Punkin' Chunkin'

Grades 3-5

Subject Areas- Science, STEM

Objectives

Students will design and build prototypes of pumpkin catapults to launch mini pumpkins while exploring the phenomenon of force and energy. Students will measure and record the results of launching the pumpkins to discover the effect of force on the motion of the pumpkin and to predict future motion of the pumpkin. Students will design, test, and revise the catapults based on the measurements while discovering ways to convert energy from one form into another and learning that gravitational force is directed down.

Vocabulary

catapult– an ancient weapon used for throwing large items, typically large rocks
cucurbit– a plant of the gourd family
force– a natural power or effect that is able to change the speed or direction of something
gourd– any one of several types of fruits that have a hard shell and that are used for decoration and not for eating
pumpkin– a large, round, (usually) orange vegetable used as food and sometimes as a decoration

Background

The **pumpkin** is a vegetable, but most pumpkins grown today are sold for decorating and carving. They come in all sizes and shapes, from mini- pumpkins, the size of apples, to giant ones, often weighing over 200 pounds. Pumpkins range in size from less than a pound to over 1,000 pounds. Each year giant pumpkins are judged at the Oklahoma State Fair. In 2018, the winning pumpkin weighed 322 pounds. According to *The Great Pumpkin Commonwealth*, the global body that sets the standards for giant pumpkin growing, a 2018 record-breaking pumpkin weighing in at 2,528 pounds, was grown in New Hampshire. This pumpkin is the largest grown in U.S. history. The *Guinness World Record* for the largest pumpkin ever grown was in 2016 in Belgium, weighing in at 2,624 pounds.

Some pumpkins are gray or pale green, but most are yellow or orange. Some are even white. Pumpkin flowers are large and yellow. Cucumbers, squash, melons, and **gourds** are all related to the great pumpkin. The pumpkin is a member of the **cucurbit** family. The tradition of carving pumpkins at Halloween started with the Irish, but the original jack-o-lanterns were made from turnips. When the Irish immigrated to the U.S., they found pumpkins aplenty, and they were much easier to carve than turnips.

Pumpkins are well known for their use as pie filling and jack-o-lanterns, but some kinds of pumpkins are also grown for cattle to eat. In the fall, pumpkin patches are a popular Agritourism venue in Oklahoma. At pumpkin patches, you can often select your own pumpkin to pick fresh from the vine. Some of these venues have other activities including: pumpkin bowling, pumpkin decorating, and even punkin' chunkin.'

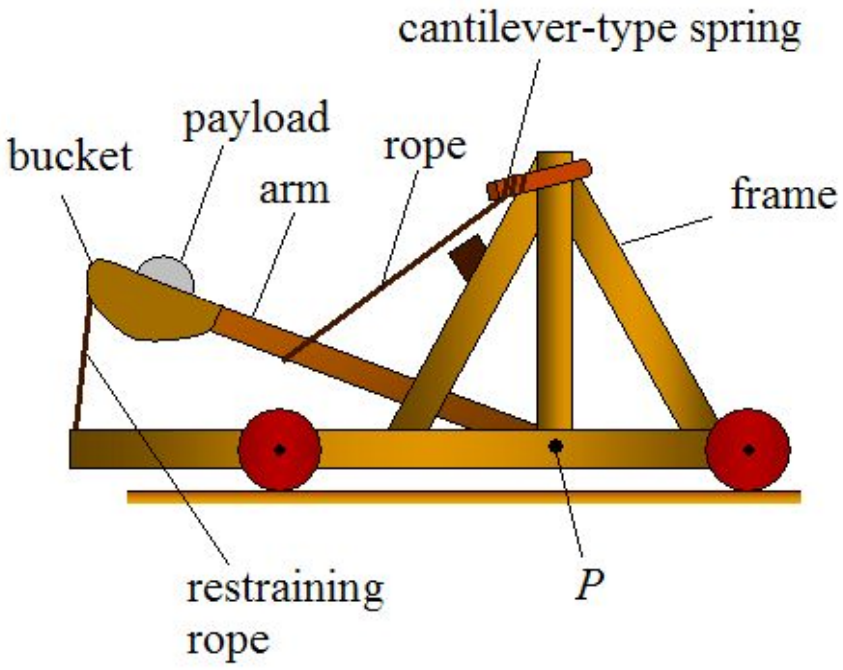
Punkin' Chunkin' (continued)

Punkin' chunkin' competitions exist throughout the United States in the autumn. Each November, *The World Championship Punkin' Chunkin'* is held in Delaware. This is the first and largest annual competition, beginning in 1986. Key rules for this competition include: the pumpkin being launched must weigh between eight and ten pounds; the pumpkin must remain whole after leaving the device until hitting the ground for the chunk to count; and teams have three minutes to launch their pumpkins.

A team of students from the town of Kansas, Oklahoma, entered the *World Championship Punkin' Chunkin'* contest in 2013. They built a 23-foot tall trebuchet with an 11-foot throwing arm. It was the only one built on a rolling track and not tied down or built on a fixed track. The students named the trebuchet Colossal Thunder and competed in the youth division for 11-17 year old students. Over the course of three days, the team got to launch one pumpkin per day. Their first launch was 1,317 feet, their second was 1,664 feet, and their final launch was 2,402 feet. The previous world record in this age group was 1,526 feet.

However, Oklahomans do not have to travel to Delaware to see pumpkins launched through the air. Vinita, Oklahoma, is home to the *Route 66 Punkin' Chunkin' Festival*, held in October. Participants from all around northeastern Oklahoma build devices, such as **catapults**, for launching pumpkins. If you travel to Hobart, Oklahoma, you can visit the *Pumpkin Palooza & Punkin Chunkin' Festival.*

A catapult uses stored energy, often stored in springs or stretched rubber bands, to launch the pumpkin. The stored energy in these catapults transfers to the arm of the catapult and then hurls the pumpkins through the air. **Force**, distance, and accuracy are used to determine the winners in the punkin chunkin' contest. Pumpkins are hurled thousands of feet from air cannons, catapults, and trebuchets. The record for hurling a pumpkin through the air without using explosives or electricity is 4,438 feet.



Additional Reading

White, Linda, *Too Many Pumpkins*, Holiday House, 1996.

Levenson, George, *Pumpkin Circle: The Story of a Garden*, Tricycle Press, 2002.

Toms, Ron L., *The Big Book of Catapult and Trebuchet Plans!*, RLT Industries, Inc, 2010.

Gurstelle, William, *The Art of the Catapult: Build Greek Ballistae, Roman Onagers, English Trebuchets, and More Ancient Artillery,* Chicago Review Press, 2004.

Videos

Oklahoma Horizons: Students from Kansas, Oklahoma Compete in World Championship Pumpkin Chunkin Contest:
https://www.youtube.com/watch?v=7uc2JgNQN0o

Pumpkin Catapult Video from National Geographic:
https://video.nationalgeographic.com/video/00000144-0a40-d3cb-a96c-7b4d462a0000

Pumpkin Catapult with Children
https://www.youtube.com/watch?v=Q44gcKANlow

New Jersey Middle School Students Trebuchet
https://www.youtube.com/watch?v=VbBt4I59tI0

Activity 1: Punkin' Chunkin', (Science, STEM) 3-4 50 minute class period

Students will design and build prototypes of pumpkin catapults to launch mini pumpkins while exploring the phenomenon of force and energy. Students will measure and record the results of launching the pumpkins to discover the effect of force on the motion of the pumpkin and to predict future motion of the pumpkin. Students will design, test, and revise the catapults based on the measurements while discovering ways to convert energy from one form into another and learning that gravitational force is directed down.

Oklahoma Academic Standards

Activity 1: Punkin' Chunkin' (Science, STEM)

3-PS2-1	Plan and conduct investigations on the effects of balanced and unbalanced forces on the motion of an object.
3-PS2-2	Make observations and/or measurements of the object's motion to provide evidence that a pattern can be used to predict future motion.
4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
5-PS2-1	Support an argument that the gravitational force exerted by the Earth is directed down.

Materials:

- craft sticks of varying sizes
- rubber bands, yarn, masking tape, pipe cleaners, etc.
- water bottle caps, condiment cups, spoons, etc. for bucket of catapult
- cool temp hot glue guns
- target (bulls-eye, bowl, solo cup wall, tape line, etc.)
- yardstick, ruler, or tape measure
- pumpkins (candy, foam, plastic, or real mini pumpkins)
- Activity 1 Worksheet 1: Pumpkin Catapult Challenge Design
- Activity 1 Worksheet Set 2: Pumpkin Catapult Launch Distance Trial
- Activity 1 Worksheet Set 2 Pumpkin Catapult Launch Distance Competition
- Activity 1 Worksheet Set 3: Pumpkin Catapult Target Trial
- Activity 1 Worksheet Set 3: Pumpkin Catapult Target Competition
- Activity 1 Worksheet Set 4: Pumpkin Catapult Wall Trial
- Activity 1 Worksheet Set 4: Pumpkin Catapult Wall Competition
- Activity 1 Worksheet 5: Evaluation of Energy, Motion, and Force

Phenomenon of Force and Motion

- This activity will demonstrate the phenomenon of force and motion as the catapult arm is pulled down and released and the pumpkin is launched through the air. Students will be able to see that as the arm of the catapult is pulled down, potential energy is stored. When the arm is released, the potential energy turns into kinetic energy. From the moment the pumpkin leaves the catapult until it falls to the ground or hits the target, its motion is known as projectile motion. The gravitational force of the Earth will pull the pumpkin back down to the ground.

Procedures

1. Begin with the activities listed under "**Engage: How do you chunk a pumpkin?"** section.
2. Then, show at least one of the videos from the "**Explore Pumpkin Catapults**" section.
3. Use the questions in the "**Discuss the Video**" section to assess students understanding of how catapults launch pumpkins.
4. Tell students that they will make a pumpkin catapult using craft sticks, spoons, rubber bands, tape, etc. Use the "**Explain Pumpkin Catapults**" section to make sure students have an understanding of the task.
5. Using "**Activity 1 Worksheet 1: Pumpkin Catapult Challenge Design**" students will design and build prototypes of pumpkin catapults to launch mini pumpkins, using popsicle sticks and other supplies.
6. They will experiment with the catapult by launching mini pumpkins and trying to launch the pumpkin the farthest.
7. Students will measure and record the results of each pumpkin launch to test the catapults on "**Activity 1 Worksheet Set 2: Pumpkin Catapult Launch Distance Trial**."
8. They will then analyze the results to predict the future motion of the pumpkin.
9. Students will revise the catapults based on the measurements in order to build a catapult that will launch the pumpkin the farthest.
10. After they have made revisions, use "**Activity 1 Worksheet Set 2 Pumpkin Catapult Launch Distance Competition**" to record their competition launches.
11. **Extension:** Change the challenge and use "**Activity 1 Worksheet Set 3: Pumpkin Catapult Target Trial**" and "**Activity 1 Worksheet Set 3: Pumpkin Catapult Target Competition**" for a challenge to land the pumpkin on a target. Or use "**Activity 1 Worksheet Set 4: Pumpkin Catapult Wall Trial**" and "**Activity 1 Worksheet Set 4: Pumpkin Catapult Wall Competition**" and challenge students to knock down a solo cup wall.
12. Use "**Activity 1 Worksheet 5: Evaluation of Energy, Motion, and Force**" to evaluate students understanding after launching pumpkins.

Engage: How do you chunk a pumpkin?

Ask students if they have ever chunked a pumpkin. Did they throw it with their arm or did they use a device, such as a catapult? Let them share what happened if they have chunked a pumpkin- how far did they chunk it? Did it break when it landed?

Explore Pumpkin Catapults

Watch one of these videos as a class:

Oklahoma Horizons: Students from Kansas, Oklahoma Compete in World Championship Pumpkin Chunkin Contest:
https://www.youtube.com/watch?v=7uc2JgNQN0o

Pumpkin Catapult Video from National Geographic:
https://video.nationalgeographic.com/video/00000144-0a40-d3cb-a96c-7b4d462a0000

Pumpkin Catapult with Children
https://www.youtube.com/watch?v=Q44gcKANlow

New Jersey Middle School Students Trebuchet
https://www.youtube.com/watch?v=VbBt4I59tI0

Discuss the Video

1. What did they notice in the video that made the pumpkin launching successful?
2. What caused the pumpkins not to launch well?
3. How can we design a catapult in the classroom that will launch a pumpkin?

Explain Pumpkin Catapults

- When you pull down the craft stick or pull back the spoon (your lever arm), you add energy to the catapult. This energy is stored in the lever arm as potential, or stored, energy. The catapult uses potential energy stored in a craft stick or spoon as you bend it. When you let go, this stored energy is released, converted into kinetic energy and transferred to the pumpkin, which then flies through the air.
- The position of the lever arm when the pumpkin becomes airborne determines the aim of the pumpkin. Does the amount of energy with which you're pulling down the lever arm factor in as well?
- Do you predict your pumpkin will fly higher and farther when you push your lever arm down farther?
- When you bend your lever arm, you load your lever arm with energy. When you let go, this energy is released and converted to kinetic energy, or energy of motion. Most of this energy transfers to the pumpkin, which launches through the air.
- Pushing the lever arm down farther takes more effort from you. Bending farther means more potential energy gets stored in the lever arm, and when you let go, all this potential energy is converted into kinetic energy, so the pumpkin flies through the air at a higher speed, or with more force. Watch to see if your pumpkin flies higher and farther.

Punkin' Chunkin'

Activity 1 Worksheet 1: Pumpkin Catapult Challenge Design

Name: _____ Date: _____

Punkin' Chunkin' Challenge

You are entering the Punkin' Chunkin' Challenge. You can only use supplies provided/approved by your teacher to build the catapult. The first challenge is to design a pumpkin catapult that will launch your pumpkin farther than anyone else's. The second challenge will be to land in/on a target. The final challenge will be to knock down a solo cup wall.

Begin by drawing a blueprint of your catapult. Label the blueprint to identify what materials will be used to construct the catapult (craft sticks, rubber bands, etc). Label the parts of the catapult (the lever arm, the bucket, etc.)

When you are satisfied with your design, use the supplies to build your pumpkin catapult. Try to build it exactly as you drew it in your blueprint.

Punkin' Chunkin'

Activity 1 Worksheet Set 2: Pumpkin Catapult Launch Distance Trial

Name: _____ Date: _____

Trial Launch Data for Distance

After building your catapult, you need to test it. Remember the goal is to launch your pumpkin the farthest. The purpose of the trial launch is to work out all the "bugs" in your catapult. Each time you launch the pumpkin, analyze the results. Measure the distance your pumpkin traveled through the air and record it on the chart below; do not include the distance it rolled. Use each launch to predict where your next launch will travel- draw inside the box to show the projectile motion of each launch.

TRIAL LAUNCH: DISTANCE PUMPKIN TRAVELED

TRIAL LAUNCH 1	TRIAL LAUNCH 2	TRIAL LAUNCH 3	TRIAL LAUNCH 4

TRIAL LAUNCH: PROJECTILE MOTION OF PUMPKIN AS IT TRAVELED

Did you make sure you placed the catapult in the same place each time? YES NO

How did you increase the distance your pumpkin traveled? _____

_____

_____

Punkin' Chunkin'

Activity 1 Worksheet Set 2: Pumpkin Catapult Launch Competition

Name: _____ Date: _____

Catapult Revisions to Increase Distance

After your trial launches, do you need to revise your catapult to increase the distance the pumpkin will travel? If so, explain what changes you made and how you believe they will increase the distance your pumpkin flies. If no revisions are needed, explain why you are satisfied with your current design.

_____

_____

_____

LAUNCH COMPETITION: DISTANCE PUMPKIN TRAVELED

LAUNCH 1	LAUNCH 2	LAUNCH 3	LAUNCH 4

LAUNCH COMPETITION: PROJECTILE MOTION OF PUMPKIN AS IT TRAVELED

Did you make sure you placed the catapult in the same place each time? YES NO

Were you able to launch your pumpkin farther during the competition? YES NO

Punkin' Chunkin'

Activity 1 Worksheet Set 3: Pumpkin Catapult Target Trial

Name: _____ Date: _____

Trial Launch Data to Land In/On Target

As you test the catapult, remember the goal is to launch your pumpkin so it will land in/on the target. Each time you launch the pumpkin, analyze the results. Measure the distance your pumpkin landed from the center of the target and record it on the chart below. Use each launch to predict where your next launch will travel- draw inside the box to show the projectile motion of each launch.

TRIAL LAUNCH: DISTANCE PUMPKIN LANDED FROM CENTER OF TARGET

TRIAL LAUNCH 1	TRIAL LAUNCH 2	TRIAL LAUNCH 3	TRIAL LAUNCH 4

TRIAL LAUNCH: PROJECTILE MOTION OF PUMPKIN AS IT TRAVELED

Did you make sure you placed the catapult in the same place each time? YES NO

Did you hit the target on any attempt? YES NO If so, which one? 1 2 3 4

How did you adjust the catapult so the pumpkin would land in/on the center of the target?

_____

_____

_____

Punkin' Chunkin'

Activity 1 Worksheet Set 3: Pumpkin Catapult Target Competition

Name: _____ Date: _____

Catapult Revisions to Increase Accuracy

After your trial launches, do you need to revise your catapult to increase the accuracy of the pumpkins landing in relation to the target? If so, explain what changes you made and how you believe they will impact your pumpkins landing. If no revisions are needed, explain why you are satisfied with your current design.

_____

_____

_____

LAUNCH COMPETITION: DISTANCE PUMPKIN LANDED FROM CENTER OF TARGET

LAUNCH 1	LAUNCH 2	LAUNCH 3	LAUNCH 4

LAUNCH COMPETITION: PROJECTILE MOTION OF PUMPKIN AS IT TRAVELED

Did you make sure you placed the catapult in the same place each time? YES NO

Were you able to launch your pumpkin closer to the target during the competition? YES NO

Punkin' Chunkin'

Activity 1 Worksheet Set 4: Pumpkin Catapult Wall Trial

Name: _____ Date: _____

Trial Launch Data to Hit and Knock Down Solo Cup Wall

As you test the catapult, remember the goal is to launch your pumpkin so it will hit the wall and knock it down. Each time you launch the pumpkin, analyze the results. Measure the distance your pumpkin landed from the wall and record it on the chart below. Use each launch to predict where your next launch will travel- draw inside the box to show the projectile motion of each launch.

TRIAL LAUNCH: DISTANCE PUMPKIN LANDED FROM WALL

TRIAL LAUNCH 1	TRIAL LAUNCH 2	TRIAL LAUNCH 3	TRIAL LAUNCH 4

TRIAL LAUNCH: PROJECTILE MOTION OF PUMPKIN AS IT TRAVELED

Did you make sure you placed the catapult in the same place each time? YES NO

Did you knock down the wall on any attempt? YES NO If so, which one? 1 2 3 4

Did you rebuild the wall in the same place each time? YES NO

How did you increase the force with which your pumpkin hit the wall?

_____

_____

Punkin' Chunkin'

Activity 1 Worksheet Set 4: Pumpkin Catapult Wall Competition

Name: _____ Date: _____

Catapult Revisions to Increase Force

After your trial launches, do you need to revise your catapult to increase the accuracy of the pumpkins landing in relation to the wall? Do you need to adjust the force with which the pumpkin hits the wall? If so, explain what changes you made and how you believe they will impact your pumpkin hitting the wall. If no revisions are needed, explain why you are satisfied with your current design.

_____

_____

_____

LAUNCH COMPETITION: DISTANCE PUMPKIN LANDED FROM THE WALL

LAUNCH 1	LAUNCH 2	LAUNCH 3	LAUNCH 4

LAUNCH COMPETITION: PROJECTILE MOTION OF PUMPKIN AS IT TRAVELED

Did you make sure you placed the catapult in the same place each time? **YES** **NO**

Were you able to knock down the wall during the competition? **YES** **NO**

Punkin' Chunkin'

Activity 1 Worksheet 5: Evaluation of Energy, Motion, and Force

Name: _____ Date: _____

What did you notice about how catapults work? _____

_____

_____

_____

How were you able to increase the distance your pumpkin traveled when it was launched? _____

_____

_____

_____

Potential energy is energy that is not yet being used, or energy that is stored. Kinetic energy is the energy of motion, observable as the movement of an object, particle, or set of particles. A pumpkin in motion is using kinetic energy.

What part of the catapult stores the potential energy? At what point did the potential energy change to kinetic energy? Draw your catapult. Label where the potential and kinetic energy occur in the launch.

Explain how the potential energy in your pumpkin changed to kinetic energy.

_____

_____

_____

_____

What variables changed the force of the pumpkin as it was launched?

_____

_____

_____

_____

What force pulled the pumpkin back down to the ground? _____

What challenges did you encounter as you built the catapult and launched the pumpkin?

_____

_____

_____

_____

Punkin' Chunkin'

Activity 1 Worksheet 5: Evaluation of Energy, Motion, and Force ANSWERS

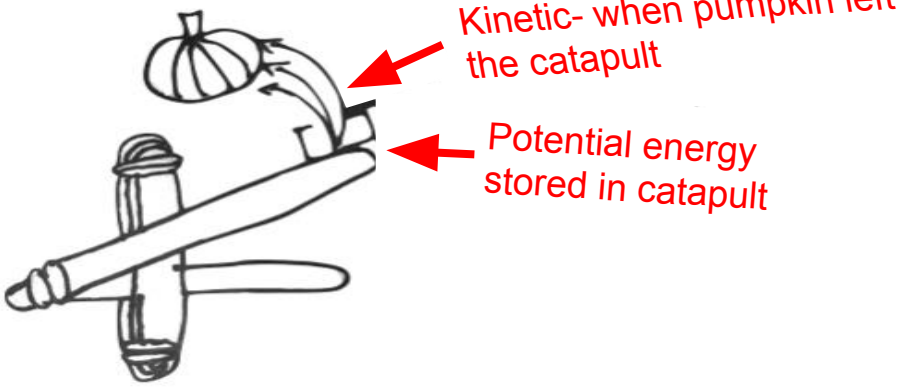
Name: _____ Date: _____

What did you notice about how catapults work? ANSWERS WILL VARY

How were you able to increase the distance your pumpkin traveled when it was launched?
ANSWERS WILL VARY

Potential energy is energy that is not yet being used, or energy that is stored. Kinetic energy is the energy of motion, observable as the movement of an object, particle, or set of particles. A pumpkin in motion is using kinetic energy.

What part of the catapult stores the potential energy? At what point did the potential energy change to kinetic energy? Draw your catapult. Label where the potential and kinetic energy occur in the launch.



Drawings will vary but should illustrate how a catapult uses stored energy, often stored in springs or stretched rubber bands, to launch the pumpkin. The stored energy in these catapults transfers to the arm of the catapult and then hurls the pumpkins through the air.

Explain how the potential energy in your pumpkin changed to kinetic energy.
Answers will vary but should include: When you pull down the craft stick (your lever arm), you add energy to the catapult. This energy is stored in the lever arm. The catapult uses potential energy stored in a craft stick as you bend it. When you let go, stored energy is released, converted into kinetic energy and transferred to the pumpkin.

What variables changed the force of the pumpkin as it was launched?

Answers will vary but should include: How far the lever arm is pushed down, how much it is bent,

What force pulled the pumpkin back down to the ground? Gravity

What challenges did you encounter as you built the catapult and launched the pumpkin?
ANSWERS WILL VARY