Pumpkin Catapult

STEM

Grade Level
4-6

Length of Lesson
2 class periods

(1 day of building, 1 day of testing)

Objective
By the end of this lesson, students will learn more about the design and use of simple machines.

Materials Needed
- Large popsicle sticks
- Rubber bands
- Plastic Bottle Caps
- Hot Glue
- Assorted additional building materials
- Small pumpkin-shaped candy
- Protractors
- Container or bin ("wagon" for challenge)
- Copies of student worksheet

Standards
NGSS
4-PS3; 3-5-ETS1; MS-ETS1-1; MS-PS3-2

Lesson Summary
This lesson is designed to help students learn more about simple machines and provide opportunities to design and test their own pumpkin catapult. Additionally, there is a design for a large catapult made from PVC pipe that will launch small pumpkins up to 40 feet.

Suggested Sequence of Events:
1. Set Up: Teachers may also want to build their own example to inspire students' creations.
2. Read *The Great Pumpkin Smash* by Lori Haskins Houran to capture student interest and introduce the concept of catapults.
3. Read through AITC Pumpkin Ag Mag to learn about pumpkins. Interactive online versions can be found on our website.
4. Watch a short pumpkin harvesting video to show students some of the machines used to harvest processing pumpkins in Illinois. Here is one good example: https://youtu.be/5Ac98DrsKmY
5. Complete the activity following the procedures:
    - Discuss the concept of a catapult and the simple machines used to make a catapult work.
    - Pass out the student worksheets to each student and read the "STEM Challenge" together. Explain that they will be trying to catapult a candy pumpkin into a container.
    - After passing out the necessary building materials have students brainstorm how the pieces work together and then draw a blueprint. They should do this before they start building.
    - Provide students time to build, discuss, and test their creations. *See Background Information on the Teacher Resources page.
    - Complete the STEM Challenge as a class and see whose catapult can launch the candy pumpkin into the wagon!
6. Additionally, the teacher could construct a PVC Pumpkin Catapult and have students experiment with launching small pumpkins outside.
7. Whole class discussion and reflection of activity. Pair students together and have them share their catapult designs with their partner. What variables can be changed to make the pumpkins launch farther?

TEACHER RESOURCES

Background Information:
A part of STEM fields is the testing that takes place behind the scenes! Your students are trying to launch a candy pumpkin into a container placed at a specified distance, determined by you. Students will need to test their catapults to determine the force needed to launch the pumpkin the correct distance. Meaning, what is the best angle or how many posicle sticks need to be stacked for the correct force. They will choose two angles to test and complete three trials for each, then find the average of those trials for each angle. This will help them determine the angle they need for the challenge.

Extension Ideas:
- Have students define the bolded words on their student worksheets.
- Talk about why the pumpkin doesn't stay in the air, what happens to the pumpkin's motion when it hits the ground, and what causes the pumpkin to travel a further distance.
- Add another variable into their tests and have students use objects of different weights to compare results.
- Read "Pick a Pumpkin" by Patricia Toht. Look at the pictures and have students analyze the images.
- Have students write pumpkin facts from the AITC Pumpkin Ag Mag on their catapults.
- Have students create a comic strip including pumpkin facts.
- Watch a time lapse video of a pumpkin growing.
- Watch a video from a local farmer discussing pumpkin growth and harvest.
- Take a field trip to a pumpkin patch and pick your own pumpkins.
- Take a closer look at squash bees and other pollinators. What is pollination? Why is it important for pumpkins?
- Go to agintheclassroom.org to contact your County Literacy Coordinator for free classroom sets of our Ag Mags!

Catapult made with instructions

Catapult designed by a 1st grader

PVC Catapult

Pumpkin Catapult

Student Worksheet

STEM Challenge: There's been a machine breakdown! A farmer needs help getting his pumpkins into the wagon. Can you design and build a *Pumpkin Catapult* to launch those pumpkins into the wagon?

The **distance** and **speed** of the pumpkin is going to depend on the **force** of the machine. The force is determined by how far back your catapult is pulled before releasing.

How will you adjust the force of your catapult?

Look at the materials your teacher has given you for your build. Draw and **label** some possible designs (blueprints) for your catapult in the box below.

STEM

Pumpkin Catapult

Student Worksheet

Time for your **hypothesis**. This should include your ideas on the relationship between force of your catapult and the distance your pumpkin will travel.

My Hypothesis:

Just as scientists and engineers do, you are going to complete a series of tests before trying to get your pumpkin into the wagon! Fill out the information below as you complete your testing trials.

Angle: this is the number of popsicle sticks and/or the angle measured with a protractor.

Distance: this is the amount of space (in inches) measured from the base of the catapult to the spot where your pumpkin ***landed*** – this does NOT include where the pumpkin stops after rolling!

Test 1

Angle of Launch =	
Trial 1	inches
Trial 2	inches
Trial 3	inches

Test 2

Angle of Launch =	
Trial 1	inches
Trial 2	inches
Trial 3	inches

Now, calculate the average distance traveled for each angle you tested.

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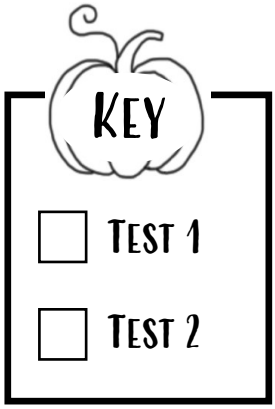
Pumpkin Catapult

Student Worksheet

Use the data you collected to create a visual representation of those measurements! You will need to add the information for the bar graph, and use two different colors to represent the two angle tests you completed. Make sure you label your graph!



Reflection Questions:

1. Why do scientists and engineers revise their original designs? Did you have to revise yours?

2. For this activity, what worked well and what was challenging?

3. Did your catapult work for getting the pumpkin into the wagon? Why or why not?

4. How would adding a heavier or lighter object change the angle needed for making it into the wagon?

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Pumpkin Catapult

Basic Instructions

Materials:

- Seven (7) large popsicle sticks
- Four (4) rubber bands
- Plastic bottle cap
- Hot glue

Follow these steps to build a basic pumpkin catapult:

1. Stack five (5) popsicle sticks together and wrap rubber bands around each end until tight.
2. Stack the remaining two (2) popsicle sticks together and wrap a rubber band around one end until tight.
3. Spread apart the two (2) popsicle sticks on the end opposite the rubber band and insert the stack of five (5) popsicle sticks in between.
4. Push the stack of five (5) sticks down until it reaches the rubber band holding the two (2) popsicle sticks together.
5. Wrap another rubber band around the spot where the two (2) stacks of popsicle sticks meet.
6. Carefully glue a plastic bottle cap to the upper popsicle stick to create a pumpkin basket for your catapult.
7. Allow to dry, then place a candy pumpkin inside the bottle cap.
8. Use your finger to pull down the popsicle stick. Release your finger and see how far your pumpkin flies!

Now that you have built a basic catapult, how can you improve the design? Can you make a more powerful catapult with a new design?

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Pumpkin Catapult

PVC Catapult Instructions

Materials:

- Fourteen (14) feet of 1" diameter PVC pipe
- Five (5) 1" diameter PVC "T" connectors
- Seven (7) 1" diameter PVC 90 degree connectors
- PVC primer and glue (often sold together)
- One (1) bungee cord
- One (1) 3" bolt and nut
- Small plastic container

Tools: Hacksaw or power saw, tape measure, drill and drill bit, permanent marker

Follow these steps to build a PVC pumpkin catapult:

1. Begin by cutting your PVC pipes into the following lengths:
    - Seven (7) 15" long pieces
    - Two (2) 7" long pieces
    - Two (2) 5 1/4" long pieces
    - Two (2) 12" long pieces
    - One (1) 27" long piece (this can be shortened or lengthened to change the catapult's launching ability)
2. Follow the diagram on the following page to attach the pieces of your catapult. **Do NOT use the PVC glue at this time!**
3. Drill a hole through the 90 degree connector on the catapult's throwing arm large enough for your bolt to fit through.
4. Drill a hole through the bottom of your plastic container and then attach using the bolt and nut.
5. Before gluing, you may want to test out your catapult to see if you want a longer or shorter throwing arm. To test, wrap the bungee cord around the throwing arm and attach to the horizontal upright. The more you wrap it, the further your catapult should launch.
6. If you are happy with your throwing arm's ability, it's time to get ready to glue. Before disassembling your catapult, use a permanent marker to mark each pipe and connector union. Draw a straight line across each union. When you glue your pieces together, you will need to make sure you match these lines up again. This is a very important step, as you only get one chance to glue!

Pumpkin Catapult

PVC Catapult Instructions

7. Lay down cardboard to protect your surface from the PVC glue. It is recommended to do the gluing in a well-ventilated area. You should also wear rubber gloves to protect your skin.
8. Unscrew the bottles of PVC primer and glue. You should notice that the lids have brushes attached to them.
9. On each connector, rub the PVC primer brush on the interior where the pipe will be inserted.
10. Then, rub the PVC glue brush on the same spot.
11. Insert the correct PVC pipe, making sure to line up your permanent marker lines as you push the pipe in as far as it will go. Take your time with this step!
12. Continue for each piece until your catapult is reassembled.
13. Let dry thoroughly before using.
14. Students can experiment with this catapult as well. Try pumpkins of different weights and sizes and see if the distance changes. Set up a wagon and see if students can hit it. Try placing the catapult on different inclines to see if the trajectory changes.