: Professional and Student Organizations

Competencies and Suggested Objectives

1. Explore the integral relationship between the FFA and agricultural education. DOK3
   a. Examine historical events that shaped school-based agricultural education.
      - Smith-Hughes Act (1917)
      - Establishment of the National FFA Organization (1928)
      - Mississippi FFA Association chartered (1934)
      - Establishment of the New Farmers of America (1935)
      - Public Law 740 (1950)
      - Merger of the FFA and the NFA (1965)
      - Female membership (1969)
      - Organizational name change (1988)
   b. Identify types of FFA membership.
      - Active
      - Collegiate
      - Alumni
      - Honorary
   c. Compare the degree levels of FFA membership and describe the requirements for each.
      - Discovery FFA degree
      - Greenhand FFA degree
      - Chapter FFA degree
      - State FFA degree
      - American FFA degree

2. Explore the role of the FFA in promoting leadership, personal growth, and career success through 21st-century skills standards. DOK3
   a. Explain the role of effective leadership.
   b. Have students self-evaluate their leadership traits and develop a plan for improvement.
   c. Identify and put into practice FFA activities that promote personal and career development, teamwork, and leadership skills.
      - Public speaking and communication skills
      - Career-development events
      - Proficiency awards
      - Community service activities
      - Conventions and leadership conferences
   d. Demonstrate basic parliamentary procedures.
      - Conducting a meeting
      - Stating a main motion
      - Voting on a motion

• Understanding the use of the gavel e. Distinguish between the types of motions used in parliamentary procedure (i.e., main, subsidiary, incidental, and privileged).
3. Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration. DOK4 a. Leadership Development Events b. Leadership retreats or conferences c. Industry-related seminars, workshops, or conferences d. Agriscience fair
4. Discuss aquaculture-specific professional organizations. DOK1 a. National Aquaculture Association (NAA) b. United States Aquaculture Society (USAS) c. Aquaculture America/World Aquaculture Society (WAS) d. America Fisheries Society (AFS)

Unit 4: Supervised Agricultural Experience (SAE) for All

Competencies and Suggested Scenarios

1. Describe the purposes and requirements of the Supervised Agricultural Experience (SAE) for All program. DOK 1
   a. Establish objectives for the SAE program.
      - Personal growth
      - Career development
      - Responsible citizenship
      - Practical application of work experience and/or skill attainment
   b. Determine the benefits of participation in an SAE program.
      - Assist with career and personal choices
      - Apply business practices, such as record-keeping and money management
      - Nurture individual talents and develop a cooperative attitude
      - Build character and encourage citizenship and volunteerism
      - Provide an environment for practical learning
   c. Describe the types of programs under SAE For All.
      - Foundational SAE
        - Career exploration and planning
        - Employability skills for college and career readiness
        - Personal financial management and planning
        - Workplace safety
        - Agricultural literacy
      - Immersion SAE
        - Placement/internship
        - Ownership/entrepreneurship
        - Research
          - Experimental
          - Analytical
          - Invention
        - School-based enterprise
        - Service learning
   d. Explore the Mississippi Work-Based Learning Manual as a companion to Immersion SAE.

2. Launch a Foundational SAE plan. DOK 2
   a. Identify potential career interests.
   b. Determine the availability of time and money/resources to invest.
   c. Set short-range goals for the SAE program.

d. Project long-range goals for the SAE program.
e. Complete a training agreement for an SAE project.
f. Establish requirements of the student, parents, supervisor, and/or employer.

3. Develop a record-keeping system for an individual student's SAE program. DOK 3
   a. Determine the types of records to keep.
      - Hours worked/spent on a project or enterprise
      - Inventory of assets
      - Expenses
      - Income
      - Skills attained during a project or enterprise
      - Leadership record
      - Community service record
      - Journal of experiences
      - Pictures
   b. Use an electronic/computer-based record-keeping system to maintain records for the SAE program.

Unit 5: Basic Water Chemistry and Management

Competencies and Suggested Objectives
1. Examine the chemical and physical properties of water. DOK 3 a. Define terms related to the physical properties of water. • Temperature • Water density • Volume • Specific heat b. Define terms related to the chemical properties of water. • Polarity • Adhesion • Cohesion • Universal solvent c. Measure water quality parameters using standard industry methods. • Temperature • Salinity • pH • Alkalinity • Dissolved oxygen • Ammonia, nitrite, nitrate (i.e., nitrogen cycle)
2. Investigate mechanical and biological filtration in recirculating systems. DOK 3 a. Define mechanical and biological filtration. • Nitrogen cycle b. Discuss and illustrate methods and equipment for maintaining water quality and correcting water quality problems. c. Compare the types of filtration systems, their function, and maintenance. • Mechanical filtration • Chemical filtration d. Compare the types of aeration devices and systems, their function, and maintenance. e. Examine system cycling for system preparation.
3. Prepare aquatic systems for fish and plants. DOK 4 a. Understand species and life stage selection. b. Take inventory of the aquatic system and begin building the system. c. Prepare the water and begin filling the tanks. d. Prepare seed tanks to establish biological filtration and test the water quality. e. Assess the water quality until the tanks are within the parameters for livestock. f. Demonstrate the procedure for cleaning and maintaining the systems under fish loads.

Unit 6: Major and Minor Crops With Applications

Competencies and Suggested Objectives

1. Describe major food aqua crops and their typical production techniques. DOK 2
   a. Investigate and critique common carp production in Asia.
   b. Investigate and critique catfish aquaculture in the southern United States.
   c. Investigate and critique tilapia aquaculture in Central America and Southeast Asia.
   d. Investigate and critique shrimp and prawn production in the Gulf of Thailand .
   e. Investigate and critique hydroponic/aquaponic vegetable aqua crops.
   f. Investigate and critique bivalve production and techniques.
   g. Investigate and critique Salmonid production and techniques.
   h. Investigate and critique microalgae and macroalgae.

2. Describe stock enhancement and the application of aquaculture to support it. DOK 2
   a. Discuss stock enhancement species for recreational fisheries.
      - Salmonids in cold water (e.g., rainbow trout, brown trout, etc.)
      - Percids in cool-water fisheries (e.g., perch, walleye, etc.)
      - Centrarchids in warm-water fisheries (e.g., bass, bream, crappie, etc.)
      - Catfish for put-and-take fisheries
      - Sea trout, striped bass, and red drum on the Gulf Coast
   b. Discuss stock enhancement conservation species.
      - Discuss darters in the Appalachian Mountains (e.g., Tellico River darters).
   c. Discuss stock enhancement species for ecosystem management.
      - Oyster reef restoration for erosion control and wave attenuation
      - Triploid grass carp for vegetation control

3. Describe major baitfish species and their typical production techniques. DOK 2
   a. Identify specific characteristics of the baitfish species grown in controlled environments.
      - Golden shiners
      - Fathead minnows
      - Goldfish
   b. Discuss the environmental requirements for raising baitfish.
   c. Explain how baitfish seed stock is obtained and managed for production.
      - Use of spawning habitat for improved hatching success
   d. Explain general feeding guidelines for baitfish.
      - Pond fertilization for natural food production
      - Prepared feed for broodstock
   e. Describe how baitfish are harvested and marketed.
   f. Describe minor baitfish production techniques.
      - Winterkill lake stocking in the northern United States (e.g., white sucker)

4. Describe major ornamental crops and their typical production techniques. DOK 2
   a. Analyze freshwater aquarium species.
      - Fancy goldfish
      - Cichlids
      - Tetras
      - Mollies and guppies
   b. Analyze saltwater aquarium species.
      - Clownfish
      - Blue tang
      - Corals and anemones
   c. Analyze ornamental ponds and water gardens.
      - Koi fish
      - Water lilies
      - Water hyacinth

5. Describe major live feed species and their typical production techniques. DOK 2
   a. Discuss the major zooplankton species used as live first feeds.
      - Rotifers
      - Copepods
      - Artemia
   b. Discuss the major photosynthesizing live feeds.
      - Microalgae in photobioreactor systems
      - Duckweed
      - Kelp ranching for abalone and other marine gastropod species
   c. Discuss pond fertilization for natural food production.
      - Phytoplankton
      - Zooplankton
      - Mosquito and other insect larvae

6. Describe minor and emerging aqua crops and their typical production techniques. DOK 2
   a. Explore zebra fish in medical research.
   b. Explore microalgae as fossil fuel substitutes.
      - Biopolymers
      - Net zero carbon addition biofuels
   c. Explore algae as food and health supplements.
      - Spirulina
      - Kelp
   d. Explore freshwater clam pearl production.

Unit 7: Aquatic Resources Management

Competencies and Suggested Objectives
1. Discuss the principles of fish and wildlife ecology. DOK 2 a. Examine how fish and wildlife relate to each other and their nonliving environment. b. Identify endangered species, the causes for endangerment, and the role of the aquaculture industry in preserving those species.
2. Trace the history of natural resource management as related to aquaculture. DOK 3 a. Examine the history and basic principles of natural resource management. b. Explore issues and techniques involved in the management of aquatic resources. c. Comprehend the role of aquaculture in natural resource management.
3. Examine and investigate the basic principles of pond/lake management. DOK 4 a. List and discuss the requirements for maintaining good sportfishing conditions in ponds and lakes. b. Sample a pond and make specific management recommendations to the owner for the maintenance or improvement of sportfishing.
4. Classify freshwater and saltwater fish species in Mississippi. DOK 2 a. Recognize all major fish families in Mississippi.
5. Practice farm pond management. DOK 4 a. Discuss farm pond management practices. b. Perform appropriate sampling techniques. c. Evaluate the results of the sampling. d. Make farm pond management recommendations to improve production outcomes.
6. Explore the opportunities for aquaculturists in the design, construction, and maintenance of ornamental fishponds. DOK 4 a. Investigate and critique existing ornamental fishponds. b. Design an ornamental fishpond.

Unit 8: The Aquaculture Industry

Competencies and Suggested Objectives
1. Examine the environmental impact of the aquaculture industry on our state, nation, and world. DOK 2 a. Research and assess the environmental impact of the aquaculture industry as a global food source. b. Explain the concept of sustainable fisheries as it applies to aquaculture production. c. Compare and contrast the costs and rewards of saltwater aquaculture versus freshwater aquaculture.
2. Examine trends and changes related to aquaculture and global economic factors. DOK 2 a. Define and discuss the concept of global economics and competition. b. Define and discuss how trade deficits affect global economics. c. Describe global economic factors and competition as related to aquaculture. d. Research and use geographic and economic data of various countries or regions to address food insecurity or hunger issues. e. Identify public policies and laws that impact aquaculture production (e.g., labeling, import/export regulations, etc.).
3. Examine self-sustaining aquaculture applications. DOK 2 a. Limited fish meal diets and alternative protein sources b. Bivalve aquaculture and carbon sequestration c. Biotechnical waste solutions d. Integrated multi-trophic aquaculture (IMTA) • Aquaponics

Unit 9: Hatchery Management and Operation

Competencies and Suggested Objectives
1. Identify and evaluate the operational requirements of a hatchery. DOK 1 a. Identify the water source. • Delivery • Effluent b. Determine the species and their specific husbandry requirements. • Requirements of different life stages • Optimal water quality parameters o Temperature o Salinity • Nutritional requirements and source c. Identify an aquaculture system. • Pond • Cage • Recirculating aquaculture system (RAS) • Flow-through
2. Explore and apply the proper operational requirements of a hatchery. DOK 4 a. Maintain and condition brood stock. • Proper nutrition • Photothermal manipulation b. Describe the sexual reproduction processes in fish, crustaceans, and mollusks. • Induced spawning • Natural spawning c. Describe and operate typical hatchery equipment used in producing the eggs, larvae, and juveniles of all aquatic livestock. • Microscope • Incubation equipment • Egg collector d. Calculate fish stocking rates and feed conversions required during the growth cycle. e. Determine and produce larval stage feed requirements. • Live vs. formulated feeds f. Raise juveniles to the desired stocking size or grow-out requirements.
3. Discuss safety procedures for the school and classroom. DOK1 a. Demonstrate safety procedures as prescribed by the local school regulations.
4. Demonstrate proper first aid procedures. DOK3 a. Perform first aid procedures properly.

5. Practice proper safety procedures for working in aquaculture facilities. DOK3
   a. Discuss general safety procedures.
   b. Demonstrate proper electrical safety procedures.
   c. Describe and discuss proper water safety.
   d. Describe and discuss proper mechanical safety procedures.
   e. Describe and discuss the proper safety procedures related to biological hazards.
   f. Describe and discuss the proper safety procedures related to chemical hazards.
   g. Describe and discuss the proper safety procedures related to the effects of weather (e.g., sun, heat, lightning, etc.).
   h. Discuss safety data sheets (SDS).
   i. Discuss the standard operating procedures (SOP).

Unit 10: Aquatic Health Management

Competencies and Suggested Objectives
1. Discuss aquatic health management practices. DOK 1 a. Define and describe some common disease agents in aquaculture. • Parasitic infections (e.g., *Amlyoodinium ocellatum, Cryptocaryan irritans*, etc.) • Bacterial infections (e.g., *Vibrio spp., Aeromonas spp.*, etc.) b. Examine the establishment of biosecurity and disease mitigation protocols (i.e., preventative measures). • Recognize the role of stress factors on aqua crop immune system strength. • Recognize signs of disease in aqua crops.
2. Examine the causes of infectious and noninfectious diseases. DOK 3 a. Define stress response. • Cortisol (i.e., stress hormone) b. Discover possible stressors and confounding factors. • Mishandling • Overfeeding • Poor water quality • Noise/abrupt change • Presence of pathogens
3. Recognize the signs and symptoms of disease. DOK 2 a. Summarize atypical behavior. • Erratic swimming • Change in feeding response • Reduced vigor b. Identify and discuss external abnormalities. • Lesions and ulcers • Abnormal coloring • Fin rot
4. Understand common disease treatments in aqua crops. DOK 1 a. Medications (i.e., dose and duration) • Medicated feed • Baths • Dips b. Whole-system treatments c. Culling/euthanasia

5. Examine the role of nutrition in aquatic species. DOK 2
    a. Compare and contrast the major types of aquaculture feeds.
    b. Explore ingredients typically used in aquaculture feeds.
    c. Calculate feed rates and conversions for selected crops.

Unit 11: Immersion Into FFA and Supervised Agricultural Experience (SAE) for All

Competencies and Suggested Scenarios
1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. DOK 3 a. Actively participate in FFA activities. • Leadership Development Events (LDEs) • Career Development Events (CDEs) • Leadership retreats or conferences • Industry-related seminars, workshops, or conferences • Other related FFA activities
2. Apply concepts learned from the school-based agricultural education program to continue the progression of immersion SAEs. DOK 4 a. Redefine and adjust the requirements of agreements between the student, parents, supervisor, and/or employer. b. Update SAE records utilizing an electronic/computer-based system of record-keeping. • SAE program goals • Student inventory related to the SAE program • Expense records • Income/gift and scholarship records • Skill-attainment records • Leadership-activity records and participation in FFA activities • Community service hours c. Complete degree and proficiency award applications as they apply to the SAE.

Unit 12: Aquaculture Wastes and Remediation

Competencies and Suggested Objectives

1. Examine waste products at the cellular and organism levels. DOK 3
   a. Define cellular and metabolic waste products.
      - Carbon dioxide (CO_2) cellular respiration
      - Ammonia (NH_3) protein synthesis
   b. Define feces and detritus as an organism's solid wastes.
      - Detritus acts as food for microorganisms.
      - Microorganisms, in turn, produce metabolic wastes.
   c. Define biologically oxidized nitrogenous wastes and their origins.
      - Nitrogen cycle and nitrification by nitrifying bacteria
      - Ammonia to nitrite by Nitrosomonas spp.
      - Nitrite to nitrate by Nitrobacter spp.
      - Ammonia to nitrate by Nitrospyra spp.
   d. Discuss denitrification and the removal of nitrate nitrogen.
      - Anaerobic bacterial denitrification with the introduction of a carbon source
      - Plant and photoautotroph-based denitrification

2. Examine the health issues and conditions associated with metabolic waste products. DOK 3
   a. Discuss the effects of carbon dioxide and hypercapnia (acidosis) on hemoglobin.
      - Functional hypoxia
      - Stress
      - Immunosuppression
      - Disease and death
   b. Discuss the effects of carbon dioxide on pH.
      - Chemical irritation of gill tissue
   c. Discuss the effects of toxicity and pH.
      - Un-ionized ammonia (NH_3) vs. ionized ammonia (NH_4+)
   d. Discuss nitrite toxicity and methemoglobinemia (brown blood disease) and their effects on hemoglobin.
      - Functional hypoxia and stress
      - Immunosuppression
      - Infectious disease
      - Death
   e. Compare the effects of nitrate toxicity on freshwater and saltwater organisms.

3. Examine the various processes and equipment used to remediate aqua crop and aquatic organism wastes. DOK 3
   a. Examine the aeration devices used to remediate CO_2. Consider their common uses and typical system applications.
      - Packed column aerators in flow-through systems
      - Paddlewheel aerators and surface agitators in ponds and large tanks
      - Air diffusers in recirculating aquaculture systems
        - Linear air pumps
        - Centrifugal blowers
   b. Discuss the biofiltration (nitrification) design parameters and requirements for optimal performance.
      - Limit sunlight
      - Add oxygen
      - Bio media agitation to promote new bacterial growth
      - Nitrogenous waste inputs
      - Nitrification capacities of different biofilter designs
   c. Compare natural biofiltration in ponds to supplementary biofilter devices in recirculating aquaculture systems.
   d. Explore biofiltration devices and applications.
      - Trickling biofilters
      - Rotating biological contactors
      - Moving bed bioreactors
      - Bio clarifiers
      - Bead filters.
   e. Explore mechanical filtration design parameters and equipment.
      - Solid wastes and detritus size categories
        - Settleable
        - Suspended
        - Colloidal
        - Dissolved
      - Solid waste remediation processes
        - Settling
        - Physical straining
        - Biofilm interception
      - Physical-chemical elimination
        - Electrocoagulation
        - Chemical precipitation
        - UV degradation
        - Ozone oxidation

f. Explore commonly used mechanical filtration and clarification devices and applications.
   - Screen and rotating drum filters
   - Bag and sock filters
   - Canister and pleated filters
   - High-density media filters (sand/bead filters)
   - Low-density media filters (bio clarifiers)

Unit 13: Advanced Culture Methods

Competencies and Suggested Objectives
1. Assess and operate aquatic-culture methods currently in use. DOK 3 a. Describe aquatic-culture methods. b. Discuss the advantages and disadvantages of various aquatic-culture methods. c. Review selection criteria for appropriate culture methods based on aquatic species and locale.
2. Construct aquatic-culture systems. DOK 4 a. Develop plumbing skills. • Measure, cut, and glue PVC pipes. • Identify various pipe diameters. • Identify various fitting types. b. Develop carpentry skills. • Decking • Securing equipment • Finishing c. Assemble aquaculture equipment. • Pump maintenance
3. Stock, manage, sample, feed, and harvest appropriate species from a culture system. DOK 4 a. Calculate feed rates based on nutritional requirements. b. Perform stock assessments as needed. c. Monitor and track growth and feed efficiency.
4. Analyze the performance of life support equipment in selected aquaculture systems. DOK 3 a. Investigate the following life support equipment. • Aeration equipment performance • Biofilter performance • Mechanical filter performance
5. Review and apply aquatic health management practices. DOK 4 a. List and identify the signs, symptoms, and causes of selected major aquatic diseases. b. Review environmental stressors and their effect on the immune systems. c. Review procedural stressors and their effect on aqua crop health. d. Select, calculate, and administer proper treatment.
6. Apply culture and management requirements specific to individual aquatic species. DOK 4

a. Investigate the characteristics related to the culture of common aquaculture species (e.g., catfish, crawfish, trout, tilapia, hybrid bass, baitfish, prawns, tropical fish, ornamental fish, oysters, sturgeons, paddlefish, flounder, clams, redfish, bluegills, largemouth bass, flounder, etc.).
b. Apply aquaculture technology practices to grow, manage, and maintain representative living specimens of as many aquaculture species as possible.

Unit 14: Pond Aquaculture

Competencies and Suggested Objectives
1. Discuss the types of ponds (e.g., watershed, levee, and excavated). DOK 2 a. Compare lined and earthen ponds.
2. Discuss viable site selection for a pond-based aquafarm. DOK 2 a. Determining the water source and depth of the water table. b. Discuss how soil composition affects pond design. c. Discuss how the climate will affect selection. d. Analyze the topography and how it will affect drainage and flooding.
3. Determine the sources and materials needed for pond construction. DOK 2
4. Analyze the engineering and construction requirements for pond construction. DOK 3 a. Determine the size of the pond (e.g., acreage, shape, capacity, depth management). b. Address dam inspection and repair. c. Address the maintenance of plant cover and clean water. d. Address the best practices for pond fertilization.
5. Discuss species selection for pond culture (e.g., catfish, crawfish, bass, tilapia, etc.). DOK 2
6. Determine stocking densities based on the species and size of the pond. DOK 2 a. Consider the following for stocking density: • Delivery • Buyer • Management • Temperature • pH • Access to the pond
7. Analyze the feeding methods used in ponds (e.g., hand, mechanical, natural). DOK 2 a. Investigate the following pond feeding methods. • Types of feed o Floating o Sinking o Neutral buoyancy pellets • Frequency of feed • Amount of feed
8. Develop a strategy for oxygen management (e.g., aeration devices). DOK 3

9. Discuss sustainable aquaculture as related to environmental and social impacts. DOK 2
   a. Understand environmental impacts on land use, water use, energy consumption, and effluent discharge.
   b. Discuss the possible negative social impacts and how to avoid these issues.

Unit 15: Independent Research Project for Aquaculture

Competencies and Suggested Objectives
1. Propose, conduct, and report on a basic aquaculture research project. DOK 4 a. Identify an aquaculture research project for approval. b. Conduct the approved project utilizing appropriate research procedures. c. Present the results of the project as an oral report.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: History and Overview of Aquaculture		
	1.	Investigate the origin and development of aquaculture.
	2.	Compare and contrast the relationship between aquatic and terrestrial farm animals. (e.g., feed efficiency and feed conversion ratio, fighting gravity vs. drag, cold vs. warm-blooded)
	3.	Discuss the current status and practices in the aquaculture industry.
	4.	Examine the different career opportunities in aquaculture and related fields.
Unit 2: Safety and Biosecurity		
	1.	Review safety procedures for the school, aquaculture classroom, and laboratory.
	2.	Implement biosecurity measures and standard operating procedures.
	3.	Demonstrate proper first aid procedures.
	4.	Describe proper safety procedures for aquaculture.
	5.	Demonstrate proper tool safety procedures.
Unit 3: Professional and Student Organizations		
	1.	Explore the integral relationship between the FFA and agricultural education.
	2.	Explore the role of the FFA in promoting leadership, personal growth, and career success through 21st-century skills standards.
	3.	Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration.
	4.	Discuss aquaculture-specific professional organizations.
Unit 4: Supervised Agricultural Experience (SAE) for All		
	1.	Describe the purposes and requirements of the Supervised Agricultural Experience (SAE) for All program.
	2.	Launch a Foundational SAE plan.
	3.	Develop a record-keeping system for an individual student's SAE program.

Unit 5: Basic Water Chemistry and Management		
	1.	Examine the chemical and physical properties of water.
	2.	Investigate mechanical and biological filtration in recirculating systems.
	3.	Prepare aquatic systems for fish and plants.
Unit 6: Major and Minor Crops with Applications		
	1.	Describe major food aqua crops and their typical production techniques.
	2.	Describe stock enhancement and the application of aquaculture to support it.
	3.	Describe major baitfish species and their typical production techniques.
	4.	Describe major ornamental crops and their typical production techniques.
	5.	Describe major live feed species and their typical production techniques.
	6.	Describe minor and emerging aqua crops and their typical production techniques.
Unit 7: Aquatic Resources Management		
	1.	Discuss the principles of fish and wildlife ecology.
	2.	Trace the history of natural resource management as related to aquaculture.
	3.	Examine and investigate the basic principles of pond/lake management.
	4.	Classify freshwater and saltwater fish species in Mississippi.
	5.	Practice farm pond management.
	6.	Explore the opportunities for aquaculturist in the design, construction, and maintenance of ornamental fishponds.
Unit 8: The Aquaculture Industry		
	1.	Examine the environmental impact of the aquaculture industry on our state, nation, and world.
	2.	Examine trends and changes related to aquaculture and global economic factors.
	3.	Examine self-sustaining aquaculture applications.
Unit 9: Hatchery Management and Operation		
	1.	Identify and evaluate the operational requirements of a hatchery.
	2.	Explore and apply the proper operational requirements of a hatchery.
	3.	Discuss safety procedures for the school and classroom.
	4.	Demonstrate proper first aid procedures.
	5.	Practice proper safety procedures for working in aquaculture facilities.

Unit 10: Aquatic Health Management		
	1.	Discuss aquatic health management practices.
	2.	Examine the causes of infectious and non-infectious diseases.
	3.	Recognize the signs and symptoms of disease.
	4.	Understand common disease treatments in aqua crops.
	5.	Examine the role of nutrition in aquatic species.
Unit 11: Immersion into FFA and Supervised Agricultural Experience (SAE) for All		
	1.	Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration.
	2.	Apply concepts learned from the school-based agricultural education program to continue the progression of immersion SAEs.
Unit 12: Aquaculture Wastes and Remediation		
	1.	Examine waste products at a the cellular and organism levels.
	2.	Examine the health issues and conditions associated with metabolic waste products.
	3.	Examine the various processes and equipment used to remediate aqua crop and aquatic organism wastes.
Unit 13: Advanced Culture Methods		
	1.	Assess and operate aquatic-culture methods currently in use.
	2.	Construct aquatic-culture systems.
	3.	Stock, manage, sample, feed, and harvest appropriate species from a culture system.
	4.	Analyze the performance of life support equipment in selected aquaculture systems.
	5.	Review and apply aquatic health management practices.
	6.	Apply culture and management requirements specific to individual aquatic species.
Unit 14: Pond Aquaculture		
	1.	Discuss the types of ponds (e.g., watershed, levee, and excavated).
	2.	Discuss viable site selection for a pond-based aquafarm.
	3.	Determine the sources and materials needed for pond construction.
	4.	Analyze the engineering and construction requirements for pond construction.
	5.	Discuss species selection for pond culture (e.g., catfish, crawfish, bass, tilapia, etc.).

	6.	Determine stocking densities based on the species and size of the pond.
	7.	Analyze the feeding methods used in ponds (e.g., hand, mechanical, natural).
	8.	Develop a strategy for oxygen management (e.g., aeration devices).
	9.	Discuss sustainable aquaculture as related to environmental and social impacts.
Unit 15: Independent Research Project for Aquaculture.		
	1.	Propose, conduct, and report on a basic aquaculture research project.

Appendix: Industry Standards

Framework for AFNR Content Standards and Performance Elements Crosswalk for Aquaculture Technology																
AFNR	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ABS- Agribusiness Systems		X	X	X		X		X	X	X	X	X	X	X	X	X
AS- Animal Systems		X			X	X	X	X	X		X	X	X	X	X	
BS- Biotechnology		X			X	X	X	X	X		X	X	X	X	X	
CRP- Career Ready Practices		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CS- AFNR Cluster Skill		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ES- Environmental Service Systems		X		X		X	X	X	X	X	X	X	X	X	X	X
FPP- Food Products and Processing Systems						X				X			X			
NRS- Natural Resource Systems		X			X	X	X	X	X		X	X	X	X		
PS- Plant Systems					X	X	X		X		X	X	X			
PST- Power, Structural, and Technical Systems		X	X	X		X		X	X		X		X		X	

AFNR Pathway
Content Standards and Performance Elements

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ABS AGRIBUSINESS SYSTEMS
AS ANIMAL SYSTEMS
BS BIOTECHNOLOGY

CRP CAREER READY PRACTICES
CS AGRICULTURE FOOD AND NATURAL RESOURCES CLUSTER SKILL
ES ENVIRONMENTAL SERVICE SYSTEMS
FPP FOOD PRODUCTS AND PROCESSING SYSTEMS
NRS NATURAL RESOURCE SYSTEMS
PS PLANT SYSTEMS
PST POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

Agribusiness Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agribusiness Systems (AG-ABS) 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.

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.
- **ABS.01.02. Performance Indicator:** Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.
- **ABS.01.03. Performance Indicator:** Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.
- **ABS.01.04. Performance Indicator:** Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.

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.).

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.).

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.

ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business 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.

ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.

ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.

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.

ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Animal Systems Career Pathway Content Standards

The Animal Systems (AS) Career Pathway encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, and 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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Animal Systems (AG-AS) 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.

AS.01. CCTC Standard: 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.
- **AS.01.02. Performance Indicator:** Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.
- **AS.01.03. Performance Indicator:** Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.

AS.02. CCTC Standard: 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.
- **AS.02.02. Performance Indicator:** Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).

AS.03. CCTC Standard: 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 Standard: 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.
- **AS.04.03 Performance Indicator:** Apply scientific principles to breed animals.

AS.05. CCTC Standard: 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.
- **AS.05.02. Performance Indicator:** Comply with government regulations and safety standards for facilities used in animal production.

AS.06. CCTC Standard: 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.

AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.

AS.07. CCTC Standard: Apply principles of effective animal health care.

AS.07.01. Performance Indicator: Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.

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 Standard: 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.

AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.

Common Career Technical Core Career Ready Practices Content Standards

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 standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for CRPs 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 CTE program of study.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.

CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.

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.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.

CRP.02. CCTC Standard: Apply appropriate academic and technical skills.

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.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

CRP.03. CCTC Standard: Attend to personal health and financial well-being.

CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.

CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.

CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.

CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.

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.

CRP.06. CCTC Standard: Demonstrate creativity and innovation.

CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

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.

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.

CRP.07. CCTC Standard: Employ valid and reliable research strategies.

CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

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.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.

CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.

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.).

CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

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.).

CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.

CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match 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.

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.

CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. CCTC Standard: Use technology to enhance productivity.

CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity 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.

CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence.

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.

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.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) 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.

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.

CS.01.02. Performance Indicator: Examine technologies and analyze their impact on AFNR systems.

CS.01.03. Performance Indicator: Identify public policies and examine their impact on 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.

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.

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.

CS.03.02. Performance Indicator: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.

CS.03.03. Performance Indicator: Apply health and safety practices to AFNR workplaces.

CS.03.04. Performance Indicator: Use appropriate protective equipment and demonstrate safe and proper use of 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.

CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that 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.).

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.

CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

Biotechnology Systems Career Pathway Content Standards

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.

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.

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.).

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.).

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).

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.

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.

BS.02.04. Performance Indicator: Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.

BS.02.05. Performance Indicator: Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.

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.

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.).

BS.03.05. Performance Indicator: Apply biotechnology principles, techniques and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).

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 Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards 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.

ESS.01. CCTC Standard: 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.

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.

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 Standard: 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.

ESS.03.02. Performance Indicator: Apply soil science and hydrology principles to environmental service systems.

ESS.03.03. Performance Indicator: Apply chemistry principles to environmental service systems.

ESS.03.04. Performance Indicator: Apply microbiology principles to environmental service systems.

ESS.03.05. Performance Indicator: Apply ecology principles to environmental service systems.

ESS.04. CCTC Standard: 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.

ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste in environmental service systems.

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.

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.

ESS.05. CCTC Standard: 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.

ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.

Food Products and Processing Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Food Products and Processing Systems (AG-FPP) 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.

FPP.01. CCTC Standard: 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.

FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.

FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.

FPP.02. CCTC Standard: 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 Standard: 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.

FPP.03.02. Performance Indicator: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

FPP.03.03. Performance Indicator: Create food distribution plans and procedures to ensure safe delivery of food products.

FPP.04. CCTC Standard: 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.

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.

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.

Natural Resource Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Natural Resource Systems (AG-NRS) 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.

NRS.01. CCTC Standard: 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.

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.

NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.

NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.01.06. Performance Indicator: Apply ecological concepts and principles to living organisms in natural resource systems.

NRS.02. CCTC Standard: 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.).
- **NRS.02.02. Performance Indicator:** Assess the impact of human activities on the availability of natural resources.
- **NRS.02.03. Performance Indicator**: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.
- **NRS.02.04. Performance Indicator:** Examine and explain how economics affects the use of natural resources.
- **NRS.02.05. Performance Indicator:** Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

NRS.03. CCTC Standard: 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.).
- **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 Standard: 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.
- **NRS.04.02. Performance Indicator:** Diagnose plant and wildlife diseases and follow protocols to prevent their spread.
- **NRS.04.03. Performance Indicator:** Prevent or manage introduction of ecologically harmful species in a particular region.
- **NRS.04.04. Performance Indicator:** Manage fires in natural resource systems.

Plant Science Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Plant Systems (AG-PS) 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.

PS.01. CCTC Standard: 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.

PS.02. CCTC Standard: 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.

PS.02.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.

PS.03. CCTC Standard: 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.

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.

PS.03.05. Performance Indicator: Harvest, handle and store crops according to current industry standards.

PS.04. CCTC Standard: 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.

Power, Structural and Technical Systems Career Pathway Content Standards

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.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Power, Structural and Technical Systems (AG-PST) 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.

PST.01. CCTC Standard: 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.

PST.01.02. Performance Indicator: Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.

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 Standard: 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 Standard: 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 Standard: 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.

PST.05. CCTC Standard: 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.

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.