Minnow Madness

Subject Area(s) Problem Solving

Associated Unit None

Associated Lesson None

Activity Title Minnow Madness

Grade Level 3 (3-5)

Time Required ~30-40 minutes day/9 days

Group Size 4-5 groups, 2-4 students per group

Expendable Cost per Group US $6

Summary
Students will create their own minnow trap while working through the engineering design process of creating a prototype, troubleshooting, and improving until reaching a final product. They will learn about the teamwork and communication skills necessary to complete these tasks, and the attention to detail necessary to create a successful model.

Engineering Connection
To create a successful model of a natural habitat, it is important to ensure the correct species are used. Students must design a trap with the proper dimensions and entryway to trap minnows.

Engineering Category = 2
Engineering analysis or partial design

Keywords
Prototype
Design
Troubleshoot
Improve
Communicate

Educational Standards (List 2-4)

ITEEA
C. Troubleshooting is a way of finding out why something does not work so that it can be fixed.

State STEM Standards (Florida)
SC.3.N.1.3

Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.

SC.3.N.1.4
Recognize the importance of communication among scientists.

NGSS
3-5-ETS1-1 Engineering Design
Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-3 Engineering Design
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Learning Objectives
After this activity, students should be able to identify the importance of creating multiple prototypes and troubleshooting to create a successful design.

Materials List
Each group needs:
- One lab notebook per person (attachment 1)

To share with the entire class:
- One minnow trap
- One ten gallon tank
- 30 minnows
- “Mini pellet” type fish food
- Tank filter
- 6 plastic bins with openings
- 6 small foldable silicone bowls
- 6 mesh bags
- 6 mesh cups
- 100 closing clips

Introduction / Motivation

1. Ask students the following questions:
   What is an engineer? What does an engineer do?

2. Have students turn and talk to share their answers to these questions.

As a whole group, create a bubble map addressing the essential questions using student responses

3. Watch Crash Course https://www.youtube.com/watch?v=owHF9iLyxic
Have students turn and talk to brainstorm a list of things they know that could have been designed by an engineer, compiling them into a class list.

Vocabulary / Definitions

Word	Definition
Minnow	A small freshwater fish.
Design	Creating something with features that make it perfect for a specific job.
Prototype	A first test of something, like a rough draft.
Troubleshoot	Asking questions and testing different parts of something to see what can be made better.

Lesson Background & Concepts for Teachers

The purpose of this lesson is to present students with an authentic engineering design challenge and assist them in designing a product that will be a viable solution. After examining a minnow trap and discussing its flaws, students will create and test a prototype through 3 trials. They will compare data collected on minnows caught and compare results to draw conclusions about which design features are most successful. They will also work with other groups and students within their groups to collaborate and refine their ideas, simulating how engineers work together in the lab. By collecting data on the minnows they catch, they will also be able to compare the different prototypes and select the most effective one based on their records.

Traps like the ones students will construct are similar in concept to the ones employed by the Whitney Laboratory for Marine Bioscience, a University of Florida campus in St. Augustine, Florida. These traps are used by researchers emulating habitats in a meso and microcosms, scaled down but accurate replicas of a habitat that allow the scientist to manipulate variables and view the effects on the plants and animals that would live in this habitat in an authentic way. It is important to select species of the appropriate species and size, and minnow traps are integral to ensure that the species selected fit these parameters - i.e. small enough to avoid catching hermit crabs and eels, but big enough that minnows can enter.

Procedure

Day 2

1. **Before the Activity**

Prepare anchor chart paper

2. **With the Students**
    1. Review why an engineer creates:
        a. What have you learned about engineers?
        b. Why does an engineer create things?

2. Watch Crash Course Engineering Process
https://www.youtube.com/watch?v=fxJWin195kU

3. Have students brainstorm at their table groups a list of problems an engineer might try to solve

4. Rewatch the video, pausing at relevant moments to create an anchor chart of the steps in the design process. Keep the chart on display throughout the lesson.

Day 3

3. **Before the Activity**

Print and prepare lab notebooks - 1 per student.

4. **With the Students**

Tell students we will return to their list of problems an engineer might solve. Tell them that “like real scientists, we will compare results.” Have table groups pair up to compare their lists of problems and discuss why an engineer might solve them.

Using illustrations and words, students will fill in the sequencing chart on page 2 individually to show how an engineer could use the design process to solve their problem.

Tell students that “now we will communicate with other scientists to receive feedback on our work.” With their shoulder partner, students will critique each others’ sequencing charts. Now, “like real scientists they will edit their work” and refine the sequencing charts.

Day 4

5. **Before the Activity**
Ensure students all have their lab notebooks in the classroom.
Gather paper and a marker to create an anchor chart.

6. **With the Students**
    1. Ask students if they have ever created a model of something. Create a circle map about models. Ask them why they created a model, how did it help them show something? Guide students’ discussion and responses to show the idea that a model can be used to represent something that we can’t bring into our classroom - i.e. a model car can be helpful for us to understand what a car is, where the wheels are, how the axel looks without really having a car in our classroom. We can more easily study the parts when we can hold it in our hand. Record student responses within the circle map.
    2. Show students the powerpoint (attachment 2) explaining how minnow traps are used in the Whitney Lab and how minnows are important to research. Present the problem that occurred: no minnows were caught in our traps! Ask students to

suggest a possible solution, guiding discussion to the idea of designing a better minnow trap.
3. Review the steps of the engineering design process using the sequencing charts created on page 2. Direct students to create a drawing on page 3 that shows what the minnow trap they design may look like.

Day 5

7. **Before the Activity**
   Gather and display closing clips, plastic bins, silicone bowls, mesh bags, and mesh cups as well as the minnow trap, and images of other commercially available minnow traps (attachment 3) as well as anchor chart paper and a marker.
8. **With the Students**
   1. Show students the minnow trap and ask what they notice about it. List the features they see. Now list features of the other traps. Ask what students notice are alike and different. Ask what they think may have helped them or stopped them from catching minnows.
   2. Direct students to the materials on display. Explain that they have constraints and the definition of constraints. Like real engineers, they have specific materials to use. Ask why they may have been chosen (suggested responses: cost effective, safe for the environment, small enough to catch minnows)
   3. Tell students they will begin constructing their prototype. Read aloud the constraints on page 4 and have student groups complete the planning sheet on page 4 to design their prototype.

Day 6

9. **Before the Activity**
   Gather and display closing clips, plastic bins, silicone bowls, mesh bags, and mesh cups. Display all anchor charts created.
10. **With the Students**
    1. From their planning sheet, students will begin constructing their prototypes. Before allowing students to come one at a time to gather their materials, remind them of group norms and safety practices because like real engineers it is important to handle materials properly to ensure everyone's safety.
    2. Students will select materials and begin construction. Utilize the duration of the science block for the construction of traps. Remind students to only use materials they have allotted for in their planning sheets, because engineers must have a rationale for their choices and accurate documentation of their planning.
    3. Throughout the rest of the day, students will place their traps in the tank for one 30 minute interval per group (as schedule permits, but be careful to ensure no trap gets more than 5 more minutes than another). Students will count the number of minnows in the trap, record in the notebook, release, and pull trap and another group then places theirs.

Day 7-8

11. Before the Activity

Ensure fish are all in good health. Display remaining building materials.

12. With the Students

1. Have students share out from their lab notebooks how many minnows were caught, and show their prototype to the class. Ask students what was the most common shape of trap, were most traps soft or hard, were most traps bigger or smaller. Now ask which shape caught the most minnows, did a soft or hard trap catch more minnows, and did a bigger or smaller trap catch more minnows. Ask if a trap with a big entryway or small entryway caught more minnows.
2. Have students complete the reflection sheet on page 5 (day 7) or page 6 (day 8). Direct lab groups to discuss what could be improved, and remind them that they are collaborating to make the product better like real engineers. Have them complete the list of improvements on page 5 (day 7) or page 6 (day 8) and work to improve their prototypes until the end of the block, repeating the procedure from Day 5 for testing and recording.

Day 9

13. Before the Activity

Prepare poster paper for each group. Project directions (attachment 4)

14. With the Students

1. Tell students that they will now communicate their results through creation of a poster to promote their minnow trap and offer it for sale to companies to buy and use for research. Remind students to use the data they collected: how many minnows can it catch? What is new and exciting about it? Is it small and easy to carry around? Does it use very few materials, making it inexpensive? (30 minutes)
2. Have students complete the final sequencing chart independently to show their process in creating their minnow trap (page 9). (10 minutes)

Attachments

1. Lab notebook
2. Minnow trap powerpoint

Safety Issues

- Staples, scissors, and binding clips can have sharp edges. Younger students may need assistance or teacher direction in using these materials.

Troubleshooting Tips

1. Students should be reminded frequently that design materials are a constraint. Many of my students wanted to use materials that I was not providing, and it is important to help them preserve their ideas while adapting them to the classroom materials. I encouraged my students to examine the materials they *wanted,* and how they could use something similar in the class. For instance, two students wanted a triangular shape that was not one of our materials. So, they cut up two other materials to make a triangular shape.

Assessment

15. Pre-Activity Assessment

Descriptive Title: Design Steps Sequencing Chart (lab notebook)

16. Activity Embedded Assessment

Descriptive Title: Reflect Questions (lab notebook)

17. Post-Activity Assessment

Descriptive Title: Post-Design Steps Sequencing Chart (lab notebook)

Activity Extensions

Students may be permitted to bring clean recyclable materials from home to use in their second and/or third trial - examples are washed and empty milk cartons, margarine tubs, soda bottles, etc.

Activity Scaling

- For lower grades, a class minnow trap may be constructed based on many different prototype drawings as opposed to each group submitting a prototype and building. This way, the class still participates and has their idea included in the synthesis but allows for a more controlled design process with less materials being handled.
- For higher grades, students may create an independent trap as well as submitting a budget with their proposal.

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