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Bruce Museum @ Home
STEAM Activities for Children

Lesson # 6: ***Flinging Flyers***
Week of April 27, 2020

This week's STEAM activity introduces new concepts and reinforces ideas from past lessons as learners continue to fly with another hands-on experiment. Learners will build on their previous weeks' knowledge of force, energy, mass, and inertia by creating and experimenting with catapults.

Your learner will need to use their science journal once again this week. If they haven't made one yet, or if their pages are full, go back to Week 1 for instructions on how to make one.

In order of appearance, this lesson contains: a materials list for Flinging Flyers and a simple art activity, general instructions, ways to add on to the activity, open-ended question ideas, a brief art activity, and NGSS Performance Expectations.

For More Advanced Learners

If this lesson is too simple for your learners, try the **Catapult Challenge**, a digital lesson plan from one of the Museum's educational partners, Engineering Tomorrow. This lesson utilizes many of the same materials and underlying scientific principles as this week's Bruce At Home STEAM lesson, **Flinging Flyers (FF)**, but Catapult Challenge is for an older learning audience. The Engineering Tomorrow lesson will help older learners connect project-based learning with essential engineering concepts. Older learners should follow this link to give it a try.

A tip for adults: *Things are about to fly through the air! Make sure your learners are experimenting in a safe space, where nothing will be broken.*

*The **Materials List** for this activity has three sections, one for materials that can be found in many households, one for materials that you will be upcycling or rescuing from being discarded, and one for an additional art activity. Consider limiting the amount of materials initially used so that your learner doesn't become overwhelmed.*

Household Materials: science journals, paper, pens, pencils, scissors, glue (craft, stick, or hot glue gun), tape (painter's, duct, or electrical), measuring tape.

Upcycled Materials: soda bottle screw tops, tongue depressors, rubber bands, clothespins, wine cork, plastic spoons, cardboard, plastic or paper cups.

Art Materials: White paper, cardboard, colored pencils, crayons or markers, painter's tape, glue stick

Make a Catapult

This week we are going to be making catapults. There are several different styles of catapults: the trebuchet, mangonel, onager, and ballista. The directions in this lesson are for multiple onager style builds, but you can look online for directions for trebuchet, mangonel, and ballista style builds. These tend to be more complicated, and require materials like hot glue.

Catapults work by storing potential energy, in the form of tension, either in twisted ropes or in a flexed piece of wood. The tension in a catapult is similar to that of an archer's bow, but on a larger scale. In the case of our homemade catapults, we will be using rubber bands, the handle of a plastic spoon, and tongue depressors (or other materials) as potential energy storage.

Before you get started, consider reviewing some basic catapult information with your learner.

- Do they know what a catapult is?
    - Catapults are a type of weapon that uses gravity and potential energy to propel a ballast or a projectile, such as a large stone, into the air.
    - Catapults were used to knock down walls and barriers, allowing troops to siege castles, forts, and cities.
    - Traditionally, catapults don't use gunpowder, electricity, or any type of propellant, and instead rely on gravity, tension, and the release of potential energy to propel a payload through the air.
- Who used catapults?
    - The first catapults were used in the 4th century BCE in Asia.
    - Historically, the use of catapults is deeply intertwined with Greek and Roman warfare, as well as Medieval battles.
- Are catapults still in use?
    - An example of a modern-day catapult is the mechanism used to launch planes from aircraft carriers. This link will take you to videos of an aircraft catapult being tested in the Brooklyn Navy Yard.

Terms to review:

Energy: power from the utilization of physical or chemical resources.

Potential Energy: the energy held by an object because of its position relative to other objects, stresses within itself, its electric charge, or other factors.

Kinetic Energy: the energy that it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its stated velocity or speed.

Angle: the space (usually measured in degrees) between two intersecting lines or surfaces at or close to the point where they meet.

There are many different ways of building a catapult using the materials suggested. The links below go to three easy and reliable builds and an additional fourth build that has a more difficult construction method. You may want to consider building one of the simple catapults as a sample for your learner to experiment with.

Basic Popsicle Stick Catapult (simplest)

Plastic Spoon Catapult

Clothespin Catapult

Rolled Paper Catapult (difficult)

Plastic Spoon, Clothespin and Popsicle Stick catapults.

- Ask your learner to look at the materials you've assembled for the project: how would they make a catapult using these items?
    - Learners can use their science journals to create a plan for using the items provided to build a catapult.
    - Limit the amount of materials you provide, it's always possible to add more later, but it can be overwhelming for some learners if there are too many options initially.
- Provide suggestions and guidance to your learner about the elements that a catapult will need.
    - Source of potential energy (pressing down on a spring, pulling a rubber band tight, flexing a plastic spoon handle, etc.)
    - A strong stable base.
    - A basket or cup to hold a projectile.
    - A projectile.
        - A note about projectiles: many of the directions provided suggest a cotton ball as a projectile. In this maker's experience, cotton balls are too light; a chunk of a wine cork or a ball of tinfoil will work better.
- Let your learner loose! They should feel free to experiment with the materials provided, and try as many combinations of materials and structural changes as they want, until they feel ready to try out their catapult.
- Possible tests of a catapult: Popsicle Stick, Plastic Spoon, and Clothespin catapults ready to fire. An improvised trebuchet joins the party
    - Distance (using a tape measure.)
    - Precision (using a target or a precise spot for aiming.)
    - Strength (stack up lightweight objects, like plastic cups, and knock them over.)
- After your learner has completed the testing round, ask them to pull out their science journal again and record their results.
    - Was their catapult successful?
        - In what ways?

- What changes would they make to their design to change the overall outcome of the tests?
- What was the most difficult part about this build?
  - How would they do this part differently or more effectively?
- What else would they like to do to test their catapult?
  - How will they accomplish these tests?

Make a Cardboard Cutout Target:

Your learner may want to test their catapult's strength against a real enemy, like a dragon or a monster! This can be difficult, as dragons and monsters are not real…or are they? With this simple cardboard cutout craft, your learner can create, and defeat, their own monsters over and over again.

Front and back of monster cutout, showing kickstand.

Directions

1. Have your learner draw an outline of the "monster" they want to aim at on a piece of paper.
2. Glue the outline of the monster onto a piece of cardboard at least 1-foot square.
3. Either you, or your learner (depending on their ability level), should cut out the "monster" using the outline as a guide.
   a. Make sure the cardboard isn't too thick to cut.
4. Have your learner color in their monster.
5. Use painter's tape or glue to attach a kickstand onto the back of the outline, made from an additional strip of cardboard at least 3 inches in height and 2-in. wide for stability.
   a. Let the glue dry if you used glue.
6. You have a monster target!

Popsicle Stick, Plastic Spoon, and Clothespin catapults ready to fire. An improvised trebuchet joins the party.

NGSS Performance Expectations

K-PS2-1 Motion and Stability: Forces and Interactions
Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

K-PS2-2 Motion and Stability: Forces and Interactions
Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

2-PS-2 Matter and It Interactions Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

3-PS2-1 Motion and Stability: Forces and Interactions
Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

K-2-ETS1-2 Engineering Design
Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps its function as needed to solve a given problem.

K-2-ETS1-3 Engineering Design
Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

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