1st STEAM – Unit 4 (ENGINEERING)

Content Area: **ENGINEERING (Grades 1)**
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 and physics) and effective engineering practices.

Skills

- Students will practice cutting, pasting, measuring, and folding skills. Several lessons will be completed. These might include designing a boat to save Harry, a bridge to help Harry, a volcano safe house for Harry, and a musical instrument.
- Practice the engineering design process.
    - In a team environment, research an engineering problem.
    - Compare things in nature to what you are going to design. (For instance, humans replicated the design of bird wings to make airplanes. Humans copied the design of bending coconut or apple tree branches to create catapults.)
    - Empathize with the stakeholders affected by the problem.
    - Draw a design of the solution to the problem.
    - Build a “working model” of the design.
    - Draw 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 physics) to plan projects.

Standards

K-2	The characteristics and scope of technology.	**8.2.2.A.1**	Define products produced as a result of technology or of nature.
		8.2.2.A.2	Describe how designed products and systems are useful at school, home and work.
	The core concepts of technology.	**8.2.2.A.3**	Identify a system and the components that work together to accomplish its purpose.
		8.2.2.A.4	Choose a product to make and plan the tools and materials needed.
	The relationships among technologies and the connections between technology and other fields of study.	**8.2.2.A.5**	Collaborate to design a solution to a problem affecting the community.

K-2	The attributes of design.	**8.2.2.C.1**	Brainstorm ideas on how to solve a problem or build a product.
		8.2.2.C.2	Create a drawing of a product or device that communicates its function to peers and discuss.
		8.2.2.C.3	Explain why we need to make new products.
	The application of engineering design.	**8.2.2.C.4**	Identify designed products and brainstorm how to improve one used in the classroom.
		8.2.2.C.5	Describe how the parts of a common toy or tool interact and work as part of a system.
	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	**8.2.2.C.6**	Investigate a product that has stopped working and brainstorm ideas to correct the problem.

Assessments

- Teacher observation
- Successful completion of project

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

Resources/Instructional Materials

Boat Design Challenge - Students learn about buoyancy, aeronautical engineering, and materials choices. Students design boats out of recycled materials in the classroom. The boat must be no bigger than 5 inches x 5 inches. The boat must hold the class pet, Harry. Boats will be tested to see how many pennies or marbles they hold. Student data will be digitally graphed and analyzed.

VIDEOS

- SCI SHOW KIDS FLOAT A BOAT
- SCI SHOW KIDS HOW DO SHIPS FLOAT
- SCI SHOW KIDS SINK OR FLOAT

PBS FLETCH FLOAT MY BOAT. http://pbskids.org/fetch//parentsteachers/activities/act/act-floatmyboat.html - In this lesson, students test tinfoil boat designs with pennies. When a boat floats, it settles into the water, pushing the water aside to make room for itself. But it's a two-way pushing match—the water pushes back on the bottom and sides of the boat. This force, called buoyancy, holds the boat up. The more water a boat pushes aside, the more force there will be pushing back on the boat and supporting it. This is why a boat's size and shape make such a difference in how much of a load it can carry without sinking.

EGFI CAN DO CANOE. http://teachers.egfi-k12.org/can-do-canoe/ Canoes have been hand-built for centuries. This lesson explores how engineering has changed their manufacturing over time, including the development of durable, lighter materials. Working in teams of “engineers, ” students design and build their own canoe models out of everyday items. Like real engineers, they have design constraints, such as limited materials. They test their models on water, where they must stay afloat for 3 minutes carrying a load. Then students evaluate their results, and present their findings to the class.

Make Harry a Safe House from the Volcano Challenge - Students learn about volcanoes, their causes, and their effects on society. Students learn about materials choices when building structures to withstand the eruption of a volcano or earthquake. Students build models of volcanoes using paper mache. Students decorate volcanoes and design a safe house for the class pet, Harry. Students are introduced to basic chemistry. Students erupt volcanoes outside.

VIDEOS

- SCI SHOW KIDS VOLCANOES
- BRAINPOP JR VOLCANOS

PERSIL HOW TO MAKE A PAPER MACHE VOLCANO. https://www.persil.com/uk/dirt-is-good/arts-crafts/how-to-make-a-paper-mache-volcano.html. Cut a large square out of your cardboard box to make the base board.Using white glue, stick the bottom of the drinks bottle to the base board.Rip half of the newspaper into inch-wide strips.In a bowl, create a mixture of thin white glue and water.Scrunch up sheets of the remaining newspaper, submerge it in the glue mixture and stick it on to the cardboard around the base of the bottle. Continue to use scrunched-up newspaper to build up the volcano around the sides of the drinks bottle. Next, dip strips of newspaper into the glue mixture and lay them on the top of each other, covering the scrunched-up paper, from the bottle opening to the cardboard base.Add several layers of torn paper until the shape resembles a volcano. Leave to dry for at least 24 hours. Once the paper mache is completely dry, use paint to decorate the volcano. Optionally, use little toy dinosaurs or foliage to make the volcano look more realistic.

SCIENCE BOB MAKE YOUR OWN VOLCANO. https://sciencebob.com/make-your-own-volcano/ A VOLCANO is produced over thousands of years as heat a pressure build up. That aspect of a volcano is very difficult to recreate in a home experiment. However this volcano will give you an idea of what it might look like when a volcano erupts flowing lava. This is a classic experiment in which a CHEMICAL reaction can create the

appearance of a PHYSICAL volcano eruption. You should look at pictures of volcanoes to be familiar with the different types. (A SHIELD volcano, for example is the most common kind of volcano, and yet few people know about them) The reaction will bubble up and flow down the side like a real volcano (only much faster!) Look for videos of volcanoes erupting and be sure that you understand how heat and pressure work to really make volcanoes erupt.

Bridges Challenge - Students learn about civil engineering, bridge design, and the transportation needs of society. Students are challenged to design bridges that hold the class pet, Harry, Harry's car, and Harry's luggage. The luggage is defined by how many pennies the bridge can hold. Student results are graphed and analyzed.

VIDEOS

- Sci Show Kids Solve Problems, Be an Engineer
- Sci Show Kids What Makes Bridges so Strong?

PAPER BRIDGES SCIENTIFIC AMERICAN https://www.scientificamerican.com/article/paper-bridges/ Have you ever walked, ridden your bike or driven in a car over a long bridge? Bridges have to be sturdy enough to support the weight of many people and cars without collapsing. One important part of designing a bridge is selecting the right materials. Another is making sure those materials comprising it are shaped in a way to make them strongest. In this project you will build a simple "bridge" using materials you already have on hand—paper and tape! Can you build a miniature bridge that doesn't collapse?

TEACHENGINEERING.ORG STRAW BRIDGES A HANDS ON ACTIVITY. ttps://www.teachengineering.org/activities /view/cub_brid_lesson01_activity2. Working as engineering teams, students design and create model bridges using plastic drinking straws and tape as their construction materials. Their goal is to build the strongest bridge with a truss pattern of their own design, while meeting the design criteria and constraints. They experiment with different geometric shapes and determine how shapes affect the strength of materials. Let the competition begin!

Musical Instruments Challenge. Students learn about sound, noise, music, vibrations, waves, wave pitch, vibrations, and wave amplitude. Students act as acoustic engineers and design instruments such as kazoos, drums, pan pipes, guitars, maracas, and tambourines.

BOOKS

Making musical Instruments with Kids, Bart Hopkin

VIDEOS

- Sci Show Kids What is Sound
- Brainpop Jr. Sound

PEEP MAKE A KAZOO.
http://peepandthebigwideworld.com/en/educators/curriculum/family-child-care-educators/sound/activity/guided-activity/61/make-a-kazoo/

EDUCATION.COM TOILET PAPER TUBE MARACAS.
https://www.education.com/activity/article/toilet-paper-roll-maracas/

INSTRUCTIBLES - RAINY DAY TISSUE BOX GUITAR.
http://www.instructables.com/id/Make-a-Rainy-Day-Tissue-Box-Guitar!---Great-for-Ki/

WIKIHOW - 3 WAYS TO MAKE A HOMEMADE DRUM. https://www.wikihow.com/Make-a-Homemade-Drum

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.