

Cannons & Catapults

Overview:

Choose your adventure: Attack or defend the port! Participants will experiment with Engineering and Physics to build a Cannon and/or Catapult.

Goals:

- Build and test a cannon and/or catapult
- Investigate Newton's Laws of Motion
- Observe Energy Transformations

Time Required: 60 minutes

Materials:

- For Cannons (for each person):
 - Toilet paper rolls or pool noodle (cut to about 3" in length)
 - Duct tape
 - Balloon
 - Marshmallows or Pom Poms (for ammunition, if using pool noodles make sure your chosen ammo fits inside the hole in the pool noodle!)
- For Catapults (for each group):
 - Bulldog clips
 - Popsicle Sticks (2 sizes)
 - Bottle Caps
 - Hot Glue and Glue Gun
 - Scissors
 - Marshmallows or Pom Poms (for ammunition)

Vocab: Newton's 3 Laws of Motion, First Law of Thermodynamics, Elastic Energy

Procedure:

1. Decide if you want to build the cannon or catapult. For the cannons, students can work individually. For the catapults, groups of 2 work well.
2. To build a cannon:
 - a. Trim the top off the balloon and tie a knot in the stem end.
 - b. Stretch the balloon over one end of the toilet paper tube / pool noodle. Center it so the knot in the balloon is centered on the hole in the tube/noodle.
 - c. Use duct tape to secure the balloon to the tube/noodle.
 - d. To fire the cannon, load it with a pom pom, then pull back on the knot on the balloon and let it go!



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- e. Our Pom Pom Cannon works thanks to Newton's Laws of Motion:
 - i. 1st Law – An Object at Rest will remain at rest until an outside force acts upon it. Ask: What force is acting on our Pom Pom? (the elastic force from the balloon)
 - ii. 2nd Law – force = mass x acceleration. Ask: What happens with you apply more force (pull the balloon back farther)? What happens if you use a heavier or lighter mass (a marshmallow also makes good ammo)?
 - iii. 3rd Law – For every action there is an equal and opposite reaction. Forces are found in pairs, in this case the balloon pushes the pom pom away, and the pom pom pushes back against the balloon.
 - f. The elastic energy stored in the balloon is transferred to kinetic energy in the pom pom causing it to fly!
3. To build a catapult:
- a. See the directions from the Guinness World Record Marshmallow Catapult – or research other options online. Here is a very simple design:
 - i. Stack 5 jumbo craft sticks together and wrap a rubber band around each end.
 - ii. Take one jumbo craft stick and the spoon, use a rubber band to attach them together at one end.
 - iii. Separate the spoon and the craft stick and insert the stack of 5 craft sticks in between them.
 - iv. Use rubber bands to secure the catapult together.
 - v. Push down on the spoon and release to launch your pom pom!
 - b. The first Law of Thermodynamics states that energy cannot be created or destroyed, only transferred from one form to another. Like with our cannons, the elastic energy in the balloon is transferred to kinetic energy in the pom pom. With our catapult, we see a similar transfer of energy. You use chemical energy stored in your muscles to move the arm of the catapult down, putting potential energy into the clip. When you release the arm, that potential energy is transferred to kinetic energy in the moving arm and to the projectile. Just like with Newton's first Law of Motion, the projectile will remain in motion until other forces (gravity and air resistance) pull it down.

Reflection:

1. Were you successful? Why or why not?
2. What changes could you make to your design?
3. What is another example of one of Newton's Laws?
4. What is another example of an energy transformation?



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Extension / Adaptations:

1. Build the other one!
2. Design and test your own design for a catapult or cannon.
3. Divide the group into 2 groups: one group builds cannons and the other group builds catapults. Set up an area with targets on each side. One side shoots cannons at targets, the other side uses catapults to hit targets. The side to knock down all the other side's targets wins!

Adapted from the following lesson:

McClelland, Sarah. "Pom Pom Shooter Craft for Easy Indoor Fun!" *Little Bins for Little Hands*, 21 Jan. 2023, littlebinsforlittlehands.com/pom-pom-shooter/.

Hsu, Agnes. "Pool Noodle Pom Pom Shooter." *Hello, Wonderful*, 13 July 2020, www.hellowonderful.co/post/pool-noodle-pom-pom-shooter/.

National 4-H Council. "Marshmallow Catapult." *CLOVER by 4-H*, 21 Sept. 2023, 4-h.org/clover/activities/marshmallow-catapult/.

