Biotechnology

Course: Biotechnology		**Total Framework Hours up to: 180**
CIP Code: 261201	☒**Exploratory** ☐**Preparatory**	**Date Last Modified:2012**
Career Cluster: Agriculture, Food and Natural Resources		**Cluster Pathway: Biotechnology Systems**

COMPONENTS AND ASSESSMENTS

Performance Assessments: (AFNR STANDARD CODES ARE ANNOTATED IN BOLD AT END OF ASSESSMENT)

- Analyze the developmental progression of biotechnology and the evolution of scientific knowledge. **BS.01.01.01.b**
- Examine and categorize current applications and gains achieved in applying biotechnology to agriculture. **BS.01.01.02.a**
- Analyze and document emerging problems and issues associated with agricultural biotechnology.**BS.01.01.03.b**
- Evaluate the short-term and long-term benefits and risks of applying biotechnology to agriculture. **BS.01.01.04.c**

Leadership Alignment: Students will access and evaluate information when researching current work in biotechnology and communicate clearly on emerging problems during their report. Students will make judgments and decisions through their debate on the use of GMO's to feed the growing population.

Standards and Competencies

Unit: What is Biotechnology: Recognize the historical, social, cultural and potential applications of biotechnology.

Competencies	**Total Learning Hours for Unit: 15**

- Define Biotechnology and develop a timeline to explain the developmental progression of biotechnology.
- Define genetically manipulated organism.
- Explain why biotechnology is so important in feeding the world's population.
- Explain how biotechnology is used.
- Research and report on current work being done in agriculture biotechnology.
- Research and report on emerging problems and issues associated with agricultural biotechnology.

Aligned Washington State Standards

Educational Technology	Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
Reading	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
Science	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
Social Studies	Understands that people have to make choices between wants and needs and evaluate the outcomes of those choices. Uses critical reasoning skills to analyze and evaluate positions.
Speaking and Listening	Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
Writing	Write arguments to support claims in an analysis of substantive of topics or texts, using valid reasoning and relevant and sufficient evidence.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Compare and contrast common record-keeping methods used in a laboratory (e.g., paper notebook, electronic notebook, etc.). **BS.02.01.01.a** • Identify, interpret, and implement standard operating procedures for laboratory equipment. **BS.02.02.01.a** • Categorize and identify laboratory equipment according to its purpose in scientific research.**BS.02.02.02.a** • Analyze and select an appropriate standard operating procedure for working with biological materials based upon their classification **BS.02.03.02.b** • Classify different types of personal protective equipment and demonstrate how to properly utilize the equipment. **BS.02.04.01.a**	
Leadership Alignment: Students will collaborate with others to keep up their laboratory notebooks. Students will solve problems while participating in classroom lab research.	
Standards and Competencies	
Unit: Demonstrate laboratory skills and safety as applied to biotechnology	
Competencies	**Total Learning Hours for Unit: 20**
• Maintain a laboratory notebook. • Operate basic laboratory equipment and measurement devices. • Demonstrate basic aseptic technique in the lab. • Perform lab procedures with biological materials according to direction. • Prepare simple solutions using standard operating procedures. • Maintain a safe environment by properly identifying and disposing of lab waste.	
Aligned Washington State Standards	
Reading	Read and comprehend complex literary and informational texts independently and proficiently.
Speaking and Listening	Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Conduct a scientific research study utilizing experimentation. • Demonstrate the steps of the scientific method through experimentation.	
Leadership Alignment: Students will access and evaluate information while researching their scientific project topics. Students will work independently to carry out their scientific research projects. Students can participate in science fairs, including the Agri-science fair held at the Washington Spring Fair.	
Standards and Competencies	
Unit: Demonstrate the principals of scientific research; the scientific method.	
Competencies	**Total Learning Hours for Unit: 25**
• Define Research and discuss the importance of research. • Explain the steps of the scientific method.	

- Distinguish between a hypothesis and a theory.
- Explain experimental design.
- Utilize the scientific method to design and conduct meaningful research projects in groups and independently.
- Evaluate how to formulate questions that can be answered through data and/or observations.

Aligned Washington State Standards	
Arts	Uses visual arts to communicate for a specific purpose.
Educational Technology	Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
Language	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
Math	Make inferences and justify conclusions from sample surveys, experiments and observational studies
Reading	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
Speaking and Listening	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
Writing	Write arguments to support claims in an analysis of substantive of topics or texts, using valid reasoning and relevant and sufficient evidence.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Summarize biological, social, agronomic and economic reasons for genetic modification of eukaryotes. **Bs.03.01.01.A**
- Analyze the benefits and risks associated with the use of biotechnology to increase productivity and improve quality of living species (e.g., plants, animals such as aquatic species, etc.). **bs.03.01.03.A**
- Develop a model of a system that related to a cell, its parts and their functions.

Leadership Alignment: Students will use and manage information while working independently to create an analogy for the basic plant and animal cells. Students will work creatively with others to model the different methods of movement across a cell membrane.

Standards and Competencies

Unit: Demonstrate the different types of cells, their parts, functions and processes in the body.

Competencies	**Total Learning Hours for Unit: 20**

- Explain why cells are the foundation of life.
- Understand how organisms use matter and energy to sustain life.
- List and distinguish between the different cell types.
- Identify and understand cell parts and their functions.
- Understand mitosis and meiosis and their importance in cell reproduction.
- Understand the role of cells in genetic research.
- Identify cells found in various organisms.
- Analyze structural, cellular, biochemical, and genetic relationships among organisms.
- Analyze how systems function, including the inputs and outputs and interconnections of a system and its subsystems.
- Understand how the human organ systems regulate growth, development, and life functions, including the endocrine, immune, nervous, reproductive, and integumentary systems.

Aligned Washington State Standards	
Arts	Uses visual arts to communicate for a specific purpose.
Educational Technology	Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
Reading	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
Science	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells**.**
Speaking and Listening	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
Writing	Write arguments to support claims in an analysis of substantive of topics or texts, using valid reasoning and relevant and sufficient evidence.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Compare and contrast the structures of DNA and RNA and investigate how genotype influences phenotype. **Bs.02.05.02.A**
- Synthesize the relationship between proteins, enzymes and antibodies. **Bs.02.05.05.A**
- Analyze the benefits and risks associated with the use of biotechnology to increase productivity and improve quality of living species (e.g., plants, animals such as aquatic species, etc.). **BS.03.01.03.a**
- Define and summarize epigenetics and synthesize the relationship between mutation, migration and evolution of transgenes in the environment. **BS.03.01.04.a**

Leadership Alignment: Students will think creatively and reason effectively to create a model of DNA with the K'nex kits. Students will work effectively in diverse teams to create a model of DNA replication and show crossing over. Students will access and evaluate research information of genetically engineered products and communicate clearly through a presentation to the class.

Standards and Competencies

Unit: Genetics; How genetics are used in biotechnology and agriculture to modify or clone organisms, develop improved species and gene transfer.

Competencies	**Total Learning Hours for Unit: 30**

- Recognize and understand the function of DNA.
- Explain the function and structure of RNA.
- Understand heredity.
- Understand terminology relating to genetics; dominant, recessive, heterozygous, homozygous, transcription, translation, gene mapping, genotype, phenotype, electrophoresis, alleles, chromosomes, GMOs.
- Understand how genetic information (DNA) is the cell is encoded at the molecular level and provides genetic continuity between generations.
- Explain how bacteria are used to produce genetically engineered products.
- Discuss the steps involved in placing foreign DNA into an organism.
- Describe how a segment of DNA is selected and removed from a DNA strand.
- Describe the process of splicing DNA into plants and animals.
- Explain how transgenic animals are used in genetic research.

- Discuss the benefits of animal cloning
- Discuss why there can be differences in animal clones
- Explain the process of embryo transfer
- Explain how plants naturally propagate by cloning
- Explain why cloning is important in the production of genetically altered plants

Aligned Washington State Standards	
Educational Technology	Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
Health and Fitness	Understands how family, culture, and environmental factors affect personal health.
Reading	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
Science	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
Social Studies	Understands and analyzes causal factors that have shaped major events in history.
Speaking and Listening	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Research and summarize the emergence, evolution and implications of bioethics associated with biotechnology in agriculture.**BS.01.03.01.a**
- Determine the significance and impacts of legal issues related to biotechnology in agriculture.**BS.01.03.02.b**
- Research and summarize public perceptions of biotechnology in agriculture (e.g., social and cultural issues).**BS.01.03.03.a**

Leadership Alignment: Students will use and manage information and make judgements and decisions about biotechnology and interact with others to put together a poster to present to the class. Students will collaborate with others in group discussion following videos selected on patents and farming. Students can participate in the Agriculture Issues CDE.

Standards and Competencies

Unit: Current Events in Biotechnology; Ethics

Competencies	**Total Learning Hours for Unit: 15**

- Research current events in relation to biotechnology.
- Understand ethics.
- Discuss patents.
- Discuss controversy around biotechnology and the products associated with it.
- Research the laws regulating biotechnology.

- Explain how ethics may impact future biotechnology.
- Understand the motivation behind the events and publicity.

Aligned Washington State Standards	
Educational Technology	Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
Reading	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
Science	Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
Social Studies	Understands and analyzes causal factors that have shaped major events in history.
Speaking and Listening	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
Writing	Write arguments to support claims in an analysis of substantive of topics or texts, using valid reasoning and relevant and sufficient evidence.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Match potential career opportunities in career clusters with personal interests, talents, goals and preferences.**CRP.10.01.02.C**
- Organize personal information to prepare and continuously update a set of tools to aid in the pursuit of a career path. **CRP.10.04.01.B**
- Apply skills to complete common processes involved in pursuing a career and assimilate input and feedback from experts to improve.**CRP.10.04.02.c**
- Examine and practice the skills needed to complete common processes for pursuing a career. **CRP.10.04.02.b**

Analyze skills needed for potential careers and compare and contrast skills needed with personal interests, talents, goals and preferences. **CRP.10.01.02.b**

Leadership Alignment: Students will access and evaluate information on careers of interest. Students will communicate clearly with the class through a presentation of their career of choice. Students will create or update job documents and manage these documents through our current school system.

Standards and Competencies

Unit: Careers in Biotechnology

Competencies	**Total Learning Hours for Unit: 5**

- Analyze career opportunities in biotechnology.
- Explain some of the characteristics associated with various jobs in biotechnology.
- Present on one career of interest.
- Create or update job documents.

Aligned Washington State Standards	
Educational Technology	Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology.
Language	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking
Reading	Read and comprehend complex literary and informational texts independently and proficiently.
Writing	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Explain and critique a decision made by a major agency that regulates agricultural biotechnology. **BS.01.02.01.c**
- Research and document major regulatory issues related to biotechnology in agriculture. **BS.01.02.02.a**
- Research and summarize factors and data that regulatory agencies use to evaluate the potential risks a new application of biotechnology may pose to health, safety and the environment. **BS.01.02.03.b**

Leadership Alignment: Students will think creatively to design and create media products for each of the 6 major biomes. Students will manage their projects and collaborate with others in their groups when peer editing is needed. Students will manage their goals and time during this unit to make sure they meet the classroom deadlines. Students will use and manage information to create artifacts showing environmental concerns and impacts and possible solutions.

Standards and Competencies

Unit: Biotechnology and the Environment

Competencies	**Total Learning Hours for Unit: 15**

- Understand the basic biomes and their unique characteristics.
- Discuss issues that are affecting the health of biomes.
- Discuss the role biotechnology plays in benefiting our environment.
- Explain how biotechnology is used to detect environmental pollutants.
- Discuss high-yield farming and its benefits to the environment and world hunger.
- Explain how genetically modified crops positively affect the environment.
- In relation to the environment, discuss conventional farming versus organic farming and the advantages and disadvantages of both.
- Explain how oil spills can be combated with biotechnology.
- Discuss how biodiesel fuel benefits the environment.
- Discuss the benefits of growing plants that can survive harsh conditions.

Aligned Washington State Standards

Educational Technology	Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
Health and Fitness	Understands how family, culture, and environmental factors affect personal health.
Reading	Read and comprehend complex literary and informational texts independently and proficiently.
Science	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
Social Studies	Understands the geographic context of global issues and events
Speaking and Listening	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
Writing	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Solve scientific questions utilizing forensic lab techniques.
- Research and document the use of gene therapy.
- Use case studies and scientific research to evaluate the benefits of genetic modification of food.

Leadership Alignment: Students will reason effectively and solve problems through labs to solve crimes. Students will use and manage information to make judgements and decisions and communicate clearly their reasoning with classmates.

Standards and Competencies

Unit: Forensic Science, Medicine and Biotechnology.

Competencies	**Total Learning Hours for Unit: 20**

- Distinguish good lab techniques.
- Discuss the role of plants and animals in human health.
- Define gene therapy.
- Discuss the problems encountered in extracting hormones from animal's organs.
- Discuss how animal biotechnology may be helpful in organ transplants.
- Explain how vaccines may be administered in food crops.
- Explain how biotechnology has revolutionized the forensic science field.
- Understand the types of labs used to solve crimes.
- Utilize some forensic science lab equipment.
- Run DNA fingerprinting labs.

Aligned Washington State Standards

Educational Technology	Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others.
Health and Fitness	Understands how family, culture, and environmental factors affect personal health.
Reading	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
Science	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
Speaking and Listening	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
Writing	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Devise, implement, and evaluate strategies for personal involvement in civic service at work and in the community **CRP.01.03.01.c**
- Identify opportunities to apply technical concepts to solve problems in the community **CRP.02.02.01.a**
- Classify the types of information (e.g., data, research, procedures, regulations, etc.) and resources (e.g., human, financial, technology, time, etc.) that may be used to make workplace and community decisions.**CRP.05.01.03.a**
- Analyze how different research methods are used to generate data in a variety of situations. **CRP.07.01.01.b**
- Analyze and demonstrate adherence to protective equipment requirements when using various AFNR tools and equipment. **CS.03.04.01.b**

Leadership Alignment: Students will access and evaluate information as they work through a science research project. Students will use and manage their information and create a display that can be used in science fairs. Students will produce results through scientific exploration. Students will work independently and manage their time throughout their research projects.

Standards and Competencies

Unit: Understanding of Supervised Agriculture Experience Programs.

Competencies	**Total Learning Hours for Unit: 15**

- Describe the various types of Supervised Agricultural Experience Programs including Experience Programs including Entrepreneurship, Placement, Improvement, and Exploratory Programs.
- Describe the purpose of Supervised Agricultural Experience Programs within the Agricultural Education program.
- Utilize and analyze appropriate record keeping techniques with their Supervised Agricultural Experience Program.
- Identify opportunities available through the Supervised Agricultural Experience Program.
- Recognize life skills that are incorporated in their Supervised Agricultural Experience Program.
- Incorporate appropriate research into Supervised Agricultural Experience Program.

Aligned Washington State Standards

Educational Technology	Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
Language	Acquire and use accurately a range of 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.
Speaking and Listening	Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
Writing	Write arguments to support claims in an analysis of substantive of topics or texts, using valid reasoning and relevant and sufficient evidence. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

21st Century Skills

Check those that students will demonstrate in this course:

LEARNING & INNOVATION	INFORMATION, MEDIA & TECHNOLOGY SKILLS	LIFE & CAREER SKILLS
Creativity and Innovation ☒Think Creatively ☒Work Creatively with Others ☒Implement Innovations **Critical Thinking and Problem Solving** ☒Reason Effectively ☒**U**se Systems Thinking ☒Make Judgments and Decisions ☒Solve Problems **Communication and Collaboration** ☒Communicate Clearly ☒Collaborate with Others	**Information Literacy** ☒Access and /evaluate Information ☒Use and Manage Information **Media Literacy** ☒Analyze Media ☒Create Media Products **Information, Communications and Technology (ICT Literacy)** ☒Apply Technology Effectively	**Flexibility and Adaptability** ☒Adapt to Change ☒Be Flexible **Initiative and Self-Direction** ☒Manage Goals and Time ☒Work Independently ☒Be Self-Directed Learners **Social and Cross-Cultural** ☒Interact Effectively with Others ☒Work Effectively in Diverse Teams **Productivity and Accountability** ☒Manage Projects ☒Produce Results **Leadership and Responsibility** ☒Guide and Lead Others ☒Be Responsible to Others