

## Cade Catapults

Even before the Wright brothers made their maiden voyage, Robert Goddard **imagined** traveling the solar system. He was heavily ridiculed in his time for the “absurd” suggestion that we could use rockets for outer space travel – and even reach the moon. Goddard took this criticism in stride, stating “Every vision is a joke until the first man accomplishes it; once realized, it becomes commonplace.” Forty-nine years after publishing a scathing editorial about the absurdity Goddard’s rocket – and a day after Apollo 11’s successful launch – the New York Times released a new article titled “A Correction” acknowledging Goddard’s work.

Our activity today involves launching projectiles. Using some common craft materials, you’ll be able to make a surprisingly powerful catapult to launch small objects! These launchers are great for demonstrating Newton’s laws of motion.

### Supplies

- 7 craft (popsicle) sticks
- 5 rubber bands
- Markers
- Hot glue gun (school glue will suffice)
- Plastic cap from a water bottle or similar

### Procedure

Adult supervision recommended when using a hot glue gun and when selecting projectiles and play area. Always use caution when using your catapult and never point it at people or animals.

1. Make a stack of 5 craft sticks and secure the ends using rubber bands.
2. Stack your other two craft sticks together and secure them on just one end using a rubber band.
3. On the unsecured end, pull apart your two craft sticks and wedge the 5-stick unit inside. Slide it down close to the bottom near the rubber band holding the pair of sticks together.
4. Secure the two halves together by wrapping 1 or 2 rubber bands around the place where the two stacks meet.
5. Using your hot glue gun or school glue, affix the top of your water bottle cap onto the top of the protruding craft stick. We suggest leaving a little bit of room at the top of the craft stick so you can pull down directly on the stick rather than the bottle cap, which would weaken the glue’s hold. Allow 5 to 10 minutes for the glue to dry.
6. Your catapult is ready to use! Give it a test try by pushing down on the end right above the bottle cap. If you’d like, use your markers to add a design to your catapult.
7. Next, find some objects that can be launched. If you’re using it inside, these should be light, soft materials like cotton or paper balls. If you’re using it outside, objects like pebbles could be suitable. Note: when using hard materials, always have parental supervision and only use in areas away from people, animals and property that could be damaged.
8. Once you’ve selected your objects and location, load your projectile into the bottle cap, push down on the popsicle stick and release! Be sure not to sit over your catapult in case the object flies more up than straight ahead.

### What Happened

In science, laws aren't just something you'd get in trouble for breaking, they are unbreakable according to all of the scientific knowledge we've assembled over the years. For example, we call gravity a law because we've never observed objects with mass *not* attracting each other. Isaac Newton came up with principles we now call Newton's laws of motion because they also always hold through hundreds of years of observation and research. The third law, commonly stated as "For each action, there's an equal and opposite reaction," is perhaps easiest to see here. When we pull back on our catapult's top, we're inputting energy and when we release the lever the stick outputs the same force away from itself, launching the projectile!

Can you describe how Newton's other two laws of motion apply to your catapult?