



Marshmallow Catapult

You'll need a good aim and a faithful lab assistant (or at least a willing buddy) to take on this *sweet* experiment. Perhaps don't mention that their role will mainly involve having marshmallows fired at them... Heads up, Sweet Pepper!

THE RECORD: Most marshmallows caught in the mouth with a home-made catapult in one minute

THE CHALLENGE: Construct your own catapult out of everyday items, such as lolly sticks and bulldog clips, then use it to hurl marshmallows at a friend (or enemy). How many sweets can your partner catch in their mouth in a minute?

Be warned - this trick is, well, tricky. *Really* tricky. You're going to need a lot of practice to nail the right technique.

No surprise, science is the key. Wrap your head around how energy works and you'll be hitting your target every time. Well, sometimes... Even if you don't, at least you can console yourself with marshmallows. Siege warfare never tasted so good!

GUIDELINES

- The details - and diagrams - of your proposed design must be submitted to GWR for approval *before* you make the catapult.
- The marshmallows can be cuboid or cylindrical, but each must be at least 2.5 cm (1 in) in all dimensions.
- The person catching the marshmallows must be standing at least 2 m (6 ft 6 in) from the catapult at all times.
- Only one marshmallow can be fired at a time. It's up to the challenger whether they eat or spit out a marshmallow once it's been caught in the mouth.

SHOPPING LIST

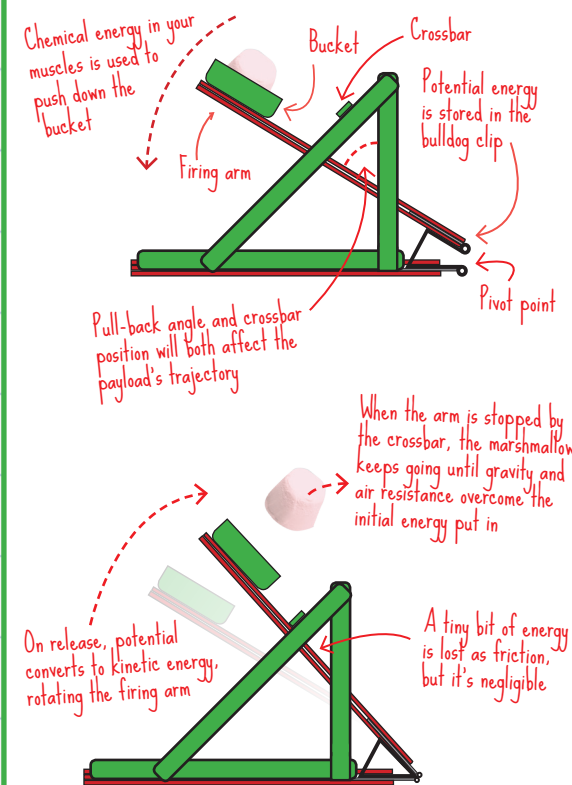


- WE USED:**
- BULLDOG CLIP
 - BOTTLE CAPS
 - LOLLY STICKS (TWO SIZES)
 - MARSHMALLOWS

You'll also need a glue gun and scissors!

We made our catapult with two types of wooden lolly stick (glued into a framework), a bulldog clip and a lid from a milk bottle. But that's just one way of doing it. Other things you can use to harness that crucial potential energy are clothes pegs, springs and elastic bands.

HOW DOES IT WORK?



The first law of thermodynamics states that energy can neither be created nor destroyed - only transferred. This experiment is a perfect demonstration of that law in action.

When the catapult is sitting on a table at rest, it's in an energy-neutral state. You use chemical energy (which we get from the food we eat - including marshmallows, incidentally) to depress the arm. Once the levered section is down, it's under tension, with energy stored in the compressed bulldog clip. As soon as you let go of the end, the potential energy converts into kinetic energy, swinging the arm until it hits the crossbar, at which point the payload is propelled forward. The marshmallow will travel in an arc at the same speed the arm moved, until other forces counteract it. The velocity of the sweet and how far it will travel are both determined by how much energy you put in, i.e., how far you pull back the arm.



FOR THE RECORD

Working on the same principle of rapidly converting stored energy into kinetic energy was this record-setting trebuchet. These medieval weapons (see *TIL*, below left) actually had a far greater range than catapults. They get their power from a counterweight attached to a long arm, with the payload suspended from the opposite end with a sling. When the weight is released, the arm rotates and the projectile is flung forward. The **most powerful trebuchet (20+-kg projectile)**, built by Nova FM - Partridge (AUS) in 2011, tossed a VW Beetle car weighing 766 kg (1,688 lb) a distance of 76.9 m (252 ft).

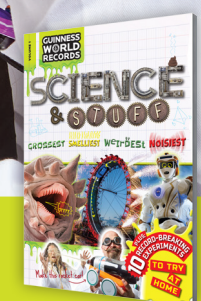
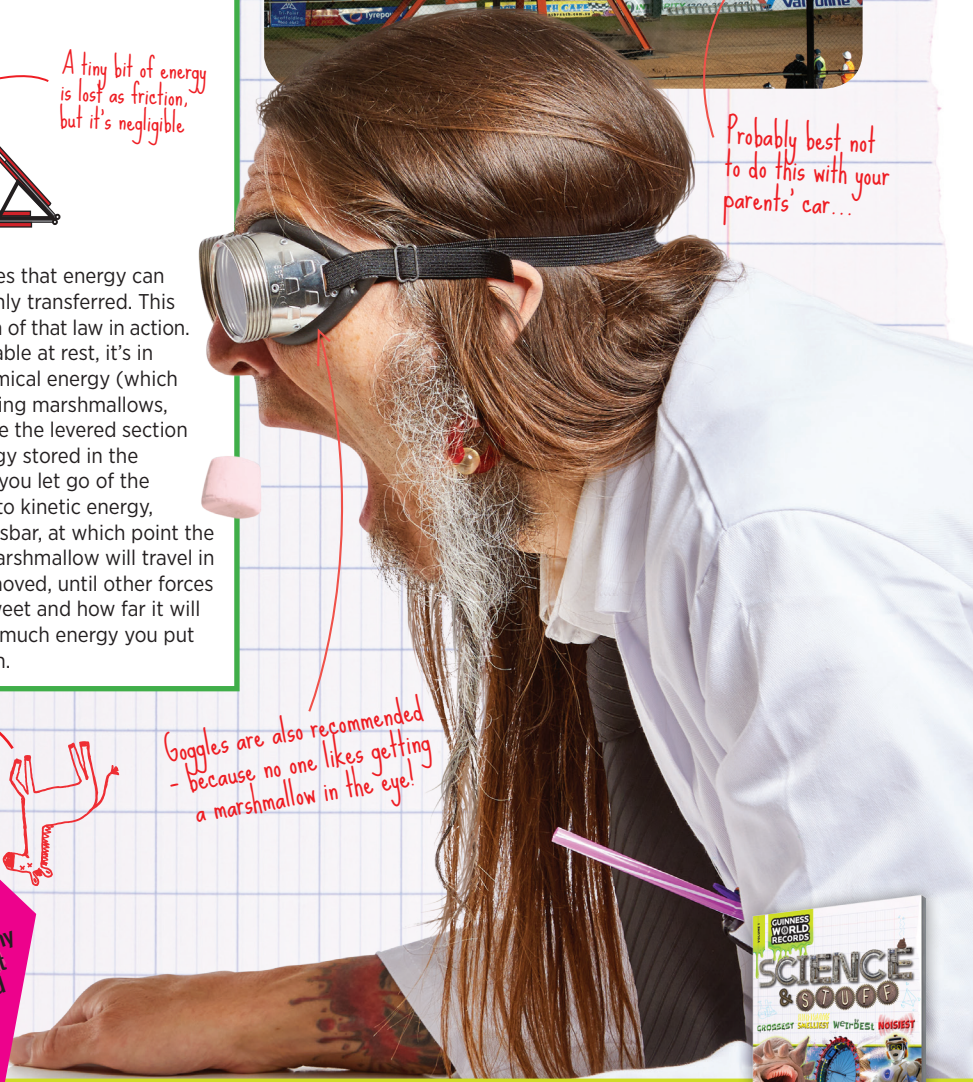
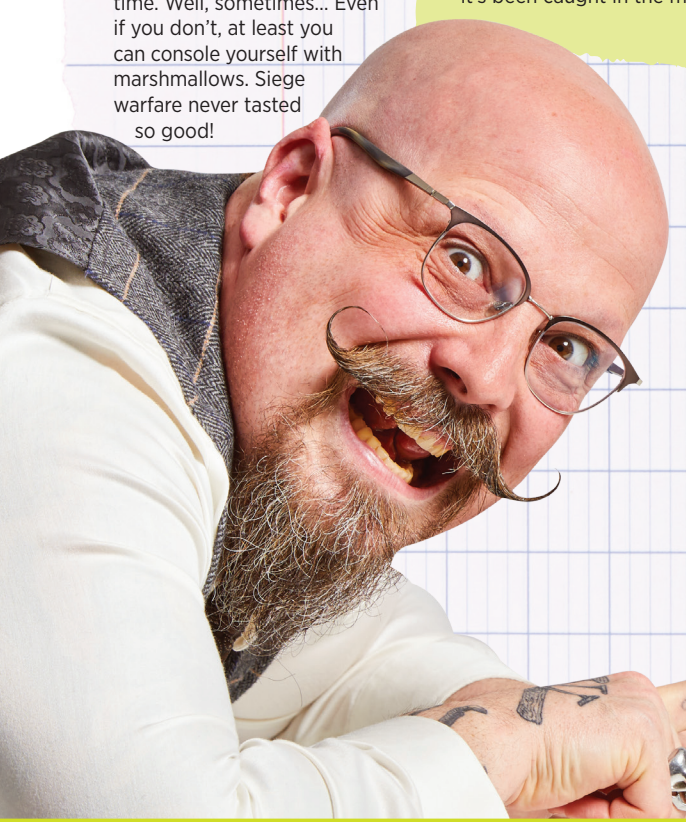


Probably best not to do this with your parents' car...

Goggles are also recommended - because no one likes getting a marshmallow in the eye!

TIL
TODAY I LEARNED

During the Middle Ages, weapons such as catapults and trebuchets were all the rage for throwing rocks at things. They were the go-to solution for storming enemy fortresses. As well as being good at smashing down walls, they could also be used to toss diseased animals into towns - one of the first forms of biological warfare.





Marshmallow Catapult (continued)



1

No matter what you use to make your catapult, you're going to need a way of sticking things together. A glue gun is the fastest and most secure way of doing this. Take care when working with hot glue as it's very... burn-y. Not quite as hot as "blue lava" (see pp.34-35), but it feels close! In fact, you might want to ask a responsible adult to help you with this bit.



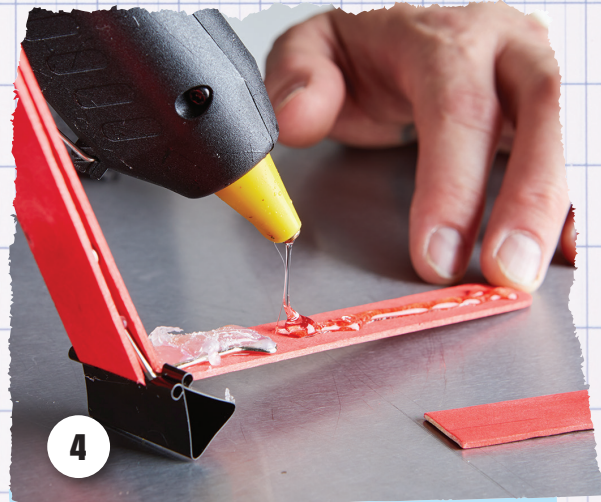
2

With the glue gun loaded and ready, the first thing to do is build the base. Whatever shape you go with, the main thing you want it to be is sturdy. With this in mind, we went for a square design, with a reinforced strip in the middle to hold the firing arm.



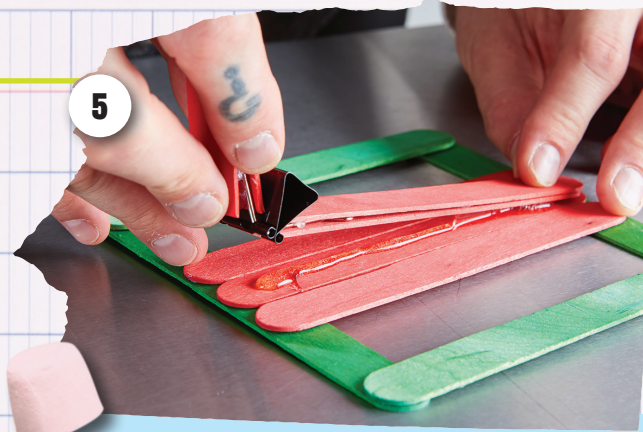
3

Now, we turn our attention to the firing arm. This is the bit that will launch the marshmallow. We made ours from four more lolly sticks. Carefully cut one end off each stick, and make sure that they're all the same length!



4

Glue the four sticks on to the bulldog clip, sandwiching the metal arms between the sticks. Don't be shy with the glue at this stage as you want the firing arm to be solid. Remember to set it aside to dry for a few minutes before you continue.



5

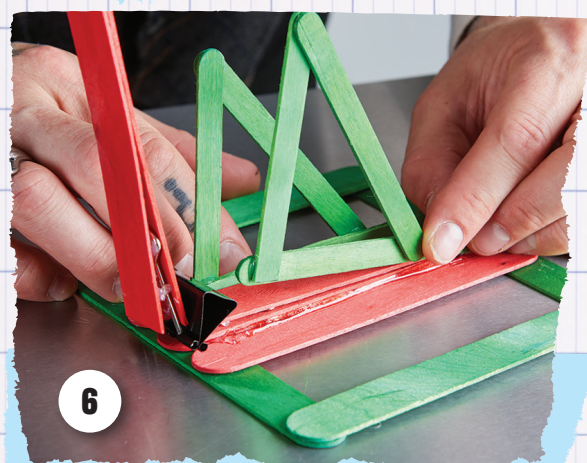
Attach one side of the firing arm to the central plate on the base. While that's setting, you can start making the two side panels. We created two right-angles out of six smaller lolly sticks (see Top Tip!, right, before you begin).



TOP TIP! FROM PROFESSOR ORBAX

One of the hardest parts about this record is consistency. Even when you've aimed a marshmallow into your partner's mouth once, it's pretty much as difficult the second time, and the third...

A trick to help with this (which is completely within the rules!) is to measure and mark out some lines on the catapult framework, so you know you're putting the same energy into each launch. You could even use geometry equipment such as a protractor or set-square as part of your catapult's design.



6

The catapult is really starting to take shape now. Glue the two triangular struts either side of the firing arm. It's worth leaving these to dry and then applying some additional glue to make sure the joints are strong. This will help extend the life-span of your candy chucker.



7

It doesn't look like much, but this small piece of lolly stick - or whatever you opt to use - is crucial. Without a crossbar, the arm keeps swinging and your marshmallow is doomed to a mediocre flight.



8

The final step is to add the "bucket" that will hold your tasty projectile. You want something deep enough so that the marshmallow won't keep falling out, but not so snug that the payload might get stuck when firing. Before sticking, lightly score the base of the lid for extra grip.

