GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

COURSE: Engineering Applications (ET-EA)

UNIT: 7. Prototype Development

INTRODUCTION

Annotation:

This unit will be an all encompassing unit for the pathway. Students shall use everything they have learned towards one culminating project. Listed below are suggested projects that can provide the scope and level appropriate for the students

Grade(s):

	9th
	10th
X	11th
X	12th

Time:

100 days

Author:

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Notes to the Teacher:

For prototype development, the teacher must choose or allow the students to choose the project. The choice should be based on many variables, including equipment available, cost, and students' interest. We are suggesting three main options: a robotics project, a hovercraft, or an electric vehicle/go-kart, with resources to help you decide.

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-EA-1 – Students will use selected discipline specific engineering tools, machines, materials, and processes.
- ENGR-EA-2 – Students will develop and follow a detailed plan for the solution of a design problem.
- ENGR-EA-3 – Students will demonstrate prototype development.
- ENGR-EA-4 – Students will explain the impact of business and marketing on engineering design.
- 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-5 – Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.
- CTAE-FS-8 – Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.
- CTAE-FS-11 – Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

GPS Academic Standards:

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 the prototype development process from beginning to end and the problem solving process involved in overcoming obstacles.

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?

- How is a prototype built?
- What resources are needed to build a prototype?
- What is the goal of the prototype?
- How will problems be addressed during the design process?

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
X 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
__ 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:

Prototype and Engineering Notebook

Assessment(s) Description/Directions:

The student should be graded upon the completion of the prototype using the engineering notebook to ensure the student has gone through entire engineering process.

Attachments for Assessment(s): Please list.

- CATT Design Loop

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-EA-1 – Students will use selected discipline specific engineering tools, machines, materials, and processes.
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2. Review Essential Questions.

- How is a prototype built?
- What resources are needed to build a prototype?
- What is the goal of the prototype?
- How will problems be addressed during the design process?

3. Identify and review the unit vocabulary.

4. Assessment Activity.

Students should follow the steps of the engineering process for the development of the prototypes.

PROTOTYPE OPTIONS

1. **Robotics**- There are several competitions that students become involved in with robotics. Even if competition is not of interest, you can use the ideas for what tasks the students should design and build the robot to perform.

   FIRST Robotics Challenge (FRC)
   http://www.usfirst.org/what/frc/default.aspx?id=366
   The game for the competition is announced in early January and then teams have six weeks to design, build, and test their robot. Every team starts with the same kit of motors and sensors, with the option of buying additional parts. With the short time period, working afterschool will probably be required. The minimum cost is about $10,000 for kit and 1 tournament registration. You may be

able to receive a NASA Grant as a rookie team. Sponsorship is very highly recommended.

FIRST Tech Challenge (FTC)
http://www.usfirst.org/what/fvc/default.aspx?id=380
This competition was designed for students beginning in robotics. A less intense version of the FRC, the FTC allows more time to design and build the robot. The competition next year (08-09) will be using a kit for the first time (previously used Vex Robotics parts). The game will be announced towards the beginning of the school year with tournaments starting December continuing until March. The cost for the kit and registration is $900 plus $100 to $300 for each competition entered.

Best Robotics
http://www.bestinc.org/MVC/
Each team designs and builds a radio-controlled machine to accomplish defined tasks in a game-type format. Six weeks before the competition, the teams gather for Kick Off Day in early September at local hub sites where they receive identical kits of equipment (motors, r/c unit, batteries, etc.) and raw materials from which to build their machines, and a detailed set of game rules. The machines must be built only from the raw materials supplied to them. There is no cost to participate in the robotics part of the competition.

Botball
http://www.botball.org/
Botball robots are completely autonomous and rely on their computer programming to start, stop, and maneuver on the game board. Each robot uses sensors to detect changes in light, sound, distance, and color. The robot's actions are based on the feedback from the sensors combined with the computer programming written and implemented by the students in advance. The Botball Program begins with a 2-day professional development workshop sometime between January and March with the competitions occurring between February and April. The fee is $2,300 which includes the kit and registration.

Vex Robotics
http://www.robotevents.com/program.php?event_id=1&sortid=8
In this competition, every team uses Vex Robotics Components. The new game for VEX Robotics Competition for the 2008/2009 season will be unveiled at the end of the summer with competitions throughout the year. The startup kit costs $300 and the registration fee is $75. Additional parts can be bought at http://www.vexrobotics.com Kits and parts may be purchased without entering the competition.

2. **Hovercraft**- The hovercraft project requires a large lab facility for construction. Most teachers prefer using kits for their first time. Kits can be found at Universal Hovercraft http://www.hovercraft.com/content/index.php and have been used by a few teachers in Georgia. Parrish Hill High School in Connecticut has some curriculum available online at http://www.parishhill.org/teched/hovercraft%20website/curriculum.htm

3. **Electric Vehicles/Go-Kart**- The Electric Vehicle (EV) Rally occurs during the spring each year near Commerce, GA. Four classes of vehicles were included in the 2008 EV Education Rally. Each vehicle must comply with the appropriate vehicle specifications

for that class of vehicles. Schools may compete in one or more classes and may enter more than one vehicle in a particular class. The classes are:

Full-size vehicle conversions
Includes vehicles manufactured by a recognized auto manufacturer that have been converted by students to operate exclusively on electricity. Note: Each vehicle shall be "street-legal" with a current license tag and appropriate state-required liability insurance. Full-size vehicles may be driven on public roads as part of the competition and must comply with all applicable laws and regulations.

E-Karts
Includes electric vehicles fabricated from commercially manufactured, gas-powered racing go-karts.

EM-TVs
Includes electric vehicles meeting the prescriptive specifications for this class or assembled from kits provided by EV Master, Inc. Single and dual motor vehicles will compete in the same class.

Innovation Class
Students build or converted vehicles using bio fuels and/or hybrid drive systems utilizing internal combustion and electric components

For more information visit the Georgia Electric Vehicle Education Program at http://www.evclubsouth.org/evep/index.html

Kits are available at EV Master http://www.evmaster.com/evm/index1.htm
The cost for the Go-Kart kit is $5250 and, if needed, $1250 for all tools and safety equipment.

Attachments for Learning Experiences: Please list.

CATT Design Loop

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

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Learning and implementing the steps in the engineering process. The performance task depends on the project chosen.

Culminating Unit Performance Task Description/Directions/Differentiated

Depends on the project chosen; see above for directions.

Attachments for Culminating Performance Task

UNIT RESOURCES

Web Resources:

http://www.usfirst.org/what/frc/default.aspx?id=366

http://www.usfirst.org/what/fvc/default.aspx?id=380

http://www.bestinc.org/MVC/

http://www.botball.org/

http://www.robotevents.com/program.php?event_id=1&sortid=8

http://www.hovercraft.com

http://www.evclubsouth.org/evep/index.html

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

Materials & Equipment:

What 21st Century Technology was used in this unit:

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