

Balloon Rockets

Topic

Space/Forces and motion

Equipment/Materials:

Wire

Drinking straw

Balloons

Paper

Felt tip pens

Scissors

Sellotape

Extension: Kitchen role cardboard middles

Thin card

String

Instructions:

1. Use a length of wire or similar, thread through two drinking straws and string it across the length of a room. Be careful to make sure it is either well above head height or clearly visible to avoid accidents.
2. Set out tables for groups to sit round. Make sure each table has everything needed for a team to build a balloon rocket.
3. **Extension:** With the kitchen role get each group to build a model rocket.
4. Use the tube for the main body of the rocket and thread the string through the middle and tie in a loop.
5. Use the card to make a nose cone and four fins.
6. Attach three of the four fins and spin the rocket round horizontally using the string. See how the rocket flies.
7. Add the fourth fin and then different nose cones to see which design flies best.
8. Explain the balloon rockets to the teams. The balloon is the rocket fuel and the paper can be used to build the body of the rocket. By attaching it to the straw and letting the inflated balloon go the rockets should go across the room along the string.
9. You can demonstrate a simple version of this by making a loop out of paper, attaching it to the straw, inflating the balloon inside the loop and then letting go.
10. Give the teams a fixed amount of time to build their rockets (10 -15 minutes).

11. Go round the teams and see what ideas they have come up with. Remind them of the initial talk about gravity, forces etc. they may build a fantastic looking rocket that is too heavy to be powered by the balloon.
12. Test each team's rocket in turn. Do a countdown and try to involve everyone. Tell them to watch closely so they can use ideas from other teams to modify their own rockets in the next round. If there isn't time, teams can be limited to one attempt.

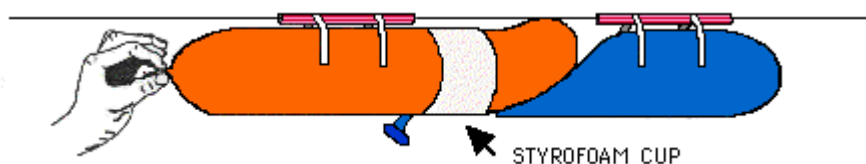
Extension: Dual stage rockets.

Make a loop which can be used to secure the rocket to the straw. Use what you learnt from the first rocket to make any design improvements.

Loosen the balloons by pre-inflating them. Inflate the first balloon about 3/4 full of air and squeeze the nozzle tight. Pull the nozzle through the loop.

While someone assists you, inflate the second balloon. The front end of the balloon should extend through the loop a short distance. As the second balloon inflates it will press against the nozzle of the first balloon and take over the job of holding it shut.

Attach each balloon to a straw and release.



Depending on the age group and the number of rounds allowed for each team, the activity can last between 45 – 60 minutes. The extensions mentioned will make it even longer.

Balloon Hovercraft

Topic

Friction

Equipment/Materials:

Plastic bottle and lid

Balloons

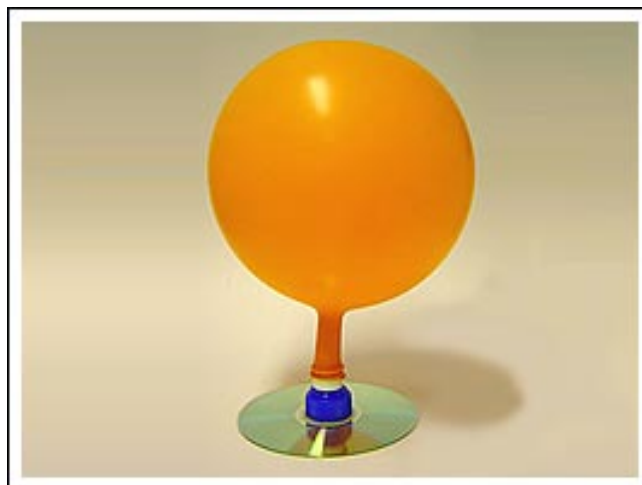
Glue gun, plasticine or blue-tac

CD

Push pin

Instructions:

1. Take the lid off of the bottle and punch a few holes in the top of the lid with a drawing pin.
2. Place the CD shiny side up on the desk in front of you. Now place the lid over the centre hole of the CD with the holes in the lid facing downwards.
3. Roll some blu-tack into a sausage shape then wrap this around the lid where it touches the CD. Press down firmly to make sure that it is secure.
4. Turn the CD over and adjust the lid so that all the holes in it can be seen in the centre of the CD.
5. Get the bottle and carefully cut off the top just below the mouth of the bottle with scissors.
6. Trim off any extra bits of the bottle so that you are left with the bit that the lid screws onto.
7. Screw this bit of the bottle onto the lid which is attached to the CD.
8. With the shiny side of the CD facing upwards, get a balloon and stretch the end so that it fits over the mouth of the bottle which is attached to the lid.
9. To inflate the balloon, unscrew the mouth of the bottle from the lid and blow up the balloon. Once inflated, hold the neck of the balloon firmly so that no air can escape.
10. Screw the balloon back onto the lid and release the neck of the balloon.



How does it work?

The air flows slowly through the holes and the force of the air pushing against the table lifts the CD up slightly. This reduces the friction between the CD and the table and allows it to slide.

For further information:

www.youtube.com/watch?v=a2iCl5zDEoU

http://sciencesquad.questacon.edu.au/activities/cd_hovercraft.html

Marshmallows in a Vacuum

Topic

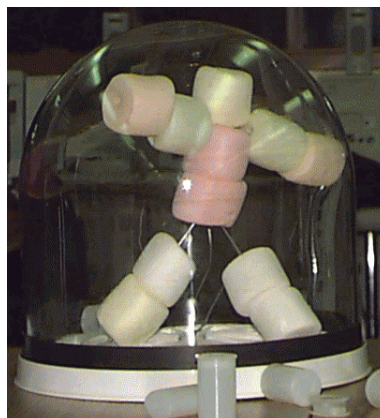
Pressure

Equipment/Materials:

Marshmallows

Wine bottle (preferably clear)

Vacuum wine saver pump and stopper



Instructions

1. Roll the marshmallows gently between your hands until they are small enough to pass through the opening of the wine bottle. Note: if the marshmallows become at all sticky then roll them in cornflour, otherwise they will just stick to the sides of the bottle and make a big mess.
2. Insert the vacuum stopper into the neck of the wine bottle. Explain to the audience that the vacuum pump removes air from the bottle. Instruct them to carefully watch the marshmallows.
3. Pump the vacuum pump a few times – the marshmallows inside the bottle begin to expand. Shake the bottle gently up and down to distribute the marshmallows throughout the bottle, then pump again. Repeat until the marshmallows are no longer expanding. Discuss with your audience.
4. Tell your audience that you are going to let the air back into the bottle. Remind them to watch the marshmallows closely as you do so.
5. Release the valve on the vacuum stopper – the marshmallows will rapidly shrink back to their normal size.

How does it work?

Marshmallows have small bubbles of air trapped inside them. These bubbles are at atmospheric pressure. When the air inside the glass container is sucked out, the volume of the container remains the same although there is much less air inside – so the pressure is reduced. The air bubbles inside the marshmallows are therefore at a much higher pressure than the air surrounding the marshmallows, so those bubbles push outwards, causing the marshmallows to expand. When air is let back into the glass container, the surrounding pressure increases again, and the marshmallows deflate back to their normal size.

For more information:

<http://www.physics.org/interact/physics-to-go/amazing-marshmallows/>

Jitterbugs

Topic
Motors

Equipment/Materials:

Motor
Battery holder
Plastic bottle
Felt tip pens
Electric tape
AA Batteries

Instructions:

1. Carefully cut a water bottle in half and discard the top half (the end with the lid)
2. Turn the bottom half of the bottle over so that the open end is facing downwards.
Attach three pens on three different sides of the bottle (using sellotape) with the bit you write with facing downwards. The bottle should be able to stand up using these pens as legs.
3. Place blu-tack onto the bottom of a battery holder and stick the battery holder on top of the closed end of the bottle.
4. Place a wheel on the spinning bit of the motor, using blu-tack to fill the gaps if the hole in the wheel is too large.
5. Place a small amount of blu-tack on the side of the wheel on one side, Cellotape the motor next to the battery so that the wires can easily attach and the wheel has room to spin over the side of the bottle.
6. Attach the ends of the wires to the motor using blu-tack to hold them in place if necessary.
7. Place batteries into the battery pack on top of the bottle. (Make sure the lids of the pens are off if you haven't already.)



How does it work?

As the weight on the motor is not equally distributed, the off-centre weight pulls the motor—and your Jitterbug—with it as it spins, creating what's called a rotational vibration. Rotational vibrations allow your Jitterbug to “dance,” but in most other situations, these vibrations are bad news. For example, car wheels have to be carefully balanced by attaching small weights to the rims or they'll cause a car to shimmy at high speeds. The balancing of spinning parts is crucial to airplane propellers, turbines, computer disc drives, and just about anything you can think of with spinning parts.

For a different design:

http://www.eng.cam.ac.uk/outreach/project_info/jitterbug.pdf
<http://www.exploratorium.edu/afterschool/activities/index.php?activity=136>

Kaleidoscope/Periscope

Topic
Light

Equipment/Materials:

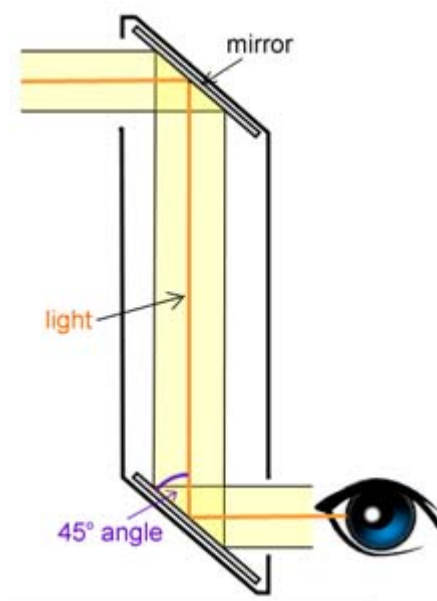
Mirrored card
A4 or larger card
Scissors
Sellotape

Periscope Instructions:

1. Using the attached template, either trace it onto the card or stick it on.
2. Cut out around the template
3. Cut two 5cm x 5cm squares out of the mirrored card
4. Use tape or strong glue to stick them together according to the template

How does it work?

In the periscope, light hits the top mirror at 45° and reflects away at the same angle. The light then bounces down to the bottom mirror. When that reflected light hits the second mirror it is reflected again at 45° , right into your eye. Light is always reflected away from a mirror at the same angle that it hits the mirror.



For more information:

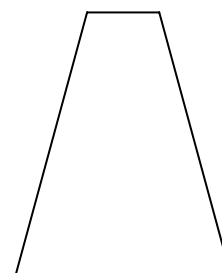
<http://www.webinnate.co.uk/science/week8.htm>

Kaleidoscope Instructions:

1. Cut three equal pieces out of the mirrored card in the shape to the right. It does not matter what size as long as they are all the same.
2. Stick the three pieces together with the mirrored side inwards

How does it work?

The light reflects off the object you are looking at and then off the three sides of the kaleidoscope to produce multiple images.



Human Electricity Circuit

1. Explain that they are going to be the electrons in the circuit. Ask for a volunteer to be the battery. Ask what batteries do - they store energy and then give it to the electrons. Demonstrate by asking the battery for a volt. Then ask for a volunteer to be a light bulb. Transfer the energy from the battery to the bulb (ie put it in the bucket), and explain this is how bulbs work. Ask the light bulb to stand on the other side of the room. Ask the class how I get the energy to the bulb - I need to move. Can I move in any direction I like? No - because electrons are confined to wires.
2. Set them up in a circuit, with one light bulb. Have them go around in a circle, get energised by the battery (ie given a ball), and then transfer energy to the light bulb. Point out that they are all moving at the same speed at all points in the circle (or that they should be), and that they get rid of all of their energy by the time they cross the classroom.
3. Add an extra bulb to the circuit - ask if they know what will happen. Compensate by adding an extra battery. If there are two bulbs across their path, how many balls will they give to each bulb? What if there were four identical bulbs? They need to get to the point where they understand that they must give away all of their volts before they return to the other side of the battery, and that they must share them between the components.
4. Now set up a parallel circuit. Tell them that they can choose which branch to take, but that no branch should be ignored, and that they must deposit their energy into the buckets every time you clap (do this so that they have to move faster). Get them to go around. They will at first not get it, and will ignore one of the branches - point this out, and get them to go to both. If they are only putting one ball in the bucket, stop them and ask if this is right - they have to get rid of all their energy. Stop them after a while. Ask them if they had to move faster. Explain that current is represented by people per second - were there more people per seconds than before? Yes, because adding branches to circuits draws more current from the battery. Ask if the current was the same on the branches - there were less people so it was less. Ask the light bulbs how many energies each person gave them - two. What was it in a series circuit? So voltage is shared in a series circuit, but not in a parallel one.
5. Now introduce the concept of resistance. Resistance makes it harder for the electrons to pass through - ask two people to be a resistor, and ask them how they would make it harder for you to get past - without touching you. They will probably put their arms out. Limbo under them, and ask if that took you more energy than walking (it probably did). So get the circuit to go round, this time with just a resistor. When enough people have gone around, they will start to wonder why they still have energy. Ask them if this is right? By now, they will know it isn't (they

probably know it intuitively anyway). Explain that there is an energy 'cost' for getting through the resistor, so they have to 'pay'. Add a bulb back in - by now they should be able to work out that they should give one energy to the bulb and one to the resistor.

6. Now ask if they could go the other way around if they wanted to - is there anything to stop them? Have them go the other way for a bit. Then introduce the concept of diodes. Ask for a volunteer. Have them stand with a stop sign in front of them, and demonstrate that you can pass by it in one direction, but not in the other. Have them go around and then let the diode stop the flow of electrons. Talk to them about what will happen - they may turn around and go back the other way - discuss whether that would really happen.

Alka Seltzer Rocket

Topic

Pressure

Equipment/Materials:

Empty film canister

Alka-Seltzer tablet

Water

Instructions:

1. Place the Alka-Seltzer tablet in the film canister
2. Add approximately 1cm of water.
3. Fit the lid on the canister, making sure the seal is tight.
4. Turn the canister upside-down and place it on a flat surface. Stand back!

How does it work?

When water is added to the Alka-Seltzer tablet, bubbles of carbon dioxide gas are given off. When the lid is fitted tightly to the canister this gas is contained within an enclosed space. As more gas is given off the pressure inside the canister rises until there is enough force to overcome the seal of the lid. The built up pressure exerts enough force to shoot the canister into the air, forming the rocket.

For more information:

<http://www.physics.org/interact/physics-to-go/alka-seltzer-rocket/index.html>

The Great Egg Drop

Topic

Forces and motion

Equipment/Materials:

Straws

Card

Paper

Scissors

Sellotape

Hardboiled eggs

Foam (optional)

Instructions:

1. The aim is to build a pod to protect an egg during a fall – set up as a competition so they can add a team design to the egg.
2. Pupils have to design and build a carrying pod to protect an egg during a fall using only the materials given to them
3. They have to think about the forces and the problems they will encounter in the fall and the protection needed for the egg
4. Give them 20 minutes and then show them one you have made using the same equipment
5. Take the class to a suitable drop site – about 10 ft is usually enough
6. Test out their designs

For more information:

<http://wilderdom.com/games/descriptions/GreatEggDrop.html>