



GEORGIA

PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

COURSE: Engineering Concepts (ET-EC)

UNIT: 5. TSA Team and Project-Based Design



INTRODUCTION

Annotation:

In this unit, students will demonstrate the engineering design process using basic engineering tools and resources. Students will work in teams to explore the functions engineers are responsible for in the design and development of products and processes. Students will also learn the process of and keep engineering notebook.

Grade(s):

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

Time:

25 hours

Author:

Gillespie

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-EC-2 – Students will demonstrate the engineering design process.
- ENGR-EC-3 – Students will solve problems using basic engineering tools and resources.
- ENGR-EC-4 – Students will demonstrate a whole systems approach to engineering and problem solving.
- ENGR-EC-5a – Use multi-view projection and pictorial drawings to communicate design specifications.
- ENGR-EC-5d – Prepare a proposal for an engineering design project.
- ENGR-EC-5e – Document engineering design processes using an engineering design notebook.
- ENGR-EC-5f – Prepare a report of engineering design activities including a description of analysis, optimization, and selection of a final solution.
- ENGR-EC-5g – Demonstrate oral communication skills in reporting results of an engineering design activity.
- 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-7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.
- 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-5 – Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.
- CTAE-FS-6 – Systems: Learners understand a variety of organizational structures and functions.
- CTAE-FS-8 – Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

GPS Academic Standards:

- 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.
- MM3P1. Students will solve problems (using appropriate technology).
- MM3P3. Students will communicate mathematically.

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.

As a team, students will learn the steps of the engineering design process.

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?

- What are the processes necessary to develop a design solution?
- What is predictive analysis?
- What communication skills are necessary in developing a design solution?
- How do leadership and teamwork affect the design team activities?
- How are multi-view projection and pictorial drawings used to communicate design specifications?

Knowledge from this Unit: Factual information.

Skills from this Unit: Performance.



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
- ☐ 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
- ☐ Subjective assessment/Informal observations
 - ☐ Essay tests
 - ☐ Observe students working with partners
 - ☐ Observe students role playing
- ☒ Peer-assessment
 - ☐ Peer editing & commentary of products/projects/presentations using rubrics
 - ☐ Peer editing and/or critiquing
- ☐ Dialogue and Discussion
 - ☐ Student/teacher conferences
 - ☐ Partner and small group discussions
 - ☐ Whole group discussions
 - ☐ Interaction with/feedback from community members/speakers and business partners
- ☐ Constructed Responses
 - ☐ Chart good reading/writing/listening/speaking habits
 - ☐ Application of skills to real-life situations/scenarios
- ☐ Post-test

Assessment(s) Title:

Co-Curricular Technology Student Association Activity

Assessment(s) Description/Directions:

Introduce a co-curricular activity that involves teamwork. One possibility is the Manufactory Prototype project from the TSA Competitive Events guide.

Attachments for Assessment(s): Please list.

Basic Criteria Analysis



LEARNING EXPERIENCES

Instructional planning: Include lessons, activities and other learning experiences in this section with a brief description of the activities to ensure student acquisition of the knowledge and skills addressed in the standards. Complete the sequence of instruction for each lesson/task in the unit.

Sequence of Instruction

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

- ENGR-EC-2 – Students will demonstrate the engineering design process.
- ENGR-EC-3 – Students will solve problems using basic engineering tools and resources.
- ENGR-EC-4 – Students will demonstrate a whole systems approach to engineering and problem solving.
- ENGR-EC-5a – Use multi-view projection and pictorial drawings to communicate design specifications.
- ENGR-EC-5d – Prepare a proposal for an engineering design project.
ENGR-EC-5e – Document engineering design processes using an engineering design notebook.
ENGR-EC-5f – Prepare a report of engineering design activities including a description of analysis, optimization, and selection of a final solution.
ENGR-EC-5g – Demonstrate oral communication skills in reporting results of an engineering design activity.
- 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-7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.
- 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-5 – Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

- CTAE-FS-6 – Systems: Learners understand a variety of organizational structures and functions.
- CTAE-FS-8 – Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.
- 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.
- MM3P1. Students will solve problems (using appropriate technology).
- MM3P3. Students will communicate mathematically.

2. Review Essential Questions.

- What are the processes necessary to develop a design solution?
- What is predictive analysis?
- What communication skills are necessary in developing a design solution?
- How do leadership and teamwork affect the design team activities?
- How are multi-view projection and pictorial drawings used to communicate design specifications?

3. Identify and review the unit vocabulary.

4. Assessment Activity.

Day 1: Team-building activity – Space Shuttle Band Aid:

- Students will be divided into teams and told to stand on the selected material. No part of anyone can be off the covering. Have the students close their eyes and imagine the following scenario:
You are no longer in the technology lab. You are now in outer space on the outside of the space shuttle. You are standing on a gigantic band-aid on the outside of the shuttle. The band-aid is the only thing keeping you from floating off into outer space. You must be touching some are of the band-aid at all times. The problem is that the band-aid is upside down. You must find a way to turn the band-aid over without anyone in the group stepping off and risk being sucked into outer space. I will not answer any questions. You must discuss a solution while standing together. You will be assessed on whether or not your group can turn over the band-aid without any of your members stepping off of its surface.

- Materials: Poster board, butcher paper, or old towels or blankets. The size of your materials will determine how many students are in a group.
- Discussion: After all groups have completed the activity (successfully or not) have them reflect on their group's ability. Possible questions include:
 - What was the most frustrating/difficult part of the activity?
 - What skills were necessary?
 - Did you work as a team?
 - What would you change if you could?
 - What did you learn about teamwork during this activity?
- Follow up with discussion of the role teamwork plays in the engineering design process.

Day 2

Introduce Engineering Design Notebook procedure (*reference PowerPoint*) – bound composition notebooks work well.

Day 3-4

- Introduce a co-curricular activity that involves teamwork. One possibility is the Manufacturing Prototype project from the TSA Competitive Events guide. If you have a project that will work for this you may use it instead.
- Identify the problem.
- Define the problem.
- Have students divide into teams (3-5 students). You may choose to group them or let them group themselves. At this point present their Engineering Notebooks. Have groups set up their notebook format & have them record the problem information. Have groups determine rolls each will be responsible for with their project.
- Give project constraints & criteria & have students record data in their engineering notebooks.

Day 5

Students will begin brainstorming, researching, and recording information. Check the progress of their notebooks to be sure they are properly recording all data. Reiterate the design process steps.

Day 6-7

Students should focus on a viable solution. They should begin making lists of materials needed. Will students provide materials or must they work with materials provided in the lab?

Day 8

Have each group present a project proposal for their engineering design project.

Day 9

Students should begin analysis step of the design process.

Day 10-22

Continue working on design & notebook. One idea is to have students photograph steps of process for slideshow presentation.

Day 23-26

Students should be close to completion of project. Tell students they will be preparing a presentation and a report of their activities. The report should include a description of analysis, optimization, and a selection of a final solution. Their slideshow presentation should include the same information along with photos of their design process. This slideshow should be presented by all members of the team. This is also when they will present their prototype.

Day 27-30

Team presentations

Attachments for Learning Experiences: Please list.

- Engineering Design Notebook PowerPoint
- Basic Criteria Analysis Excel Worksheet

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



CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Engineering Design Notebook

Culminating Unit Performance Task Description/Directions/Differentiated

See PowerPoint

Rubrics for Performance Task

See PowerPoint

Attachments for Culminating Performance Task

EC_5_Engineering Design Notebook PowerPoint



UNIT RESOURCES

Web Resources:

- www.engineeringk12.org
- www.teachengineering.org

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

Materials & Equipment:

What 21st Century Technology was used in this unit:

<input checked="" type="checkbox"/>	Slide Show Software	<input type="checkbox"/>	Graphing Software	<input type="checkbox"/>	Audio File(s)
<input type="checkbox"/>	Interactive Whiteboard	<input type="checkbox"/>	Calculator	<input type="checkbox"/>	Graphic Organizer
<input type="checkbox"/>	Student Response System	<input type="checkbox"/>	Desktop Publishing	<input type="checkbox"/>	Image File(s)
<input type="checkbox"/>	Web Design Software	<input type="checkbox"/>	Blog	<input type="checkbox"/>	Video
<input type="checkbox"/>	Animation Software	<input type="checkbox"/>	Wiki	<input type="checkbox"/>	Electronic Game or Puzzle Maker
<input type="checkbox"/>	Email	<input type="checkbox"/>	Website		