

3.2 Lolly stick catapults

The Wow

This is a really fun activity to get children thinking about forces and simple machines.

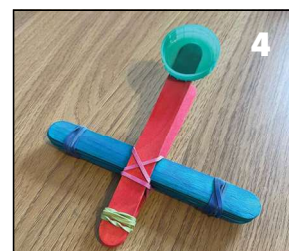
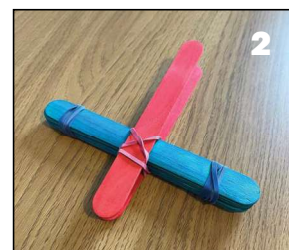
To build your own lolly stick catapult, you will need:

- Lolly sticks
- Bottle top
- Elastic bands
- Strong craft glue or double-sided sticky tape

Instructions:

1. First, place seven lolly sticks together, one on top of the other, and add elastic bands to each end to hold them in place.
2. Then, place another lolly stick above and one below this bunch, so that they make a cross shape. There should be more sticking out on one end than the other. Fix these in place by adding an elastic band around the point at which the lolly sticks cross over the bunch of seven.
3. Secure the ends of these two lolly sticks together with another elastic band.
4. Use strong glue or double-sided sticky tape to attach the bottle top to the end of the lolly stick that is sticking up.

Your catapult is now ready to use with some projectiles! Small, light and/or soft objects work best, such as ping-pong balls or marshmallows.



What's going on?



Forces are pushes or pulls. On a simple level, the ball, or other projectile, moves because it is pushed by the catapult. Going into a bit more detail, the ball is moved upwards because the force pushing it upwards is stronger than the force of gravity. After the ball leaves the catapult, the combined forces of **gravity** and **air resistance** slow it down and the ball is pulled back towards the ground. This is about as much as children will need to know for most primary curricula, including the National Curriculum for England.

The catapult also uses a simple machine called a **lever** to magnify forces. A lever is a beam or rigid rod that pivots on a fixed hinge known as a **fulcrum**. A lever allows a smaller amount of force or effort to have a greater effect. Common examples of levers in real life include seesaws, wheelbarrows and scissors.

Going deeper, the catapult works because it converts one type of energy to another; when it is pulled back, **potential energy** is stored up inside the elastic bands around the lolly sticks. When the lever is released, this energy becomes **kinetic energy** (movement energy), which allows the lolly stick lever to move, pushing the ball upwards.

The Why



This activity will allow children to see the forces of gravity and air resistance in action in an exciting way. The catapult itself is also a kind of simple machine, called a lever, and so this activity fits in well with learning about levers, gears and pulleys and gives children some first-hand experience of a lever in action. It is very unlikely, however, that children will be thinking about simple machines, gravity and air resistance as they fling projectiles across the classroom! To make this activity more meaningful, there are many elements of 'working scientifically' that children could be practising while they explore.

There are many variables that could be investigated in terms of how well the catapult works, or how far the projectile is thrown. Among other things, children could investigate the mass of the projectile, the length of the throwing arm, or the amount of lolly sticks in the base. Because there are so many options, this is a great activity to give children the opportunity to ask their own scientific questions, then plan an investigation that would help them find answers. If children are not well-practised in developing their own scientific questions, they might need a 'question frame' to help them for their ideas, such as:

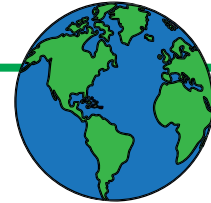
'How does the _____ affect the distance that the projectile is thrown?'

The gap above could be filled with:

Size of the projectile,
Shape of the projectile,
Mass of the base,
Length of the arm,
Thickness of the base etc.

If children are measuring the distance that objects are flung, it would be good to use projectiles that don't roll, such as cotton wool balls or marshmallows. You could, of course, give children the option of a range of different projectiles so that they can experiment with these and find this out for themselves. Be sure to also offer a range of different measuring equipment at the planning stage so that they can make decisions about which will be useful and which won't. Children will often end up choosing additional equipment that they don't need if this is not a skill that they have had a lot of practice with, but this is something that they will be able to reflect upon when they evaluate their investigation afterwards.

In the Real World



There are great links between science and history with this activity, as children could learn about how real catapults and trebuchets have been used in different time periods to lay siege to castles, forts and other strongholds. There is evidence of them being used as early as 400 BCE. Many of these also used gears to work, bringing in an additional element of learning about different types of simple machines.

Children could also explore examples of levers in their own lives, as they are surprisingly common. As well as the examples mentioned above, children may find levers in their schools or homes in the form of pliers, bottle openers, clothes pegs, hammers and chopsticks. The science behind how levers can allow a smaller force to have a greater effect also comes into play with a lot of sports equipment, such as hockey sticks and golf clubs, which are held at the top and swung to hit balls, sending them over long distances at high speeds.

Health and Safety Notes

- Make sure that children are paying attention to where their projectiles will go when launched; they should not be shot in the direction of others
- Softer, lighter projectiles like marshmallows, cotton balls or ping-pong balls will make this activity safer. Do not allow children to launch hard, heavy or pointy objects