GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

COURSE: Foundations of Engineering and Technology

UNIT: 10: Bioengineering Systems

INTRODUCTION

Annotation: Briefly describe the unit topics, tasks, methods, etc.

This unit introduces students to the many branches of bioengineering. Bio-agricultural, biomedical, and biomechanical engineering will be the focus. This lesson includes the development of a prosthetic device for physically or mentally challenged end users.

Grade(s):

X	9th
X	10th
X	11th
X	12th

Time:

15 days

Author:

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Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

FOCUS STANDARDS

GPS Focus Standards: Please list the standard and elements covered.

ENGR-FET-2b – Describe the issues of wealth, fame, power, and necessity that have influenced innovation and technological development.
ENGR-FET-2d – Describe the impact of governmental and political systems on technological innovation.
ENGR-FET-2e – Explain the interaction between technological development and social change.
ENGR-FET-3a – Describe the processes of input, processing, output, and feedback that comprise the universal systems model.
ENGR-FET-3b – Demonstrate applications of the universal systems model across the spectrum of technologies.
ENGR-FET-4a – Describe the role of mathematics and science in technological development.
ENGR-STEM-1 – Students will recognize the systems, components, and processes of a technological system.
ENGR-STEM-2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.
ENGR-STEM-3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
ENGR-STEM-4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.
ENGR-STEM-5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.
ENGR-STEM-6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.
CTAE-FS-1 – Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.
CTAE-FS-2 – Academic Foundations: Learners achieve state academic standards at or above grade level.
CTAE-FS-3 – Communications: Learners use various communication skills in expressing and interpreting information.
CTAE-FS-4 – Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.
CTAE-FS-7 – Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.
CTAE-FS-9 – Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

GPS Academic Standards:

ELAALRC2 The student participates in discussions related to curricular learning in all subject areas.
ELAALRC3 The student acquires new vocabulary in each content area and uses it correctly.
ELAALRC4 The student establishes a context for information acquired by reading across subject areas.
MM3P1 Students will solve problems (using appropriate technology).
MM3P2 Students will reason and evaluate mathematical arguments.
MM3P3 Students will communicate mathematically.
MM3P4 Students will make connections among mathematical ideas and to other disciplines.

SCSh1 Students will evaluate the importance of curiosity, honesty, openness and skepticism in science.
SCSh2 Students will use standard safety practices for all classroom laboratory and field investigations.
SCSh3 Students will identify and investigate problems scientifically.
SCSh4 Students use tools and instruments for observing, measuring and manipulating scientific equipment and materials.
SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.
SCSh6 Students will communicate scientific investigations and information clearly.
SCSh7 Students analyze how scientific knowledge is developed.
SCSh8 Students will understand important features of the process of scientific inquiry.
SSUSH11 The student will describe the growth of big business and technological innovations after Reconstruction.
SSUSH21 The student will explain economic growth and its impact on the United States 1945 – 1970.
SSUSH24 The student will analyze the impact of social change movements and organizations of the 1960's.
SSWH21 The student will analyze globalization in the contemporary world.

National / Local Standards / Industry / ISTE:

UNDERSTANDINGS & GOALS

Enduring Understandings: Enduring understandings are statements summarizing important ideas and have lasting value beyond the classroom. They synthesize what students should understand – not just know.

Students will understand that there are ethical, moral, legal, environmental and economical controversies and challenges associated with bioengineering.

Essential Questions: Essential questions probe for deeper meaning and understanding while fostering the development of critical thinking and problem-solving skills. Example: Why is life-long learning important in the modern workplace?

1. What is bioengineering?
2. What is the difference between bioengineering-agricultural and environmental, biomedical engineering and biomechanical engineering?
3. What are the ethical and legal issues associated with bioengineering?
4. What are the social, economic, and environmental issues associated with bioengineering?

Knowledge from this Unit: Factual information.

1. Students will identify career areas in Bioengineering.
2. Students will recognize the code of ethics for Bioengineering.
3. Students will be able to define Bioengineering.

Skills from this Unit: Performance.

1. Students will be able to distinguish various ethical issues within the field of Bioengineering.
2. Students can describe the differences in the bioengineering fields of study.

ASSESSMENT(S)

Assessment Method Type: Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

- ____ Pre-test
- ____ Objective assessment - multiple-choice, true- false, etc.
  - __ Quizzes/Tests
  - __ Unit test
- ____ Group project
- X Individual project
- ____ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
  - __ Self-check rubrics
  - __ Self-check during writing/planning process
  - __ Journal reflections on concepts, personal experiences and impact on one's life
  - __ Reflect on evaluations of work from teachers, business partners, and competition judges
  - __ Academic prompts
  - __ Practice quizzes/tests
- X Subjective assessment/Informal observations
  - __ Essay tests
  - _X_ Observe students working with partners
  - _X_ Observe students role playing
- ____ Peer-assessment
  - __ Peer editing & commentary of products/projects/presentations using rubrics
  - __ Peer editing and/or critiquing
- X Dialogue and Discussion
  - __ Student/teacher conferences
  - _X_ Partner and small group discussions
  - _X_ Whole group discussions
  - __ Interaction with/feedback from community members/speakers and business partners
- X Constructed Responses
  - _X_ Chart good reading/writing/listening/speaking habits
  - _X_ Application of skills to real-life situations/scenarios
- ____ Post-test

Assessment(s) Title:

Biomechanical Design Challenge

Assessment(s) Description/Directions:

Students will apply the systems model and design process to design a solution for osteoarthritis sufferers. This is a project modified from University of Georgia's Dr. Roger Hill. Portfolio assessment and rubric can be found as an instructional material for this lesson.

Attachments for Assessment(s): Please list.

Documents: Biomechanical Design Challenge (includes rubric), Code of Ethics

LEARNING EXPERIENCES

Sequence of Instruction

1. Identify the Standards. Standards should be posted in the classroom for each lesson.

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2. Review Essential Questions.

1. What is bioengineering?
2. What is the difference between bioengineering-agricultural and environmental, biomedical engineering and biomechanical engineering?

3. What are the ethical and legal issues associated with bioengineering?
4. What are the social, economic, and environmental issues associated with bioengineering?

3. Identify and review the unit vocabulary.

Bioengineering
Biomechanical
Canons
Osteoarthritis

4. Assessment Activity.

1. Using the PowerPoint titled Bioengineering, lead the students in a discussion defining and differentiating the areas of bioengineering. Career information is also included. Students will read the canons of the code of ethics (attached) and discuss the ethical issues in various scenarios presented in the class. Answers should be based on ethical code and not personal belief systems.
2. Assign the Biomechanical Engineering Design Challenge.

Attachments for Learning Experiences: Please list.

PowerPoint: Bioengineering
Documents: Biomechanical Design Challenge (includes rubric), Code of Ethics
Excel Spreadsheet: Engineering Criteria Analysis
PDF: UGA Engineering Academic Programs

Notes & Reflections: May include notes to the teacher, pre-requisite knowledge & skills, suggestions, etc.

Student will encounter discussions on the process of bioengineering plants, animals, and mechanisms and the potential legal and ethical ramifications. More advanced classes may engage students in the engineering design process, engineering design graphics, mathematical models, and scientific research methodologies to develop a solution to a biomechanical problem.

CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Biomechanical Design Challenge

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Students will design a device that osteoarthritis suffers can use to plug in and unplug electrical devices.

Attachments for Culminating Performance Task: Please list.

Rubric:

Portfolio Cover	20 points
Stating the problem	40 points
Design Rationale	175 points
Plan of Action	65 points
Results	50 points
Photographs	50 points *Bonus*

UNIT RESOURCES

Web Resources:

Georgia Tech Engineering Academic Programs:
http://www.bioengineering.gatech.edu/general/overview.html
Biomechanical Engineering Information from Stanford:
http://www.stanford.edu/group/biomech/

Attachment(s): Supplemental files not listed in assessment, learning experiences, and performance task.

Catt Ergonomics Materials

Materials & Equipment:

Powerpoint display, computer access with CAD software program, various drafting instruments

What 21st Century Technology was used in this unit:

X	Slide Show Software	X	Graphing Software		Audio File(s)
	Interactive Whiteboard	X	Calculator	X	Graphic Organizer
	Student Response System		Desktop Publishing	X	Image File(s)
	Web Design Software		Blog		Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email	X	Website		