STEM TOOLKIT ACTIVITY

Catapult

SOCIAL-EMOTIONAL CONNECTION: Insulation GRADES: 5th TIME: 90 Minutes

INSTRUCTOR EXPERIENCE: Beginner

OBJECTIVES: To develop a sense of competence and usefulness through building something to solve a problem.

ESSENTIAL QUESTION: How can we solve problems?

MATERIALS:

- Book- Be a Maker
- I Can Make Handout
- Design Process Guide
- Computer
- Projector
- Craft Sticks
- Rubber Bands
- Pom Pom

STANDARDS: VA STEM 5.1a-f;5.2a,b, and c

SCIENTIFIC AND ENGINEERING PRACTICES:

5.2b: make observations to provide evidence that energy can be transferred from place to place through contact between objects

5.2c: apply scientific ideas to design, test, and refine a device that converts energy from one form to another

Lesson delivery note: This lesson is designed to take approximately 90 minutes. Adapt the lesson to fit the amount of available time.

INSTRUCTIONS

1. Ask (5 minutes)

   Introduce the activity to students by writing, “How can we solve problems?” on the board. Have students write their thoughts down on a piece of notebook paper.

   Provide time for students to write down their thoughts and then have several students share what they have written down.

2. Research (15 minutes)

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Read the book titled, “Be a Maker”.
Hold up the book and ask students to join you for a whole group read aloud.

- Preview the book by showing the cover and a few images.
- Ask students how they think the characters in the book will solve problems.
- Tell students that they’ll learn about what people can make in a day—from small to large—and after reading, explain they are going to make things just like the characters in the book.
- Read the story aloud, pausing periodically to ask students:
    - Would you like to make this?
    - Why do you think the character(s) is making this/these?
    - Is this solving a problem or helping people? If the answer is yes, what problem is it solving or who is it helping?
- Once the story is finished, revisit the question, “How can we solve problems?”
    - identify some problems the characters in the book solved or tried to solve.
    - Ask how the characters in the book solved these problems and if there would be additional ways to solve the same problem.

3. Connect to Careers (10 minutes)

Help students understand careers that may be related to making a catapult. Tell students there are numerous careers that might perform work designing complex machines including:

- Mechanical Engineers article-explains various skills needed in this career
- A Day in the Life of a Mechanical Engineer video for children
- Mechanical Engineering Crash Course video for children

Have a class discussion about the skills or qualifications a person would need for these careers. Expand on the discussion by asking students how they already use some of those skills every day in school or at home.

4. Tinker to Discover (10 minutes)

Distribute “I Can Make” handouts to students and explain that it’s their turn now to make something.

- Have students brainstorm items they can make in the box on the handout. They can use items from “Be a Maker” or come up with their own ideas.
- Then, have students finish the sentence at the bottom of the page (“I can make...”) and share it with a friend.
- Ask students if any of them wrote something on their handout that solves a problem. If so, have them share what they wrote and the problem(s) it solves.
- On the back of the “Be a Maker” handout, allow students to brainstorm ideas on how to make the catapult after showing them the parts they have to work with from the kit.

5. Build a Prototype (15 minutes)

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Next, introduce the four types of energy to students by providing definitions. These are:

- **Potential energy** - Stored energy.
- **Gravitational energy** - A form of potential energy depending on how far away the object is from the ground.
- **Kinetic energy** - Energy of an object in motion.
- **Mechanical energy** - The sum of kinetic and potential energy.

- Once students have brainstormed solutions and discussed the different types of energy, allow them to use the materials from the kit to create their catapult
    1. Stack 6 craft sticks and tie a rubber band tightly around one end.
    2. Tie another rubber band tightly around the opposite end so all 6 sticks are bound together.
    3. Take the remaining 2 sticks and tie a rubber band on one of the ends. Try to tie the band close to the edge to the sticks.
    4. Insert the 6 sticks banded together through the 2-stick bundle as shown in the catapult link.
    5. Tie a rubber band in a cross fashion joining the two pieces. The closer the 6-stick bundle gets to the edge, the more leverage the catapult will have.
    6. Use the double-sided foam to adhere the plastic egg bottom to the end of the catapult as shown in the catapult link.

6. Test & Improve (15 minutes)

Have stations set up around the room to test the accuracy and distance the catapult launches an object.

Tell students to perform tests in this order:

1) Record the distance of an object launched from the catapult
2) Record the accuracy of an object launched from the catapult by launching the object 3 times at a target.

Set a timer for 10 minutes. Have students test their catapult and record the results on their instruction sheet.

Set another timer for 15 minutes for students to review their results, make improvements and retest their designs. When students re-test, they should record the results again.

7. Discuss and Reflect (10 minutes)

After the tests, have students review the data from each test (before and after improvements were made) and make observations about how their catapult performed. Facilitate a class discussion by talking about the following questions:

1. What type of simple machine is the catapult? How do you know?

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- A catapult is a simple machine called a lever. A lever changes the distribution of the weight, as seen in the catapult, as the weight is moved from the object being launched to the fulcrum, where the craft sticks are banded together. The weight is pivoted to send the object flying.

2. What are the different parts of this lever?
    - The fulcrum is a pivot point which moves the load. The weight, or load, is the object that you are trying to move (or fling) with the lever. The force is the pressure applied to the end of the craft stick.
3. What class lever is this? Why?
    - This catapult is a Class 1 Lever as the pivot is located between the effort and the load. In this case, the pivot is where the small, rubber-banded craft sticks meet the large craft sticks. The pivot allows the force from pressing on the craft stick to be transferred to the object, causing it to fly off the catapult.
4. How does this simple machine perform work? How does it make work easier?
    - A lever reduces the amount of force needed to lift an object, or in this case fling an object. A lever can do this by converting a small amount of force (pressing down on the craft stick) into potential energy. When you let go of the craft stick, the force is converted to kinetic energy, sending the object flying. The more force that is converted, causes more force to be applied on the object (and the further it flies!).

EXTENSION ACTIVITIES

- Allow students to make various versions of the catapult. Students can then test the best design by determining which catapult launches the object the furthest.
- Students can experiment with the amount of effort, or force, used when pushing down on the end of the catapult. Students can observe the best amount of force to launch further or higher.