



DUKE ENERGY SCIENCE NIGHT

# Galilean Cannon

## Big idea

Use the law of conservation of energy to make your own "Galilean Cannon".

## You will need

### WHAT WE GAVE YOU:

- seismic accelerator (Astro Blaster)
- 3 bouncy balls
- safety glasses
- Galilean Cannon instructions

### STUFF YOU PROVIDE:

- a large area to serve as the launch zone\*
- basketball and tennis ball (see fun options)

## \*Safety notes

This experiment requires adult supervision and an area with a lot of space and high (or no) ceilings.

It may be a good idea to mark the area as a launch zone.

The top ball can shoot off at high speeds; wear the safety glasses when using the seismic accelerator and perform the demonstration away from students.

## Set it up

Mark off an area with plenty of open space - preferably with high ceilings or outdoors. Lay out the instruction sheet. It's a good idea to practice a time or two before the event begins so you will become familiar with the process.

## It's showtime!

As families approach, ask them what happens when they drop a bouncy ball. They'll probably say it falls down, hits the ground, and bounces back into the air. You can demonstrate with one of the bouncy balls. Ask the students to observe that the ball bounces a little bit lower every time. Have them make predictions about what will happen when we try dropping the bouncy ball on top of a stack of other larger balls. Add the bouncy ball to the top of the seismic accelerator, then drop the entire contraption. Stand back - the top ball will shoot higher into the air!

## Fun options

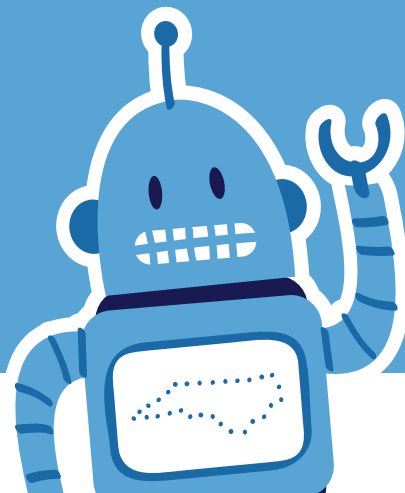
Before using the accelerator and the bouncy ball, demonstrate using a tennis ball to discuss the "law of conservation of energy" discussed on the back. You can then drop the tennis ball on top of a basketball to discuss the "elastic collision" and the Galilean Cannon.

## If they love it...

Set up a mechanism to measure the height of the bounces.

Try this with different types and sizes of balls to see which Galilean Cannon bounces the top ball the highest.

Continued ›



# Galilean Cannon

## Why is this science?

In this experiment, we are using something called the law of conservation of energy, which states that energy cannot ever be created or destroyed, but it can be transformed. When we lift up a ball, we are giving it potential energy - the force of gravity will pull it back towards Earth, so we call this "gravitational potential energy." As the ball falls downwards, the potential energy changes into kinetic (or moving) energy. When the ball hits the ground and bounces back up, that kinetic energy changes back into potential energy. The ball bounces a little bit lower every time because some of the energy is lost to friction, sound, and heat as the ball changes shape when it hits the ground.

When we placed the bouncy ball on top of a stack of balls, we created a Galilean Cannon! When the largest ball hits the ground, it starts bouncing up into the air, but there's a smaller ball in the way. This creates something called an "elastic collision" and energy from the bottom ball is transferred to the next ball. When you stack more than two balls, you can transfer even more energy. This means that the top ball bounces upwards with its own energy plus extra energy from all the balls below it - allowing it to bounce way higher than it normally would!

## North Carolina connection

The NC Science Festival team worked with members of the Department of Physics and Astronomy at the University of North Carolina at Chapel Hill to set the world record for the highest launch from a Galilean Cannon. We used a similar stack of 4 rubber balls (called a "Seismic Accelerator") to transfer all the energy into the smallest ball and designed a special device to help us maximize the results by ensuring the stack dropped perpendicular to the ground so the ball would launch straight up into the air.

When we did this experiment, we were able to launch the ball over 13 meters – or 42 feet!

Do you think you can break that record? Try experimenting with your Galilean cannon and use #NCSciFest to share your results with us on social media!

Learn more about the Guinness World Record:

[www.guinnessworldrecords.com/world-records/428375-highest-launch-from-a-galilean-cannon](http://www.guinnessworldrecords.com/world-records/428375-highest-launch-from-a-galilean-cannon)



PROUDLY PRODUCED BY



# Galilean Cannon

## Supplies

- a stack of balls (known as a seismic accelerator)
- safety glasses

## SAFETY NOTE

In this activity, the top ball can shoot off at high speeds! Be sure you wear the safety glasses when using the seismic accelerator - or are at a safe distance when the balls are dropped.

## What to do

1. Hold the bouncy ball between two fingers, stretch out your arm, and observe the height of the ball.
2. Release the ball so that it drops and strikes the ground.
3. Observe how high the ball bounces relative to the original height of the ball.
4. Add the bouncy ball to the top of the seismic accelerator.
5. Hold the top of the seismic accelerator contraption between two fingers, stretch out your arm, and observe the height of the top ball.
6. Release the entire contraption. Stand back - the top ball can shoot into the air at high speeds!
7. Compare how high the ball bounced when it was on the stack versus not on the stack.

