Engineer Inside

Hints and Tips

Launch an Object Challenge

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So I said that my idea was to store up energy by trapping lots of air in one place - like blowing up a balloon, but unlike a balloon that bursts and all the air goes everywhere - I'm going to try and concentrate it and direct the air in one jet. As if I'm producing a really powerful gust of wind.

The first thing that I needed was a container to store all of this air: something that I could attach a pump to because my lungs aren't that strong and I can't breathe that much air in to make a really powerful gust of wind. So I actually used a 3D printer. Now I've made a tube - this is hollow down here so that tube can be filled with air, using a bike pump, but I need to keep that air in there somehow. So in one end I'm going to use a cork. So I can just push a cork into the end of this tube like that. So that's one end sealed, but then I don't want this cork to come back out I don't want it to go pop while I'm trying to film or while I'm trying to launch something out of this end - I don't want the other end to fly backwards.

So then I take a little cap and I can screw the cap over the end of the cork and that just holds it in place. Like that. What I can do is take a needle, this is the needle from my bike pump, and push that through the cork. Because I've already made the hole it goes through quite easily.

So now I've got this plastic tube, sealed at one end with a cork but with a needle going through it, so if I blow in this end, [air rushing through tube] I can still breathe air into there.

And then the plan to seal the other end up is to place a piece of tape over the other end. Then I can use a screw thread to screw down onto it and hold the tape in place really tight. So at one end a cork and at the other end, some tape.

Now I'm going to start blowing it up with a bike pump. So I'm pushing air in behind this. You can see the pressure going up and up and up, and sooner or later.. bang! The tape gives up, it ruptures. Out comes all of that air.

We can use that jet of air to launch a rocket. By building up all this pressure, and using the air I can launch these objects much, much further than the piece of paper at the start of the video.

Now obviously we've come outside to launch these and it's important that you check around to make sure that no one is there and that you warn anyone you're with what's about to happen.

So for the rockets that you just saw me launching this is what they look like. Again I've made them with the 3D printer so these are plastic. That just makes them a little bit sturdier. You could make them using a piece of paper and roll it up into a tube. If you want to see how you might be able to do that, have a look at Antony Allen's videos on this launch page, because he's done exactly that. But these rockets are open at the bottom, so there's a big opening here which is just the right size to

slide onto the end of this tube. So then when I connect up the bike pump to the needle here and I start pumping the air in, all of that pressure starts to build up, it starts to stretch the tape at the end until it ruptures and bang! Out comes that jet of air and it launches our rocket.

My experiment was to try and see what difference it would make having bigger or smaller rockets.

So if this one is heavier, it needs more momentum, more energy to travel the same distance as this one.

So here are the results. Now, the x axis, that goes along the bottom, that's the thing I have control over. So whenever you plot a graph - the thing that you're changing - put that on the bottom. On the x axis. On the y axis, you put the thing that you measure.

I measured how far each rocket went. So I weighed the rockets using a set of scales from my kitchen - that's along the bottom. How much the rocket weighs. And then when I launched it, I measured how far it went. So with a really light rocket, it doesn't weigh much so it doesn't go far along the x axis and it's far to the left of that image, I had to walk a really long way. The 10 gram rocket went really far. As the rockets got heavier so they go further to the right on the x axis the points are lower down on the picture, they're lower on the y axis so they didn't go as far.

The other thing that I thought about trying is changing the angle that I launch these at so I built this little stand and that just holds my launcher in place. So I can put my launcher there and that's at about 45 degrees and then I can change the position of this peg by every 15 degrees and then pop my launcher back on and launch the rocket at a different angle. And this time, changing the angle that I launched at so how far up I moved this or low down it was changed how far it went.

Like I predicted, my hypothesis was, somewhere in the middle - not too low so that it crashes into everything, not too high - so it doesn't go very far. But somewhere in the middle the rocket will go the furthest. It gets enough height to clear all the objects on the floor but not so much height that it has no horizontal velocity. Somewhere in the middle - that was my prediction - and as you can see 45 degrees - that's where the highest point is. So if you follow the x axis into the middle where it says 45 and then go up and up and up, the highest point is right above there. So the highest value on the y axis is the most distance travelled that is the best angle to launch your rocket at.

So if you try this and you want your rocket to go really far, 45 degrees - somewhere in the middle between flat and vertical, somewhere there. That's what you want to aim for.

Let's look at a DIY version that anyone can make at home. If you take a normal 2 litre drinks bottle, a cork and a push a needle from a pump through it, then you can add a little water to the bottle, push the cork in, and start pumping up. You'll build up pressure in your rocket and, bang! All of that energy will be released at once and propel your rocket. Let's listen: [Bang]

You've got an idea for a rocket launcher that you could build now. You know how you could test it - you know what you should be measuring. How far does it go? Can you make it go any further? Can you make it go any higher? Over to you now! Try it out at home and see what you can build!

Bye!