

Bioprocess Engineering

Career Cluster	STEM
Course Code	21014
Prerequisite(s)	None
Credit	.5
Program of Study and Sequence	Foundational course, cluster course, and career pathway course
Student Organization	None
Coordinating Work-Based Learning	None
Industry Certifications	None
Dual Credit or Dual Enrollment	TBD
Teacher Certification	Agriculture, Food & Natural Resources Cluster Endorsement; Food Products & Processing Pathway Endorsement; Natural Resources & Environmental Service Pathway Endorsement; STEM Cluster Endorsement; Engineering & Robotics Pathway Endorsement; 9-12 Engineering Endorsement; 7-12 Technology Education Endorsement
Resources	http://www.iseek.org/careers/viewCareers?id=15

Course Description: This course is designed to provide information on broad application of ever-emerging field of bioprocessing for students in South Dakota. Students are engaged in an instructional program that integrates academics and technical preparation and focuses on career awareness in bioprocess engineering. This course will prepare students for advanced opportunities that lie in the area of biotechnological advancement. The student will apply the knowledge of engineering and biological sciences to design and develop a process capable of ameliorating environmental pollution, producing valuable products and applying novel technologies to produce alternative sources of transportation fuel. Topics that will be covered in this course include: water and wastewater treatment plants, recycling and reuse, and fermentation processes.

Program of Study Application: This is a pathway course in the STEM cluster engineering pathway. It is recommended that the course be preceded by a series of foundation courses, a cluster course in STEM and more specialized pathway courses such as Introduction to Engineering, Engineering Design and Development, and Introduction to Manufacturing and followed by dual credit course and/or capstone course.

Course Standards**Indicator # BE 1: Understand the basic concepts of bioprocess system and biotechnological processes**

<i>Webb Level</i>	<i>Sub-indicator</i>	<i>Integrated Content</i>
Level, Recall and Thinking	BE 1.1 Identify bio-based products Examples: <ul style="list-style-type: none"> List different types of the products that you think are based on biological materials and can be recycled and reused. Compare and contrast products that are processed and unprocessed 	Physical sciences, chemistry, biology Industry tours and field visits
Level Recall and Understanding	BE 1.2 Identify microbial processes that can be implemented in bioprocessing Examples: <ul style="list-style-type: none"> List different types of microbial processes used for food and feed production Demonstrate ways that microorganisms can be used to convert waste to valuable products 	
Level Understand Demonstrate	BE 1.3 Understand how biotechnology can be integrated with engineering Examples: <ul style="list-style-type: none"> Show how agricultural products are modified to produce several products in large scale Evaluate ways that perishable food products are being stored for longer periods of time without deteriorating the quality. 	Industry visits

Notes:

Indicator # BE 2 Apply basic knowledge of biological science and engineering in developing products

<i>Webb Level</i>	<i>Sub-indicator</i>	<i>Integrated Content</i>
Level Recall, thinking, explaining	BE 2.1 Understand how raw materials are used for developing products Example: <ul style="list-style-type: none"> List various types of snack foods that you like to eat and the raw materials that are used to produce them. Differentiate between various types of food that you eat or drink on a daily basis. Explain how these products might have been developed 	Industry visits, product development etc.
	BE 2.2 Understand how the chemical composition of a raw material affects the design process Example: <ul style="list-style-type: none"> Differentiate between the biochemical components of different food products; for example banana and corn. Can banana be stored the same way as corn? Why or why not? Analyze what kind of storage design would banana require as compared to corn 	Industry tours, Grocer

Notes:

Indicator # BE 3 Understand issues associated with implementation and operation of biotechnological processes

<i>Webb Level</i>	<i>Sub-indicator</i>	<i>Integrated Content</i>
	<p>BE 3.1 Analyze problems associated with bioprocessing; for example, environmental, technical, sustainable</p> <p>Example:</p> <ul style="list-style-type: none"> • Discuss ethical issues associated with bioprocessing • Analyze economic and environmental impacts of bioprocessing • Differentiate between sustainable and non-sustainable bioprocessing techniques • Identify different procedures used in biotechnological processes 	
	<p>BE 3.2 Understand how to operate a bioreactor</p> <p>Examples:</p> <ul style="list-style-type: none"> • Label the components of a bioreactor. • List different types of products that can be produced from agricultural products. Understand what kind of reactors or operating machine you may need for producing these products • Understand what kind of skills you may need to operate a bioreactor 	

Notes:

Indicator # BE 4 Career exploration in bioprocess engineering

<i>Webb Level</i>	<i>Sub-indicator</i>	<i>Integrated Content</i>
	<p>BE 4.1 Explore the role of bioprocess engineering in an agriculture related area</p> <p>Example:</p> <ul style="list-style-type: none"> • List different types of products that are produced from agricultural products, for example, candles, corn syrup, potato chips, bioethanol etc. • Describe the methods for using corn starch and corn stove to produce bioethanol 	
	<p>BE 4.2 Understand the role of bioprocess engineering in food processing</p> <p>Example:</p> <ul style="list-style-type: none"> • Describe how milk can be processed to produce cheese, yogurt and other dairy products • Explore how fresh produce are transported from the area of production to the consumer without compromising quality • Analyze different means of food storage technologies • Analyze the importance of packaging systems and proper labels for effective deliver of quality agricultural products 	
	<p>BE 4.3 Understand how bioprocess engineering is critical to water and wastewater treatment technologies</p> <p>Example:</p> <ul style="list-style-type: none"> • Describe how drinking water is processed for a city or municipality • Compare different types of wastewater treatment technologies • Describe how waste water from drainage or sewage is treated • Critique the importance of proper solid waste management 	

	<p>BE 4.4 Understand how bioprocess engineering can improve the rural economy</p> <p>Example:</p> <ul style="list-style-type: none"> • Identify ways that agricultural products can be converted/modified to produce the high value products, for example corn to corn ethanol, distillers dried grains (DDGs) to animal feed • Identify the fact that corn stover and other grasses such as switchgrass can be converted to ethanol which has higher market value and demand • Identify ways that oils from soybean or corn can be converted into transportation fuels (e.g. biodiesel) 	
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Indicator # BE 5 Understand workplace ethics and professionalism in bioprocess engineering

<i>Webb Level</i>	<i>Sub-indicator</i>	<i>Integrated Content</i>
Level 1: Recall	BE 5.1 Investigate and demonstrate understanding of professionalism and workplace ethics in the technological environment.	Health, hygiene, personal attire
Level 2: Skill/ Concept	<p>Example:</p> <ul style="list-style-type: none"> • Identify different work environments and recognize appropriate professional attire. • Demonstrate an understanding of professional ethics issues such as plagiarism, copyright and intellectual property laws. • Differentiate between possible ethical choices. Role play to model different possible outcomes. • Brainstorm potential responses to various workplace ethics violations 	Language arts, English Teamwork

Notes:

Indicator # BE 6 Understand safety and health in bioprocessing engineering

<i>Webb Level</i>	<i>Sub-indicator</i>	<i>Integrated Content</i>
Level 1: Recall	<p>BE 6.1 Understand implications of health and public safety standards</p> <p>Example:</p> <ul style="list-style-type: none"> • List the safety procedures and equipment used in various technology sectors. • Demonstrate and understand the importance and use of safety equipment. • Evaluate the effectiveness of safety tools available for a given task. • Analyze potential consequences to self and others of not following health and safety standards. • Design a plan to improve the safety of a bioprocessing work environment. 	

Notes: Please refer to OSHA safety guidelines for more information and resources