3rd STEAM – Unit 5 (ENGINEERING)

Content Area: **ENGINEERING (Grades 3rd)**
Course(s):
Time Period: **Ongoing**
Length: **Ongoing**
Status: **Published**

Big Idea

Engineers are constantly confronted with societal problems that must be solved as thoroughly as possible. Many times the solution involves designing a product (like a machine or computer code) that meets certain criteria and/or accomplishes a certain task. Typically engineers start with a simple solution and then redesign it in order to make the solution more reliable and efficient. The engineering design process is a series of steps that engineers follow to come up with a solution to a problem. The steps of the engineering design process are to: (Science Buddies, 2017)

- Define the Problem
- Do Background Research
- Specify Requirements
- Brainstorm Solutions
- Choose the Best Solution
- Do Development Work
- Build a Prototype
- Test and Redesign

Students should practice the engineering design process in the classroom. Just like engineers, students should design something, test it, identify issues or problems, and fix them. This way of working is called iteration.

Enduring Understanding

SWBAT understand the engineering design process. SWBAT identify the importance of using models and iteration in design. SWBAT empathize with stakeholders to improve design outcomes. SWBAT make connections between scientific concepts (such as chemistry, physics, and circuitry) and effective engineering practices.

Skills

- Practice the engineering design process.
    - In a team environment, research an engineering problem. (For instance, veterans need more specialized wheelchairs for active sports.)
    - Empathize with the stakeholders affected by the problem.
    - Draw a design of the solution to the problem.
    - Take a digital picture of the design and list the materials (resources) needed to build it.
    - Shop for materials and build a “working model” of the design.
    - Take a digital picture of the “working model” and reflect (in writing) on the building process.
    - Present the working model to the class. Explain what problem the invention solved. Describe how each part of the model is part of a working system.
- Use scientific concepts (such as simple machines, circuitry, and magnetism) to plan projects.

Standards

3-5	The attributes of design.	**8.2.5.C.1**	Collaborate with peers to illustrate components of a designed system.

		8.2.5.C.2	Explain how specifications and limitations can be used to direct a product's development.
		8.2.5.C.3	Research how design modifications have lead to new products.
	The application of engineering design.	**8.2.5.C.4**	Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models.
		8.2.5.C.5	Explain the functions of a system and subsystems.
	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	**8.2.5.C.6**	Examine a malfunctioning tool and identify the process to troubleshoot and present options to repair the tool.
		8.2.5.C.7	Work with peers to redesign an existing product for a different purpose.

3-5	The characteristics and scope of technology.	**8.2.5.A.1**	Compare and contrast how products made in nature differ from products that are human made in how they are produced and used.
		8.2.5.A.2	Investigate and present factors that influence the development and function of a product and a system.
	The core concepts of technology.	**8.2.5.A.3**	Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria and constraints.
	The relationships among technologies and the connections between technology and other fields of study.	**8.2.5.A.4**	Compare and contrast how technologies have changed over time due to human needs and economic, political and/or cultural influences.
		8.2.5.A.5	Identify how improvement in the understanding of materials science impacts technologies.

Assessments

- Teacher observation

- Successful completion of project
- Successful completion of portfolio
- Successful presentation of project to the class

Resources/Instructional Materials

ENGINEER A SAIL CAR THAT USES RENEWABLE WIND ENERGY TO TRANSPORT HARRY In this unit, students design sail cars to transport the class pet Harry. The sail cars use a renewable energy (wind) to move. Students practice the engineering design process while building and testing the sail cars using a box fan. At the end of the project, students measure the distance travelled by the sail cars. Students graph and analyze the data and try to ascertain what engineering practices resulted in the car that could travel the farthest distance. During testing, the students may not touch the car with their hands to make it move. The car must also safely hold the class pet, Harry.

VIDEOS

- Brainpop Wind
- Brainpop Wind Energy

TEACHENGINEERING.ORG Hands-on Activity: Wind-Powered Sail Cars. https://www.teachengineering.org/activities/view/ucd_sailcars_activity1 Student pairs design and construct small, wind-powered sail cars using limited quantities of drinking straws, masking tape, paper and beads. Teams compete to see which sail car travels the farthest when pushed by the wind (simulated by the use of an electric fan). Students learn about wind and kinetic and renewable energy, and follow the steps of the engineering design process to imagine, create, test, evaluate and refine their sail cars. This activity is part of a unit in which multiple activities are brought together for an all-day school/multi-school concluding "engineering field day" competition.

ENGINEER A MAGNETIC CAR THAT USES THE FORCE OF MAGNETISM TO TRANSPORT HARRY In this unit, students design magnetic cars to transport the class pet Harry. The magnetic cars use a magnetic force to move. Students practice the engineering design process while building and testing the maglev cars. At the end of the project, students measure the time it take the maglev cars to travel a specific distance. Students graph and analyze the data and try to ascertain what engineering practices resulted in the car that could travel the fastest over a set distance. One important part of the challenge is that the magnet may not be taped to the car. In addition, the students may not touch the car with the magnet or their hands to make it move. The car must also safely hold the class pet, Harry.

VIDEOS

- Mystery Science - What Can Magnets Do?
- Brainpop Magnets
- Sci Show Kids Fun with Magnets

DAYTONA REGIONAL STEM CENTER. MAGNETS LIKE TO MOVE IT, MOVE IT. http://daytonregionalstemcenter.org/curriculum/magnets-like-to-move-it-move-it/. These scientific investigations will engage students in understanding the force of magnetism and how this force can be used for work. The students will begin the unit by forming generalizations about magnets and their forces through their own knowledge and scientific investigations. The students will explore the variations between different magnet strengths. Finally, the students engineer a system that will utilize magnets to propel and guide a vehicle through a track. Students will use the engineering design process to determine the optimal type and placement of magnets around a predetermined track through testing and synthesis. Students will engage in collecting, analyzing and sharing data throughout this collaborative, inquiry-based unit.

ENGINEER A PLAYGROUND. In this unit, students learn about simple machines. They begin working in teams to design and build playground equipment for the class pet, Harry. Using recycled materials, students design perches, slides,

bouncy seats, merry-go-rounds, swings, zip lines, etc. The equipment must mimic the motions of a life sized version while holding the class pet, Harry, safely.

VIDEOS

- Sci Show Kids Swings, Slides, and Science
- Sci Show Kids Wheel and Axle
- Sci Show Kids Super Simple Machines: Levers
- Sci Show Kids Super Simple Machines: Ramps
- Sci Show Kids Super Simple Machines: Wheel and Axle
- Sci Show Kids Super Simple Machines: Need a Lift? Use a Pulley
- Brainpop Jr. Simple Machines

LOYOLA UNIVERSITY CALIFORNIA/PLAYA VISTA ELEMENTARY SCHOOL. Building an Ideal Playground: An Engineering Project-Based Learning Unit. https://www.stemcalifornia.org/cms/lib/CA01929101/Centricity/Domain/35/Building%20an%20Ideal%20Playground-%20An%20Engineering%20Project-Based%20Learning%20Unit.pdf In this unit, students will learn how forces affect our daily lives and how we can create simple machines to make work and life easier if we know how to use the principles of force. Students will then explore the community by critically observing playgrounds to learn how engineers use force to create fun and safe playgrounds and playground equipment. Once students make these observations, they will work in groups of 4 to engineer models of several playground structures that highlights what they have learned about force. Then, they will design the ideal playground that is not only fun, but also, safe for all children. The equipment on the playground must mimic the motions of the life size version, include a simple machine, and it must hold Harry (class pet) safely.

WEB SITES

- Teachengineering
- EGFI
- Engineering is Elementary
- Science buddies
- Foss
- Smithsonian
- Design Squad PBS
- Discovery Education - Energy
- Mystery Science Curriculum
- South Carolina Science Curriculum
- Steve Spangler
- Science Bob
- Exploratorium Science Snacks
- Imagination Station Toledo.org
- http://globaldayofdesign.com/
- http://worlds-of-learning.com/
- Pbs learning media nj
- Siemens Lesson Plans
- Lesson Planet

Modifications

Individual accommodations

• Additional support

• Adapting lessons to meet various learning styles

Integration of 21st Century Skills

Focus on the development of 21st Century Content Skills:

- Global awareness
- Civic literacy
- Health and wellness awareness
- Environmental literacy

Focus on the Development of Learning and Thinking Skills:

- Critical Thinking and Problem Solving Skills
- Communication Skills
- Creativity and Innovation Skills
- Collaboration Skills
- Information and Media Literacy Skills
- Contextual Learning Skills

Focus on the Development of Life Skills:

- Leadership
- Ethics
- Accountability
- Adaptability
- Personal Productivity
- Personal Responsibility
- People Skills
- Self Direction
- Social Responsibility

Interdisciplinary Connections

- Academic and Technical Rigor - Projects are designed to address key learning standards identified by the school or district.
- Authenticity - Projects use a real world context (e.g., community problems) and address issues that matter to the students.
- Applied Learning - Projects engage students in solving problems calling for competencies expected in high-performance work organizations (e.g.,teamwork, problem-solving, communication, etc.).
- Active Exploration - Projects extend beyond the classroom by connecting to community explorations.
- Adult Connections - Projects connect students with the wider community.
- Assessment Practices - Projects involve students in regular, performance-based exhibitions and assessments of their work; evaluation criteria reflect personal, school, and real-world standards of performance.