



San Francisco  
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## STEM CHALLENGE

# POMPOM CATAPULTS

### WHAT MAKES THIS STEM?

This device demonstrates **Newton's Three Laws of Motion** (paraphrased slightly below):

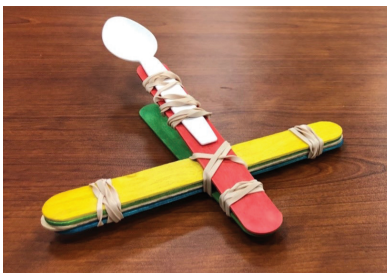
1. An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.
2. When an external force acts on an object, it produces an acceleration (change in velocity) of the object in the direction of the force.
3. Every action has an equal and opposite reaction.

You will notice that without touching the catapult, nothing happens. The pompom is not going to launch itself without you applying **force**.

When you pull back the spoon and let go, you overcome the pompom's **inertia** and fling the pompom into the air. The force of the spoon exerted on the pompom produces **acceleration** upward and makes the pompom fly into the air. The action of letting go of the spoon causes the reaction of the pompom getting launched.

Because of **gravity** and **air friction**, the pompom is pulled down to the ground instead of flying in the air forever. Then when the pompom hits the ground, it rolls until the friction of the floor eventually stops it.

### DESIGN #1 : SIMPLE



### MATERIALS

- 7 Popsicle sticks
- 7 Rubber bands
- Pompom balls
- Plastic spoon
- OPTIONAL: Paints & paintbrush or markers for decorating\*

\* These materials are not provided in the kit. If you would like to make your kit in the library, ask a librarian to use their craft materials.

### HOW TO DO IT

(Optional step) Before you begin, use the paint or markers to decorate the popsicle sticks, or tongue depressors, and let dry.

1. Prepare fulcrum: Stack five popsicle sticks or tongue depressors and wrap a rubber band around each end of the stack.
2. Prepare "flinger": Stack two popsicle sticks and wrap a rubber band around one end.
3. Pull the two popsicle sticks slightly apart and wedge the larger stack (the fulcrum) in between the two, pushing it gently down toward the rubber banded end of the two sticks (the flinger).
4. Wrap a rubber band around the entire flinger and fulcrum where they meet and then wrap another around the other way, making an "X."
5. Place the plastic spoon on top of the flinger and wrap two rubber bands around it to hold it in place.
6. Hold down the short end of the flinger, place pompom in the bowl of the spoon, press down on the spoon and let go!



For easy video instructions and other challenges, visit [on.sfpl.org/stem-challenge](https://on.sfpl.org/stem-challenge).

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# POMPOM CATAPULTS

### DESIGN #2 : PYRAMID

### MATERIALS



- 6 Popsicle sticks
- 8 Rubber bands
- Pompom balls
- Plastic spoon
- OPTIONAL: Paints & paintbrush or markers for decorating\*

\* These materials are not provided in the kit. If you would like to make your kit in the library, ask a librarian to use their craft materials.

## HOW TO DO IT

(Optional step) Before you begin, use the paint or markers to decorate the popsicle sticks, or tongue depressors, and let dry.

1. Wind a rubber band around the ends of two of the sticks, joining them together. Pull them into a "V" and rubber band a third stick to each of their free ends. This should make a triangle.
2. Wedge a stick between the two rubber-banded stick ends of each corner. Do this one corner at a time. Secure the stick with another rubber band.
3. Carefully bend the three free-ended sticks up into a pyramid, joining them together with another rubber band at the apex (the high point of the pyramid).
4. Slide the handle of the spoon in alongside the back of one of the three vertical sticks. Use the last rubber band to wrap around the stick and spoon handle and hold it in place.

5. Place a pompom in the bowl of the spoon, hold down the front corner of the catapult, press down on the top of the spoon, and let it go!
6. Hold down the short end of the flinger, place pompom in the bowl of the spoon, press down on the spoon and let go!

## CHALLENGES

- Create targets for their catapults using paper, bowls and pencils/markers to make a launching range or game.
- Practice measurement and division by calculating the catapult projectile's (pompom's) overall speed. To do this, measure how far it traveled in inches (or another unit of measurement) and the time from launch until landing. Then divide the distance traveled by the time to find the projectile's velocity. Find the average velocity by adding the velocities of your trials all together and dividing this figure by the number of trials. Compare different catapults to see which launches the fastest projectiles. Use a table like the one below to record your data.

Trial	Distance (in inches)	Time (in seconds)	Velocity (=distance/time)
1			
2			
3			



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