GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

PATHWAY: Manufacturing

COURSE: Robotics and Automated Systems

UNIT: 5.1. Design and Mechanics; Mechanisms & Simple Machines

INTRODUCTION

Annotation:

Students will understand how simple machines are the basis for all mechanical connections, movement, and processes that are not chemical or electrical in nature.

Grade(s):

	9th
X	10th
X	11th
X	12th

Time:

15 hours

Author:

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Additional Author(s):

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:

ENGR-RAS-3. Students will discuss the systems and applications of automation including: AGV, PLC, CNC, CIM, CAD, CAM, and robotics as essential to succeeding globally in a manufacturing market.
ENGR-RAS-5. Students will apply the principles of PLC, CIM, CAD, CAM, and robotics in the manufacturing of a product.
ENGR-STEM-1. Students will recognize the systems, components, and processes of a technological system.
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.

GPS Academic Standards:

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.
MM3P1. Students will solve problems (using appropriate technology).
MM3P2. Students will reason and evaluate mathematical arguments.
MM3P4. Students will make connections among mathematical ideas and to other disciplines.

National / Local Standards / Industry / ISTE:

UNDERSTANDINGS & GOALS

Enduring Understandings:

Students will understand the use of simple machines in everyday technology. They will also gain a basic understanding of the science of motion.

Essential Questions:

- What is a simple machine? How do they relate to all complex machines?
- How does one calculate work? Mechanical advantage? Gear ratios?
- What is the relationship between force, distance, speed, and direction when discussing simple machines?

Knowledge from this Unit:

- Students will be able to identify simple machines operating in everyday tools, equipment, and complex machinery
- Students will identify the laws of science regarding energy conservation, energy transformation, mechanical advantage, and how to calculate this advantage and determine work accomplished

- Students will be able to explain how motion is transmitted from rotary, linear, or reciprocal to any form
- Students will be able to identify the advantages gained by using specific simple machines.
- Students will be able to explain gear types, ratios, gear boxes, and perform basic computation in determining torque, rotation, and advantages of gearing a system up or down.

Skills from this Unit:

- Students will better develop their critical thinking skills.

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.

_x___ Pre-test
_____ Objective assessment - multiple-choice, true- false, etc.
  __ Quizzes/Tests
  __ Unit test
_x___ Group project
_x___ Individual project
_x___ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
  _x_ 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
  __ Observe students role playing
_x___ Peer-assessment
  _x_ Peer editing & commentary of products/projects/presentations using rubrics
  __ Peer editing and/or critiquing
_x___ Dialogue and Discussion
  _x_ Student/teacher conferences
  _x_ Partner and small group discussions
  _x_ 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
_x___ Post-test

Assessment(s) Title:

Simple Machine Exam (*see Simple Machine exam.doc)*

Assessment(s) Description/Directions:

Responses can be varied. Students may pick up on many different simple machines, or focus on a few main components. How you grade this exam is very subjective. You may wish to procure an apple peeler/corer/slicer and demo the machine to the class. Many of my kids enjoyed the food, the mess, and the hands-on experience before this examination. Be sure to clean the tool well before and after each use. Digital photos are included for your use as well.

Attachments for Assessment(s):

- http://www.discoveryeducation.com *(formerly United Streaming Subscription service)*
- Resources.doc
- Http://www.howstuffworks.com (*multiple entries… see HowStuffWorks Mechanical.doc)*
- Vex for the Technically Challenged.pdf
- http://edoutreach.wpafb.af.mil/ *(Technology resources galore)*

LEARNING EXPERIENCES

Sequence of Instruction

1. **Identify the Standards. Standards should be posted in the classroom for each lesson.**
2. **Review Essential Questions.**
3. **Identify and review the unit vocabulary.**
4. **Assessment Activity.**

Step 1:
Discuss the simple machines. Use a variety of demonstrations to show each machine, and how the advantage of using each is accrued. Alternate strategy is to use the jigsaw activity (*See simple machine jigsaw.doc*) and have students present the various simple machines to their peers. Cut the topics into strips and assign to students / groups as appropriate.

Step 2:
Demonstrate or discuss a variety of compound and complex machines to show how simple machines are the basis for all equipment used anywhere. Multiple video resources are available online. *(see resources.doc)*

Step 3:
Research on the Internet. Find illustrations of simple machines, and complex machines. Use the How Stuff Works exercises to investigate multiple examples. *(see HSW_simple_machines.doc; How Stuff Works Mechanical.doc)*

Step 4:
Discuss gears and their relationships to simple machines. *(see Gear Ratio Worksheet.doc; Gears.ppt; How Stuff Works-Gears.doc; Torque and power.pdf; Vexfor_the_Technically_Challenged.pdf; Manipulators_Needel.ppt)*

Step 5:
Bring in a mechanical toy, and perform an autopsy to determine how it operates *(see Toy_Dissection_Assignment.doc; Rubric_for_Toy_Autopsies.doc; Robotic_furby_sites.doc; & Microid Autopsy.doc)*

Attachments for Learning Experiences:

Notes & Reflections:

Multiple videos are available from sources throughout the internet with regard to simple machines. Your own science dept. or media center may already have some resources covering this topic. Perhaps you could have your students create their own demonstrating the various simple machines.

How Stuff Works is a marvelous site. It is constantly changing, growing, and often carries links to other sites. Use this resource often.

Students often know the formulas, but not the real world implications of mechanical advantage. This advantage often takes the form of greater distance, speed, force, direction, or shortened time, at the expense of one of the other factors. Nothing is free. The energy input/output is the same. They may push or pull with less, but have to move an object further, as in an inclined plane or block and tackle. They often fail to see the trees for the forest. You might want to point some of these things out to them.

Nothing is more educational in learning about how something is built than taking that something apart. Reverse engineering is the basis for the Toy Autopsy project. Students need to bring in a “Toy to Destroy”. Remind them that in spite of their best efforts, sometimes they cannot put the toy (Humpty Dumpty) together again. Ensure they do not rob their siblings toy box, or bring in their collector / memorabilia items. (Interesting note: research studies have confirmed that boys are more attached to their childhood toys than girls are.)

The following observations have been made regarding this assignment as given over several classes:

Safety first! Small toys, big tools, destructive minds can equal injuries, especially when a stubborn piece does not want to yield. Safety glasses are a must.

This activity works great as a co-curricular assignment with a core physics class, or a Language Arts writing class. Timing is a problem if the science classes don’t cover the same material at the same time. English teachers may have other priorities for their time.

Photos are often fuzzy (students are unfamiliar with the cameras); do not show sufficient detail (students do not truly comprehend what they are looking at or for); students do not comprehend the impact of the photos on their paper (photos are poor quality; don’t show the intended info; used improperly [big photos, almost no wording], or are simply not used.) Sufficient cameras, time, and image download space required.

Students bring in toys that are more electronic than mechanical in nature. Some simply will not bring in toys. I usually purchase a selection of simple windup toys from the dollar store right after Halloween, Christmas or Easter (clearance / marked down). A buck or even less is often a much better deal than some of the toys students may bring in. By having a few stuck back, I can cover the unexpected theft, the forgotten, or the unacceptable toy.

Kids hate writing. When they do write, they often do not write well, especially technical writing, since they are least familiar with it. They are more comfortable in an expository or persuasive setting.

Students drag their feet about bringing in toys, rush to destroy the toy, with few good photos and almost no notes of their actions, drag to a near stop in organizing their non-existent notes, then rush to write the paper (at the last minute) to turn in.

Keep examples of bad, as well as good projects to show the next group of students. Nothing drives home a point like a good example. I keep the toy I destroyed (*see Microid Autopsy.doc*) as an example for them on my desk. It is a box of pieces, but they can make the mental connection between them and the document.

Whenever a teacher finds themselves without certain necessary equipment for lessons, such as having no CNC equipment, they must improvise, or skip the lesson. Since a discussion of a technique often takes considerably less time than actually providing hands-on experience, the teacher finds time to spend elsewhere on extended projects. This unit is an area where teachers could spend an unbelievable amount of time and only scratch the surface. Multiple projects and variations exist, with the options of doing more projects, or going more in depth on any given topic. Provided is another project, specifically, designing a mousetrap vehicle. *(see Mouse.doc & Mousetrap Vehicle Rubric.xls)* It is not included in the steps for this unit, but is a viable alternative or add-on if needed. Another is to create geared battery operated vehicles using multiple gears available from sources such as Pitsco, Kelvin Scientific, Vex kits, or other sources. The vehicle could be designed to compete as either the fastest or slowest in its field.

CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Toy Autopsy

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Students are given the challenge to deconstruct a mechanical toy and through reverse engineering, find out what makes it tick.

Attachments for Culminating Performance Task:

See attached files:

Toy_Dissection_Assignment.doc
Rubric_for_Toy_Autopsies.doc
Robotic_furby_sites.doc
Microid Autopsy.doc

UNIT RESOURCES

Web Resources:

Attachment(s):

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		Desktop Publishing		Image File(s)
	Web Design Software		Blog	x	Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email	x	Website		