eDynamicLearning
CAREER & ELECTIVE COURSES

Course Title: Biotechnolgy 1a/1b

State: WA
State Course Title: Principles of Agriculture, Food and Natural Resources
State Standards: WA Career and Technical Education Program Standards
Date of Standards: 2011

Percentage of Course Aligned: 100%

Standards	Course Title (a or b), if applicable, e.g. Game Design 1a	Unit Name(s)	Lesson(s) Numbers	How Standard is Taught	How Standard is Assessed	Comments	Standard Rating (Fully Met / Partially Met / Not Met)
CAREER AND TECHNICAL EDUCATION PROGRAM STANDARDS – Exploratory **1. Demonstrate application of the state and national core content standards in the context of preparing for living, learning and working.**							
1.1 Each CTE course will apply and contextualize state and national core content standards.	Biotechnology 1a	Unit 5: The Beginning of Genetics	Lesson 2	Theories before Mendel" aligns with several high school level Next Generation Science Standards (NGSS) within the domains of Biological Evolution: Unity and Diversity, and Heredity: Inheritance and Variation of Traits. For the part of the lesson that discusses Lamarck's theory and the concept of traits being passed from one generation to the next, the relevant NGSS standards are: HS-LS4-3: 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. HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations. For the segments of your lesson that delve into Mendel's work and the inheritance of traits, including the discussion on DNA and genetic variations, the standards are: HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	**Unit 5 Lab** HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. This standard is assessed when students inquire about ancient DNA and the role of genetic instructions in determining traits of extinct species. Understanding how DNA codes for traits helps clarify the genetic basis of inheritance and how these codes could potentially be reconstructed or altered to bring back extinct species.	Course follows both NGSS and CASE curriculum This is just one example of many found throughout both courses	Fully Met
2. Demonstrate foundational and career cluster specific skills required to meet current industry or nationally defined standards.							
2.1 Each CTE course will teach to current industry or nationally defined standards, as evidenced in the curriculum frameworks, endorsed by local program specific advisory committees, and approved by the CTE program supervisors at OSPI.	Biotechnology 1a	Unit 7: Regulation of Biotech	Lesson 3	This lesson involves understanding the complex interplay between innovation in the biotechnology sector and the regulatory frameworks that govern it. It delves into product development, the role of regulatory agencies, and the impact on society, encapsulating aspects critical to careers in biotechnology, regulatory affairs, and policy. The lesson covers: The Coordinated Framework's approach to balancing safety oversight with promoting innovation, illustrating how regulation can support the advancement of biotech products while ensuring public and environmental safety. The roles of product development and regulatory agencies in navigating the product approval process, highlighting the importance of early conversations between product developers and regulatory bodies to ensure compliance and mitigate risks. The societal implications of biotech innovations, including ethical considerations and the role of public opinion in shaping regulatory policies. By teaching students about these dynamics, the lesson addresses industry standards related to biotechnological product development and regulation.	**Unit 7 Lab:** Industry-Relevant Research Skills: Students are tasked with navigating official government websites to gather information. This skill is essential in many biotech industry roles, where professionals must stay informed about regulatory changes and ensure compliance. Understanding Regulatory Frameworks: By exploring the specific oversight responsibilities of the FDA, USDA, and EPA, students gain insight into the complex regulatory landscape of the biotechnology industry. This knowledge is critical for anyone working in or with biotech companies, from product development to marketing. Critical Thinking and Presentation Skills: The requirement to create a document, poster, or slide presentation encourages students to organize and present their findings logically and effectively. These are valuable skills in the biotech industry, where professionals must often communicate complex information clearly and persuasively. Objective Reporting and Attention to Detail: The lab emphasizes objectivity, accuracy, and thoroughness in research and presentation. These are key qualities for regulatory affairs specialists, researchers, and other professionals in the biotech field who must compile and review regulatory submissions and support materials. Real-World Application: The activity prompts students to apply what they've learned about biotechnology regulation by exploring current examples, such as vaccine resources provided by the FDA or the process of pesticide registration by the EPA. This direct application of knowledge prepares students for careers where they might navigate these processes.	This is one example. This standard is generally met throughout both courses	Fully Met
2.2 CTE courses will incorporate curriculum focused on the interrelationships of family, career, and community roles and responsibilities.	Biotechnology 1b	Unit 8: The Role of Ethics and Public Policy	Lesson 2	Family and Medical Ethics: The section on bioethics in medicine addresses ethical considerations in new medical treatments like CRISPR and CAR-T therapies. It highlights the importance of considering the long-term implications of genetic editing, which could affect not just individuals but their families and future generations. This discussion prompts students to consider how medical decisions can extend beyond the patient to impact family dynamics and genetic legacies. Career and Professional Ethics: By discussing the roles of professionals in ensuring ethical conduct in clinical trials and not distorting data or research results, the lesson emphasizes career responsibilities towards ethical scientific practice. It outlines the expectations for professionals in biotechnology to navigate ethical dilemmas and the importance of integrity in scientific research, impacting career development and public trust in biotechnology industries. Community and Agricultural Ethics: The exploration of genetically modified organisms (GMOs) in agriculture and the controversy surrounding them touches on community responsibilities and the societal impact of biotechnological innovations. It examines how the decisions made by scientists and companies in the biotech field can affect community food resources, environmental sustainability, and public health. This segment encourages students to consider how communities can engage in informed discussions about the benefits and risks of biotechnological advancements. Global and Environmental Ethics: The lesson's focus on bioethics in industrial and environmental biotech, especially regarding climate change, underscores the global interconnections of family, career, and community roles. It presents the ethical imperative for biotech professionals to contribute to combating climate change, highlighting the broader responsibility of the biotech field to global communities and future generations.	**Unit 8 Lab:** Family Implications: Ethical decisions in biotechnology can directly affect family health and well-being, such as decisions related to genetic testing or treatments for hereditary diseases. By exploring these decisions through the lens of the ethical framework, students understand the weight of these decisions on family dynamics and personal health. Career Responsibilities: Biotechnologists face ethical dilemmas that can impact their careers, from conducting research responsibly to the implications of their findings on public health and safety. The lab teaches students to navigate these challenges thoughtfully, emphasizing the role of ethics in maintaining professional integrity and trust. Community and Societal Impact: Many biotechnological advancements, like GMOs or biofuels, have broad implications for communities and global society, including environmental sustainability, food security, and public health. The lab encourages students to consider how ethical decisions in biotechnology can promote or harm community well-being and environmental stewardship. Ethical Framework Application: Walking students through the Markkula Center's Ethical Decision Making Framework encourages them to recognize ethical issues, gather facts, evaluate alternative actions, make decisions, and reflect on outcomes. This process fosters a deep understanding of how ethical decisions are made and the far-reaching consequences these decisions can have beyond the immediate context. Critical Thinking and Reflection: By applying the framework to hypothetical scenarios, students practice critical thinking and reflection on the ethical dimensions of biotechnological innovations. This practice prepares students to consider the ethical implications of their work and its impact on families, careers, and communities.		Fully Met

2.3 Each CTE course will include extended learning into the, community/family, and business/industry. Extended learning is managed and supervised by certified CTE teachers.	Biotechnology 1a	Unit 3: Food Preservation and Fermentation	Lesson 2	Community and Family Engagement: The lesson on food preservation methods ties directly to community and family practices, particularly through the historical context of food storage and preservation methods like root cellars, drying, and curing. By understanding these methods, students can appreciate and apply traditional knowledge in modern contexts, fostering a connection between historical practices and contemporary family and community life. Business and Industry Connections: Highlighting the transition from traditional preservation methods to modern techniques, such as refrigeration and the use of nitrites in curing, establishes a clear link to the food industry. Students learn about the scientific advancements that have shaped food storage, safety, and distribution practices, which are critical to careers in the food industry, from production to retail. Extended Learning Opportunities: By encouraging students to explore and document the decision-making processes behind different preservation methods, this lesson prompts them to engage in research that could extend beyond the classroom. Activities could include visiting local museums to learn about historical food storage, interviewing family members about traditional preservation techniques, or engaging with local businesses to understand contemporary practices in food safety and preservation.	**Unit 3 Lab:** Community/Family Engagement: The comparison between raw and pasteurized milk touches on public health and safety concerns, which are crucial for community wellness. This discussion can extend into community education on food safety, dietary choices, and the implications of consuming non-pasteurized products. Understanding the process and benefits of pasteurization can lead to informed discussions within families about food safety and nutrition, fostering a culture of health awareness and critical evaluation of food sources. Business/Industry Connections: Exploring the reasons behind some farmers' preference for selling raw milk, despite the proven risks, opens a window into the agriculture and dairy industry's challenges and market demands. This aspect of the lab can prompt investigations into the economics of dairy farming, regulatory environments, and consumer trends. The section on the art and craft of bread, including the use of enzymes and fermentation, connects to the food and biotechnology industries. It highlights how traditional methods are being enhanced by scientific understanding, thereby influencing product development, quality, and innovation in the baking and broader food industries. Extended Learning Opportunities: Students could engage in projects that involve visiting local dairies or bakeries to learn firsthand about the production processes, challenges, and safety measures. Such activities promote an understanding of the practical applications of the scientific principles discussed in class. This lab can inspire students to conduct their own experiments or projects related to food science, such as fermenting bread at home or researching the impact of pasteurization on different nutrients in milk. These activities not only solidify their understanding but also connect classroom learning to real-world applications.		Fully Met
2.4 CTE courses must be taught by a certified CTE teacher with appropriate certification, knowledge, skills and occupational experience. 2.4.a After initial certification and five years of teaching, certified CTE teachers should gain additional experience in one or more of the jobs or careers in their teaching area. This experience should take place every five years.						The school district is responsible for this standard	Fully Met
2.5 Each CTE course will provide safe and appropriate environments that support CTE program standards. 2.5.a Laboratories and equipment are appropriate to and support the OSPI approved curriculum framework and industry training procedures. 2.5.b Facilities and equipment meet or exceed the related federal, state and county safety standards. 2.5.c Learning and training stations are of sufficient quantity to assure safe and appropriate supervision, delivery of instruction and student skill development.	Biotechnology 1a	Unit 7: Regulation of Biotech	Lesson 1	The lesson underscores the importance of following regulatory guidelines, which inherently includes using laboratories and equipment that adhere to approved curricula and industry standards. By understanding the regulatory framework, students learn the importance of maintaining environments that are conducive to safety and compliance, which is integral for industry training and professional practice. Through discussing the purpose of regulation, the lesson implicitly highlights the necessity of facilities and equipment meeting or exceeding safety standards set by various levels of government. This ensures that students are aware of the legal and ethical implications of non-compliance and understand how regulations serve to protect them, consumers, and the environment. The lesson's focus on navigating regulations within the US biotechnology sector teaches students about the importance of not only the quality but also the quantity of learning resources and environments. This knowledge prepares them to expect and contribute to safe learning environments where there is adequate supervision and resources for effective instruction and skill development.	**Unit 7 Lab:** By educating students on the roles and responsibilities of the FDA, USDA, and EPA, the lab underscores the importance of regulatory compliance as a cornerstone of safety in biotechnology. This knowledge ensures students are aware of the regulatory framework that protects consumers, the environment, and professionals working in the field. Understanding regulatory standards informs the selection and use of laboratories and equipment that meet approved curriculum frameworks. For instance, knowing FDA regulations around biologics can guide the setup of laboratory exercises that simulate real-world biotech product development, ensuring the equipment and procedures used are relevant and adhere to industry standards. Through researching how the EPA regulates pesticides, students learn about safety standards that must be met for facilities and equipment used in the production and testing of biotech-derived plant or microbial pesticides. This aspect of the lab teaches students the importance of using facilities and equipment that not only meet but exceed federal, state, and county safety standards to protect all stakeholders.	School district is responsible for some of this standard. These standards are generally met throughout both courses	Fully Met
2.6 Curriculum is based on occupational needs and is developed and maintained in consultation with program specific advisory committees.	Biotechnology 1a	Unit 4: Collection and Breeding	Lesson 4	The lesson addresses fundamental agricultural practices and scientific principles of plant genetics, which are crucial for careers in agriculture, horticulture, and genetic engineering. Understanding hybridization and breeding practices equips students with knowledge directly applicable to modern farming and plant breeding professions. Given the complex nature of genetic science and its application to agriculture, EDL lessons are developed with input from experts in the field. By tracing the evolution of hybridization from early human practices to contemporary biotechnological methods, the lesson bridges traditional agricultural wisdom with cutting-edge genetic science. This comprehensive approach ensures students appreciate the depth and breadth of knowledge that informs current practices, making them well-rounded candidates for the workforce. The lesson covers both the theoretical underpinnings of hybridization (including the concepts of polyploidy and the genetic basis of trait inheritance) and practical applications (such as the development of crops with desired characteristics). This dual focus ensures students are prepared for both laboratory and fieldwork in their future careers. Discussing the implications of hybridization and genetic manipulation on food security, environmental sustainability, and biodiversity introduces students to the ethical dimensions of their future work. Recognizing the societal impact of their occupational choices fosters a sense of responsibility and ethical professionalism. The lesson indirectly emphasizes skills crucial for the agriculture and biotech industries, such as critical thinking, problem-solving, and the ability to apply scientific knowledge to real-world challenges. These skills are developed through analyzing the outcomes of different hybridization techniques and understanding their applications.	**Unit 4 Lab:** This lab focuses on cutting-edge topics within bioengineering, including the practical and theoretical aspects of plant biology, genetic manipulation, and the potential of directed evolution. These areas are of increasing importance in various industries, including agriculture, pharmaceuticals, and environmental science. By understanding these concepts, students are better prepared for careers in fields that rely on bioengineering techniques and knowledge. By discussing the "three waves of evolution" in bioengineering and the implications of directed evolution, the lab introduces students to the forefront of biological research and its applications. This not only prepares students for the technological aspects of their future occupations but also encourages them to think innovatively and understand the progression of scientific discovery. Questions about the ethics of bioengineering, the nature of plant intelligence, and the practicalities of working with plant versus animal hybrids address the broader considerations of working in bioengineering. This prepares students for the complex decision-making processes they may face in their careers, emphasizing the importance of ethical considerations in scientific research. The lab encourages critical thinking, research skills, and the ability to synthesize and discuss complex concepts. These skills are invaluable in any scientific or engineering discipline, equipping students with the ability to analyze information, draw informed conclusions, and contribute to discussions on bioengineering's future directions.	Generally met through out both courses	Fully Met
3. Demonstrate knowledge of career options within the related career clusters.							
3.1 Curriculum related to foundational knowledge and skills of a broad range of career options in a related program of study. 3.1.a These learning experiences include exploration of traditional and nontraditional careers in the program of study ranging from entry to professional level positions.	Biotechnology 1b	Unit 6: Modern Pharmaceutical Biotechnology	Lesson 5	This lesson offers foundational knowledge in biotechnology with a specific focus on the healthcare sector, highlighting the role of vaccines in preventing diseases. By exploring both preventative and therapeutic vaccines, it lays a groundwork for understanding the diverse applications of biotechnology in medicine. The discussion on the development and function of vaccines introduces students to traditional careers in biotechnology and pharmaceuticals, such as research scientists, immunologists, and pharmacologists who work on vaccine development. It also touches on nontraditional roles, including biotechnological research on therapeutic vaccines for conditions like HIV and cancer, which could involve interdisciplinary work spanning virology, oncology, and genetic engineering. By mentioning cutting-edge technologies like monoclonal antibodies and genetically engineered antigens, the lesson paves the way for careers in emerging biotech fields, which require innovative approaches to vaccine development and disease prevention. The lesson's content is relevant to a broad spectrum of career levels within the biotechnology and healthcare industries. Entry-level positions might include laboratory technicians or assistants involved in the production or testing of vaccines. At the professional and advanced levels, the lesson relates to careers in biomedical research and development, regulatory affairs, and public health policy—areas that require a deep understanding of vaccination technology and its regulatory landscape. Traditional careers are represented by roles in vaccine research, development, and public health implementation, which have been the backbone of medical advancements in immunology. Nontraditional careers might involve roles in biotech startups focusing on innovative vaccination methods or positions in global health organizations working to deploy vaccines in developing countries, where traditional methods face logistical challenges. By discussing the development of vaccines against diseases like malaria and the potential for vaccines to address antibiotic resistance, the lesson connects classroom learning with real-world health issues and innovative solutions, highlighting the impact of these careers on global health challenges.	**Unit 6 Lab:** Foundation in Biotechnology and Synthetic Biology: This lab introduces students to cutting-edge research in biotechnology and synthetic biology, providing foundational knowledge that is essential for a variety of careers in these fields. By exploring real-world applications, students gain an understanding of how biological systems can be programmed or modified to address complex health issues. Exploration of Traditional and Nontraditional Careers: The discussion on the use of programmable bacteria for cancer detection introduces students to nontraditional careers in biomedical engineering and synthetic biology, where scientists design biological systems for specific medical applications. The segment on re-engineering mosquitoes to combat dengue fever and other mosquito-borne diseases highlights careers in genetic engineering, public health, and vector control. These are fields that may not traditionally be associated with biotechnology but are increasingly important due to the global impact of infectious diseases. Ranging from Entry to Professional Level Positions: For entry-level positions, this lab provides a basis for roles such as laboratory technicians who support research projects in genetic engineering or synthetic biology. At a professional level, the lab content is relevant to research scientists, bioengineers, and public health professionals who work on developing and implementing biotechnological solutions to health problems. It also touches on the regulatory and ethical considerations inherent in deploying genetically modified organisms in the environment, relevant for careers in bioethics and regulatory affairs. Inclusion of Career Exploration: The lab encourages students to explore a wide range of careers by examining how biotechnology can be applied to solve health challenges. This exploration includes traditional research and development roles in pharmaceuticals and biotech companies, as well as careers in emerging fields like synthetic biology. Engagement with Real-world Problems and Solutions: Through the examination of ongoing projects to program bacteria for cancer detection and to re-engineer mosquitoes, students learn about the practical applications of biotechnology and the interdisciplinary nature of the work involved. This not only provides insight into the challenges and opportunities in the field but also highlights the impact of biotechnology on societal health and well-being.	Generally met through out both courses	Fully Met
4. Demonstrate leadership skills and employability skills.							

4.1 Leadership and employability skill development for all students is a required and integral component of all CTE courses. 4.1.a These leadership and employability skills are identified in the CTE Core Leadership Skills document, the CTE Core Employability Skills document and/or 21st Century Skills document. 4.1.b All students demonstrate leadership and employability skills integrated in the approved curriculum framework and applied in real-world family, community, business/industry applications. 4.1.c These skills are developed and practiced at the highest professional level through integration of aligned state-recognized Career and Technical Student Organizations (CTSOs). 4.1.d Locally developed leadership plans must demonstrate that these skills are developed and practiced at the highest level through classroom integration of individual, group and community programs and activities.	Biotechnology 1b	Unit 8: The Role of Ethics and Public Policy	Lesson 3	The exploration of public policy principles and practices in biotech educates students on navigating complex regulatory environments. This knowledge is crucial for leadership roles in biotech, where professionals must make informed decisions that comply with legal standards and societal expectations. Understanding the intersection of biotech innovations with public policy demands skills in critical thinking, ethical reasoning, and strategic planning. These are part of the CTE Core Leadership and Employability Skills, equipping students to evaluate the implications of biotech developments and public policies critically. By analyzing current public policy debates in healthcare, agriculture, and environmental regulation, students apply leadership and employability skills in contexts that mirror real-world challenges. This approach encourages students to think about how they would navigate these issues in professional settings, fostering problem-solving and decision-making skills.	**Unit 8 Lab:** By engaging students in the process of ethical decision-making, the lab fosters critical thinking, ethical reasoning, and decision-making skills—key components of leadership. Students learn to navigate complex ethical landscapes, preparing them for leadership roles in biotechnology and related fields. The lab incorporates CTE Core Leadership and Employability Skills by requiring students to identify ethical issues, gather and analyze information, evaluate alternatives, and make informed decisions. These activities align with 21st-century skills like problem-solving, ethical and global awareness, and the ability to work in diverse teams. Students are tasked with applying the ethical framework to real-world biotechnological issues, demonstrating how leadership and employability skills are applied in family, community, business, and industry settings. This not only shows the integration of these skills into the curriculum but also their application in addressing tangible ethical dilemmas.	Generally met through out both courses	Fully Met