

Biotechnical Engineering Course					
<i>The major focus of the Biotechnical Engineering I/II (BE) course is to expose students to the diverse fields of biotechnology including biomedical engineering, biomolecular genetics, bioprocess engineering, and agricultural and environmental engineering. Lessons engage students in engineering design problems that can be</i>					
Program of Study to which the course applies	Course Code				
STEM:	100165				
	Course Content	Reference Standards	Academic Crosswalk to Common Core Standards	Academic Crosswalk to Nebraska Standards	Comments
Standard 1	Students will carry out Biotechnical Engineering procedures.	PLTW-BE-BE			
Benchmark 1.1	Students will be able to describe the various design processes that guide professionals in developing solutions to problems.	PLTW-BE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students <i>describe</i> information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Sample Performance Indicator 1.1.1	Communicate ideas for designing a project using various drawing methods, sketches, graphics, or other media collected and documented.	PLTW-BE			
Sample Performance Indicator 1.1.2	Amend ideas, notes, and presentations based on personal review and feedback from others and will document them.	PLTW-BE			

Benchmark 1.2	Students will develop notebooks used by engineers to document communication and to keep a record of the entire design process.	PLTW-BE	ELA.WHST.11-12.10	LA.12.2.2.a	
Sample Performance Indicator 1.2.1	Describe in daily journals the advantages and disadvantages of various information-gathering techniques, communications, and design processes in the development of the project.	PLTW-BE			
Benchmark 1.3	Students will use lab instruments precisely and accurately in order to provide reliable information.	PLTW-BE	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2 SC.12.1.1.d	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 1.3.1	Follow procedures for ensuring accuracy and precision in measuring solutions.	PLTW-BE			
Sample Performance Indicator 1.3.2	Follow laboratory safety procedures.	PLTW-BE			
Benchmark 1.4	Students will work in a biotechnical laboratory following safe procedures to protect themselves and others.	PLTW-BE	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2 SC.12.1.1.d	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 1.4.1	Follow procedures for ensuring accuracy and precision in measuring solutions.	PLTW-BE			

sample Performance Indicator 1.4.2	Follow laboratory safety procedures.	PLTW-BE			
Standard 2	Students will do research about the history of biotechnical engineering and relate their findings to personal events in their lives; students will research a major industry that utilizes genetic technology.	PLTW-BE			
Benchmark 2.1	Students will gain an appreciation for the rapid advancements in biotechnical engineering through guided research of important discoveries and inventions, such as the Human Genome project, magnetic resonance imaging techniques, and artificial heart research.	PLTW-BE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c SC.12.1.2.c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7-9; NE: LA.12.1.6.j, LA.12.4.1.a-c).
Sample Performance Indicator 2.1.1	Conduct a Biotechnology Timeline WebQuest to gather information about the evolution of biotechnical engineering.	PLTW-BE			
Sample Performance Indicator 2.1.2	Develop a scaled timeline illustrating major biotechnical engineering milestones through the use of the internet, available hard copy resources, and their individual milestone impact cards describing future biotechnical developments.	PLTW-BE			
Sample Performance Indicator 2.1.3	Assess the impact of each milestone based on their research.	PLTW-BE			

Benchmark 2.2	Students will further their knowledge of biological information and engineers by using scientific principles to enhance their design solutions.	PLTW-BE		SC.12.1.2.c SC.12.1.3.h	
Sample Performance Indicator 2.2.1	Identify the fundamental concepts common to all major industries in biotechnical engineering.	PLTW-BE			
Sample Performance Indicator 2.2.2	Identify and explain how biotechnical engineered products impact society.	PLTW-BE			
Benchmark 2.3	Students will explore the rapid rate of new biological discoveries is due in a large part to scientists' knowledge and their use of engineering concepts.	PLTW-BE		SC.12.1.2.b SC.12.1.2.c	
Sample Performance Indicator 2.3.1	Identify and explain how biotechnical engineered products impact society.	PLTW-BE			
Sample Performance Indicator 2.3.2	Predict future developments in biotechnical engineering.	PLTW-BE			
Sample Performance Indicator 2.3.3	Investigate and begin to develop an understanding of the relationship between financial markets and scientific research.	PLTW-BE			
		PLTW-BE			
Benchmark 2.4	Students will explore the correlation between what is happening in the financial markets and what drives the biotechnology industry.	PLTW-BE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c SC.12.1.2.b	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7-9; NE: LA.12.1.6.j, LA.12.4.1.a-c).

Sample Performance Indicator 2.4.1	Predict future developments in biotechnical engineering.	PLTW-BE			
sample Performance Indicator 2.4.2	Investigate and begin to develop an understanding of the relationship between financial markets and scientific research.	PLTW-BE			
Standard 3	Students will demonstrate lessons from Prometheus by working through a series of steps addressing the bioethical issues that are inherent in technological advancements.	PLTW-BE			
		PLTW-BE			
Benchmark 3.1	Students will consider the impact of new technologies and the potential to benefit or harm living systems.	PLTW-BE		SC.12.1.2.b	
Sample Performance Indicator 3.1.1	Work individually and as a group to generate definitions of key terms to be addressed in the lesson.	PLTW-BE			
Sample Performance Indicator 3.1.2	Discuss the differences between values and morals.	PLTW-BE			
Sample Performance Indicator 3.1.3	Discuss the differences between morals and ethics.	PLTW-BE			
Benchmark 3.2	Students will apply variables that shape one's ethics and understand how those variables are distributed in society.	PLTW-BE			

Sample Performance Indicator 3.2.1	Describe the variables that shape one's ethics.	PLTW-BE			
sample Performance Indicator 3.2.2	Role-play a bioethics case study to address and personalize the different perspectives involved.	PLTW-BE			
Benchmark 3.3	Students will pose questions that have no clear-cut easy answers.	PLTW-BE	ELA.WHST.11-12.7	LA.12.1.6.j	
Sample Performance Indicator 3.3.1	Role-play a bioethics case study to address and personalize the different perspectives involved.	PLTW-BE			
Sample Performance Indicator 3.3.2	Analyze the bioethical issues that arise when various technological advancements create new options.	PLTW-BE			
		PLTW-BE			
Benchmark 3.4	Students will reflect on one's values, moral principles, and self-image.	PLTW-BE			
Sample Performance Indicator 3.4.1	Describe the variables that shape one's ethics.	PLTW-BE			
Sample Performance Indicator 3.4.2	Role-play a bioethics case study to address and personalize the different perspectives involved.	PLTW-BE			
Benchmark 3.5	Consequences of actions need to be considered for the individual, for others, and for society as a whole.	PLTW-BE			

Sample Performance Indicator 3.5.1	Role-play a bioethics case study to address and personalize the different perspectives involved.	PLTW-BE			
Sample Performance Indicator 3.5.2	Analyze the bioethical issues that arise when various technological advancements create new options.	PLTW-BE			
Sample Performance Indicator 3.5.3	Create and test a public opinion survey on the bioethics of biotechnology.	PLTW-BE			
Standard 4	Students will address genetic engineering on the technical and applied front.	PLTW-BE			
Benchmark 4.1	Students will investigate the DNA sequence information that has recently been achieved has led to the development of a new field in biotechnology called bioinformatics.	PLTW-BE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c SC.12.3.2.b	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7-9; NE: LA.12.1.6.j, LA.12.4.1.a-c).
Sample Performance Indicator 4.1.1	Investigate molecular techniques that are used by bioinformaticists.	PLTW-BE			
Sample Performance Indicator 4.1.2	Create a portfolio demonstrating the research and integration of forensics with engineering.	PLTW-BE			
Sample Performance Indicator 4.1.3	Design and create a 3D model of a fuming chamber for lifting prints from evidence.	PLTW-BE			

Benchmark 4.2	Students will provide research on the technological advances necessary for the identification and processing of DNA.	PLTW-BE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c SC.12.1.1.b SC.12.3.2.b	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7-9; NE: LA.12.1.6.j, LA.12.4.1.a-c).
Sample Performance Indicator 4.2.1	Analyze the technology utilized in the field of forensics.	PLTW-BE			
sample Performance Indicator 4.2.2	Create methods for evaluating collected evidence from a crime scene and prepare justifications for their conclusions.	PLTW-BE			
Benchmark 4.3	Students will identify how Engineers provide the technological advances necessary for the identification and processing of DNA.	PLTW-BE		SC.12.1.2.c	
Sample Performance Indicator 4.3.1	Apply the skills of reverse engineering to a crime scene and solve the mystery.	PLTW-BE			
Sample Performance Indicator 4.3.2	Create methods for evaluating collected evidence from a crime scene and prepare justifications for their conclusions.	PLTW-BE			
Benchmark 4.4	Students will demonstrate how Bioprocessing provides an organic method of mass producing necessary products that may be much less expensive than using chemical synthesis.	PLTW-BE		SC.12.1.1.b SC.12.1.1.d SC.12.1.1.e	

Sample Performance Indicator 4.4.1	Apply their practical knowledge of genetic engineering to the design of a novel and beneficial application of the reporter gene, green fluorescent protein.	PLTW-BE			
Sample Performance Indicator 4.4.2	Determine the proper techniques for isolating proteins.	PLTW-BE			
Sample Performance Indicator 4.4.3	Form a start-up pharmaceutical company with an appropriate name that will attempt to produce a pharmaceutical via previous genetic engineering work followed by scaled up growth of genetically modified bacteria.	PLTW-BE			
Standard 5	Students will be introduced to the engineering principles involved in developing and implementing methods of measuring rates of fermentation in yeast.	PLTW-BE			
Benchmark 5.1	Students will explore the importance of lactic acid and alcoholic fermentation has been on the applications of biotechnology for the last 10,000 years and many of the products have not changed.	PLTW-BE		SC.12.1.1.b SC.12.3.1.c	
Sample Performance Indicator 5.1.1	Determine the applications of fermentation in food production and renewable energy.	PLTW-BE			

Sample Performance Indicator 5.1.2	Design a method or instrumentation to be used for measuring rates of fermentation.	PLTW-BE			
Benchmark 5.2	Students will investigate that whole organisms can be used as bioreactors to produce useful products instead of practicing complex synthetic approaches in the laboratory.	PLTW-BE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c SC.12.1.1.b SC.12.1.1.c SC.12.3.1.c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7-9; NE: LA.12.1.6.j, LA.12.4.1.a-c).
Sample Performance Indicator 5.2.1	Research and test different variables which affect CO2 production in yeast in order to determine the ideal conditions for fermentation.	PLTW-BE			
Sample Performance Indicator 5.2.2	Design and run a yeast-powered vehicle.	PLTW-BE			
Benchmark 5.3	Student will explore bioprocessing, which can lead to novel approaches of renewable energy.	PLTW-BE		SC.12.1.1.b SC.12.1.1.c SC.12.3.1.c	
Sample Performance Indicator 5.3.1	Research and test different variables which affect CO2 production in yeast in order to determine the ideal conditions for fermentation.	PLTW-BE			
Sample Performance Indicator 5.3.2	Design a method or instrumentation to be used for measuring rates of fermentation.	PLTW-BE			
Benchmark 5.4	Students will demonstrate hydro-aquaponic systems can be designed to optimize nutrient availability.	PLTW-BE		SC.12.1.1.b SC.12.1.1.c SC.12.3.1.c	

Sample Performance Indicator 5.4.1	Design and run a yeast-powered vehicle.	PLTW-BE			
sample Performance Indicator 5.4.2	Design a method or instrumentation to be used for measuring rates of fermentation.	PLTW-BE			
Standard 6	Students will gain an understanding of the devices and equipment used by professionals in the biomedical field.	PLTW-BE			
		PLTW-BE			
Benchmark 6.1	Develop extensive and detailed engineering plans exist to better assist professionals at work.	PLTW-BE	ELA.WHST.11-12.4	LA.12.2.2	
Sample Performance Indicator 6.1.1	Demonstrate the application of engineering design principles by improving upon existing hospital designs or surgical equipment designs.	PLTW-BE			
Sample Performance Indicator 6.1.2	Demonstrate the application of product liability, product reliability, product reusability, and product failure.	PLTW-BE			
Benchmark 6.2	Understand product evaluation must exist to improve equipment and meet the needs of patients.	PLTW-BE			
Sample Performance Indicator 6.2.1	Demonstrate the application of engineering design principles by improving upon existing hospital designs or surgical equipment designs.	PLTW-BE			

Sample Performance Indicator 6.2.2	Demonstrate the application of product liability, product reliability, product reusability, and product failure.	PLTW-BE			
Benchmark 6.3	Explore the importance of continued education must exist in order to advance with changes in technology.	PLTW-BE			
Sample Performance Indicator 6.3.1	Demonstrate the application of engineering design principles by improving upon existing hospital designs or surgical equipment designs.	PLTW-BE			
Sample Performance Indicator 6.3.2	Demonstrate the application of product liability, product reliability, product reusability, and product failure.	PLTW-BE			
Standard 7	Students will design replacement bones and joints considering various factors including physical needs, human physiology, movement, and alternative materials.	PLTW-BE			
Benchmark 7.1	Analyze human muscular-skeletal anatomy is the primary support system in the human body.	PLTW-BE			
Sample Performance Indicator 7.1.1	Develop a portfolio identifying anatomical joint features and movements.	PLTW-BE			
Sample Performance Indicator 7.1.2	Design and sketch a new joint replacement and solid model approved sketches.	PLTW-BE			

Benchmark 7.2	Investigate the human skeletal systems' five functions that affect the quality of human life.	PLTW-BE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7-9; NE: LA.12.1.6.j, LA.12.4.1.a-c).
Sample Performance Indicator 7.2.1	Build a joint model with the same degrees of freedom as the human counterpart.	PLTW-BE			
sample Performance Indicator 7.2.2	Design and sketch a new joint replacement and solid model approved sketches.	PLTW-BE			
Benchmark 7.3	Identify the common disorders of the human musculo-skeletal anatomy can be overcome by use of artificial orthopedic devices made up from a variety of specialized materials.	PLTW-BE	ELA.RST.11-12.4	LA.12.1.5	
Sample Performance Indicator 7.3.1	Develop a materials and development cost for the joint design and surgical implant.	PLTW-BE			
Sample Performance Indicator 7.3.2	Synthesize skeletal system concepts with the design process for engineering joints.	PLTW-BE			
Standard 8	Design Cardiovascular Devices and Imaging.	PLTW-BE			
Benchmark 8.1	Students will accurately measure Normal and abnormal cardiac function using a medical tool called an ECG.	PLTW-BE	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2 SC.12.1.1.e	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 8.1.1	Research heart diseases and disorders.	PLTW-BE			

Sample Performance Indicator 8.1.2	Sketch and provide a solid model of heart chambers and valves.	PLTW-BE			
Sample Performance Indicator 8.1.3	Research procedures involving artificial heart surgery and present the cost of a proposed noninvasive implant.	PLTW-BE			
Benchmark 8.2	Know cardiac defects can be corrected using prosthetic devices such as heart valves or stents.	PLTW-BE			
Sample Performance Indicator 8.2.1	Research procedures involving artificial heart surgery and present the cost of a proposed noninvasive implant.	PLTW-BE			
sample Performance Indicator 8.2.2	Research and create a set of improvements for imaging techniques.	PLTW-BE			
Benchmark 8.3	Study the heart as an electrical as well as a mechanical organ which produces electrical fields that can be measured.	PLTW-BE			
sample Performance Indicator 8.3.1	Research and create a set of improvements for imaging techniques.	PLTW-BE			
sample Performance Indicator 8.3.2	Design a portable ECG monitor and study the electrical aspects associated with the heart.	PLTW-BE			
Benchmark 8.4	Delineate electrical signals that correspond to the cardiac cycle.	PLTW-BE			

Sample Performance Indicator 8.4.1	Design a portable ECG monitor and study the electrical aspects associated with the heart.	PLTW-BE			
Sample Performance Indicator 8.4.2	Research and design improvements in heart implants or instruments.	PLTW-BE			
Sample Performance Indicator 8.4.3	Perform a virtual heart surgery to better understand the instruments and implants in need of improving.	PLTW-BE			