Big idea
Explore the physics behind a simple machine by building a catapult.

You will need
WHAT WE GAVE YOU:
• jumbo craft sticks
• small craft sticks
• plastic spoons
• rubber bands
• pom poms
• Catapults instruction sheet

Fun options
BEFORE SCIENCE NIGHT
Set up a “castle wall” for participants to destroy! Launch heavier objects, like marbles, into stacks of cups or other lightweight materials. Encourage participants to experiment with the angle of the launch to deal the maximum damage to the castle walls! Then, allow them to build a structure for the next group.

Set it up
Lay out all materials on the table in order: Catapults instruction sheet, small craft sticks, rubber bands, jumbo craft sticks, and spoons. You may want to create multiple building stations, or try an assembly line. It’s a good idea to make your own catapult as an example. This way the students can see the finished product, and you get a chance to make sure you understand the instructions as well as anticipate any issues children may face when building their catapult. The trickiest part for younger children is wrapping the rubber bands, so make sure you have extra help or call on families to help with this step. Or you may want to prep some steps ahead of time to streamline the process.

Make targets for students to hit with their pom poms. Make a variety of targets: some on the wall, some on the floor, some near and some far. Place pom poms in the plastic container and put near the launching area.

It’s showtime!
Show families how your example catapult works: place a pom pom on the spoon and pull back, letting go to launch. The example will help them understand how to make their own catapult.

Help families build their catapult according to the instruction sheet. Younger children may have difficulty wrapping the rubber bands around the ends of the craft sticks. Encourage their adult or an older sibling to help them with this part, and allow the student the chance to count out the supplies they need to build the catapult.

If they love it...
After participants have successfully completed their catapult, encourage them to play and experiment with it by aiming for the targets around the room. They can change the angle of the launch by sliding the fulcrum – the stack of craft sticks. How does this affect their catapult’s launch?
Catapults

Why is this science?
Catapults are a great example of a machine engineered to do work, using a lot less energy and force to complete a task. It uses a simple machine called a lever; in this case, the craft stick that served as the launching arm. The lever was attached to a fulcrum, the stack of smaller craft sticks, and supported the lever. When you pull down the lever, you are providing the force, but the lever magnifies this force, launching the pom pom into the air!

There are two types of energy: potential energy (stored energy) and kinetic energy (energy of motion). In the case of the catapult, you store up potential energy as you pull back the lever. Once you release it and it snaps back into place, the energy that was stored is turned into kinetic energy, launching the pom pom into the air as it travels. What will happen to the pom pom? Newton’s first law of motion says that an object in motion stays in motion, unless an external force is applied to it. In this case, the external force is gravity, which will eventually pull the pom pom back to the ground.

By sliding the fulcrum, participants were changing the amount of potential, and therefore kinetic energy. When the fulcrum is closer to the front of the catapult, more force was needed to pull the lever back, storing up more energy and therefore launching the pom pom a greater distance. When the fulcrum was further back, less energy was stored and so the pom pom couldn’t fly as far.

The levers on catapults were used in ancient and medieval warfare to throw stones to knock down walls. But levers are also found many other places: seesaws, scissors, wheelbarrows, tweezers or brake pedals on cars. Simple machines are all around us!

North Carolina connection
The USS North Carolina was part of history on November 5, 1915 when a plane was launched from a ship by catapult for the first time ever. Naval aviator Henry Mustin used an early catapult system to launch successfully from the ship. At the time, launching a plane from a moving ship had not been attempted. After that risky start in 1915, US aircraft carrier abilities quickly advanced. By 1922, the US operated the USS Langley, an aircraft carrier that could carry 30 planes. Today’s Nimitz supercarriers can carry upwards of 62 aircraft. Still, the Nimitz owes one of its major functions – the use of catapults to launch planes at high enough speeds for flight from a short runway at sea – to Mustin’s original takeoff from the USS North Carolina.

Note: Rather than using levers like the catapult we made, the catapults used on aircraft carriers today use energy from steam to launch the planes.
# Catapults

## Supplies
- 5 small craft sticks
- 4 rubber bands
- 2 jumbo craft sticks
- 1 plastic spoon
- pom poms

## What to do
1. Stack five small craft sticks and wrap a rubber band around each end. This creates the fulcrum.
2. Insert a jumbo craft stick into the base, between the bottom two craft sticks in the fulcrum.
3. Next take the second jumbo craft stick and rubber band it to the other jumbo craft stick. This makes the launching arm.
4. Place the handle end of the spoon under the launching arm rubber band. Then wrap another rubber band around the spoon and launching arm to hold it in place.

## Test your catapult
Place a pom pom on the spoon, pull back the launching arm, and release! How close to the target can you land your pom pom?