Tennessee 4-H Youth Development

Sun S'mores

Understanding the Engineering Design Process

Skill Level
Beginner, Intermediate, Advanced

Learner Outcomes
The learner will be able to:

- Understand the steps of the engineering design process.
- Use the steps of the engineering design process to design a solar oven.
- Understand the importance of prototyping and revising designs.

Educational Standard(s) Supported
4.ETS2.2
5ETS.1
5.ETS.2
5.ETS.3
6.ETS1.2

Success Indicator
Learners will be successful if they:

- Construct a solar oven.
- Effectively cook a s'more.

Time Needed
45 Minutes—1 Hour

Materials List
Student handout, two per student
Per Group:

- Cardboard box with attached lid
- Aluminum foil
- Clear plastic wrap
- Glue
- Tape
- Stick Ruler
- Box Cutter
- S'mores materials (Marshmallows, graham crackers, chocolate, napkins)

Introduction to Content

In this lesson, students will take part in a hands-on activity that challenges them to use the engineering design process. This lesson presents students with a problem, and then asks them to work as a group to determine the best plan for solving that problem. In this lesson, the problem is that students need to construct an oven that is strictly powered by solar energy.

Introduction to Methodology

The lesson begins by assessing students' prior knowledge related to the engineering design process, and then moves to the experience. In this section, students are presented with the problem of needing to construct an oven powered by solar power. Students then work through each of the steps of the engineering design process and work as a team to construct their oven.

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Terms and Concepts Introduction

- Engineering Design Process — The process of gathering information, designing, building, testing and improving a prototype that meets a specific need.

Tips for Engagement

As students design and construct their solar ovens, rotate around the groups to offer advice or guidance as needed.

Setting the Stage and Opening Questions

Say, **"Today, we are going to put on our engineer hats. Everyone find a partner."** After the students find a partner, pass out the index card set, and say, **"You have a set of index cards in front of you. On each card is one step of the engineering design process. With your partner, put the cards in order of the steps starting with what you believe to be the first step in the engineering design process, then the second step, and so on. After you place the cards in what you believe is the correct order, write down one example of how you use that step in your daily lives."**

Allow the students to work to put the steps in order and write their examples. Ask the pairs to share their order with the class and their examples. Correct any misconceptions that the students shared.

Say to the students, **"Today, we are going to be working with the engineering design process. By the end of class today, you will be able to understand the steps of the engineering design process, and use those to construct a prototype. You'll also understand the importance of prototyping and testing those designs."**

Experience

Say to the students, **"Now, everyone take your engineering hats out and put them on. You all have been tasked by NASA with a very important design project. You are to construct an oven that is completely solar powered. The oven will serve a very important task on future NASA missions. It will be used to cook s'mores ... on Mars. As a contractor for NASA, it will be critical for you to document your design process so your oven can be recreated by astronauts on Mars. The steps of the engineering design process are:**

1. **Explore — Gather information on other designs and identify the materials needed to make your design work.**
2. **Design — Draw out your design and have a solid plan before you move to the next step.**
3. **Create — This is where you will build your prototype.**
4. **Try it out — Test your design! Make notes of what worked well and what did not.**
5. **Make it better — Using what you found in the Try It Out Section, revise your design and try it out again. After all, the engineering design process is a *process.***

In just a minute, you will form your engineering groups and have 30 minutes to work through the design process. Remember, take very good notes. The future of s'mores on Mars is depending on you."

Form student groups of two to three, pass out the materials, and let students work on their designs.

Share

Allow students to test the efficiency of their ovens by making s'mores. When the students have completed this task, ask them to reflect on two improvements they can make to their ovens and share those ideas with the class.

Process

After students have completed their designs and tested their efficiency, ask each group to share with the class what makes their design unique. Examples of these traits could be multiple reflecting panels or a larger surface area to cook more s'mores.

Generalize

Ask students the following questions:

- **"What do you think are the most important things to consider when working on a design problem?"**
- **"What are some ways that you can use the design process in your everyday life?"**

Apply

Say to the students, **"Now that you have a firm understanding of the design process, let me present you with a new challenge. You have been tasked with designing a new space shuttle. The design should be fairly simple and easy to construct. Work through the first three steps, and then define how you would test that design."**

Allow students to complete this process, and then ask the students to share their designs with the class.

Adapted from: NASA Making Sun S'mores Lesson Plan

Life Skill(s) from TIPPs for 4-H

4th Grade

See the perspective of others and their value by summarizing others' points of view. (Hands)
Gather relevant information for decision-making. (Hands)
Communicate information effectively about a given topic. (Hands)

5th Grade

Define issues of a given problem or situation. (Hands)
Speak clearly and effectively in group settings. (Hands)
As part of a group, identify and agree on a common task (set a goal). (Hands)
Divide a team task by identifying contributions by each person. (Hands)

6th Grade

Understand the meaning of information. (Head thinking)
Understand the methods and skills for learning. (Head thinking)
Use the senses to gain new information or find new ways to use information. (Head thinking)
Identify/clearly define a problem or situation. (Head thinking)
Identify the parts, steps, and necessary sequence or order to achieve a goal. (Head thinking)
Make an action plan to achieve a goal. (Head thinking)
Follow a plan to achieve a goal. (Head thinking)
Use basic reading, writing, arithmetic, and mathematical skills. (Hands working)
Accept responsibility for one's part of a shared task. (Hands working)
Make the needed effort to carry out a task or a plan. (Hands working)
Coordinate the interaction to complete the task (work together). (Hands working)

Supplemental Information
Educational Standards Met

4th Grade

4.ETS2.2 Determine the effectiveness of multiple solutions to a design problem given the criteria and constraints.

5ETS.1 Research, test, re-test, and communicate a design to solve a problem. 1) Use appropriate measuring tools, simple hand tools, and fasteners to construct a prototype of a new or improved technology.

5.ETS.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

5.ETS.2 Describe how human beings have made tools and machines (X-ray cameras, microscopes, satellites, computers) to observe and do things that they could not otherwise sense or do at all, or as quickly or efficiently.

5.ETS.3 Describe how failure provides valuable information toward finding a solution.

5.ETS.3 Identify how scientific discoveries lead to new and improved technologies.

6.ETS1.2 Design and test different solutions that impact energy transfer.