Grade Level: 6 (6-8) Time Required: Two 70 minute lessons

Keywords: engineering process, problem solving, design, prototype

"Engineering Design and Problem Solving: Prototyping a Bird Beak"

Angel Chukwu

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Summary:

In these lessons, students will learn about the engineering process and its application in basic problem solving. The end goal of this teaching module is for students to design a functioning bird beak out of given materials after completing background research. Participating in this activity will allow students to become familiar with basic ideas of engineering.

Learning Objectives:

Upon completion of this teaching module, students will:

- Understand the general principles of the engineering process
- Improve on critical thinking and problem solving skills
- Understand the importance of working in a team environment
- Be able to describe the purpose of research in the engineering process
- Create a physical prototype from the given materials

Lesson Plan: The lesson plan can be completed in two 70-minute class sessions. The first session will serve as an introduction to the engineering process and the second will allow students to apply the information that they have learned and researched to design a model to test.

Lesson 1 – The Engineering Process

Time: 70 minutes
Materials:
Videos:

- *What's an Engineer? Crash Course Kids #12.1:* https://www.youtube.com/watch?v=owHF9iLyxic&list=PLhz12vamHOnZ4ZDC0dS6C9HRN5Qrm0jHO&index=1
- *The Engineering Process: Crash Course Kids #12.2:* https://www.youtube.com/watch?v=fxJWin195kU&list=PLhz12vamHOnZ4ZDC0dS6C9HRN5Qrm0jHO&index=2
- *What Bird? The Ultimate Bird Guide (Brows birds by bill shape):* http://www.whatbird.com/browse/attribute/birds_na_147/102/Bill%20Shape/
- Connection Video, *Beauty and the Beak:* *https://vimeo.com/15184546*

Connection (15 min): Ask students to list the names of as many engineers as they can think of. Then, ask students to describe what an engineer does for work, and explain that engineers gather information to effectively solve problems, if necessary show students the Crash Course Kids Video *What's an Engineer?* Finally, ask students if they can properly list the steps that engineers take to design solutions to these problems.

Lecture (20 min): Begin the lecture by explaining the steps of the engineering process, as listed below:

1. Define the problem
2. Research background information
3. Develop an alternate solution
4. Design the alternate solution
5. Prototype the alternate solution
6. Test the prototype
7. Evaluate the alternate solution

Make sure explaining the importance of each step. See the Crash Course Kids video *The Engineering Process* as a resource to explain the concept to students. Next, introduce a problem for students to solve: design a prototype of a bird beak to carry the most materials possible. Students should be told that they will follow the engineering process, so preliminary research is necessary. Students will be broken into groups of 3-4, and will be able to research different types of bird beaks to determine the type of beak they want to design.

Activity (25 min): Have groups break up and perform internet research to plan the design of their bird beaks using the database website provided. Let students know beforehand what materials will be provided to them to build the prototype and what this prototype will have to pick up. Encourage students to think critically and creatively about how they will design their bird beaks. (See materials in Lesson 2 below).

Discussion (10 min): Have an open class discussion about what students have learned during the lesson. Recap Questions: What does an engineer do? What did you learn from your research?

Lesson 2 – Designing a Functional Bird's Beak

Time: 70 minutes
Materials:

- Station 1 (building materials): tape, popsicle sticks, pipe cleaners, plastic cutlery, rubber bands, recycled cardboard, scissors
- Station 2 (testing materials): 3-5 containers for different materials, sand, marshmallows, macaroni noodles, marbles
- Videos:
    - *Defining Success: Crash Course Kids #18.2 - https://www.youtube.com/watch?v=XyFUqFQfl30&list=PLhz12vamHOnZ4ZDC0dS6C9HRN5Qrm0jHO&index=4*

- *Got Some Solutions? : Crash Course Kids #26.1* - *https://www.youtube.com/watch?v=WGESd7O4_Uk&index=5&list=PLhz12vamHOnZ4ZDC0dS6C9HRN5Qrm0jHO*

Connection (10 min): Remind students of the previous lesson, and that they will be using the designs from previous research to construct their bird beak prototypes with the materials available to them. If necessary, use the provided Crash Course Kids videos to refresh the memories of students.

Activity (50 min): Allow students to break up into their groups and begin constructing their bird beak models. Be sure to facilitate the process and answer any questions students may have about their prototypes. As student groups finish their beak models, allow them to go to Station 2 to test the effectiveness of their beaks by trying to scoop the given materials using only the model they created (no extra hands!). If students feel their design is not working, allow them to go back to their tables to refine their designs to try again.

Discussion (10 min): Watch *Crash Course Kids* videos and ask students a series of debriefing questions about the activity and the engineering process.

- How did your research help you design your beak?
- Does your design require a lot of work to pick up materials?
- Could your beak crush the food?
- If you had to re-design your beak, how did you change it?
- What was helpful about working with a team?
- What would you do differently if you knew what you know now?

Wisconsin academic standards covered in this lesson plan:

- ENG2.a Analyze the attributes of engineering design
- ENG2.b Describe and apply engineering design
- ENG4.a Research the background information of a proposed design
- ENG4.b Design Solutions based on gathered information
- ENG4.c Evaluate completed solutions and provide feedback