Rocket Car

Materials Needed:

- **Card Sheet**
- **1 balloon**
- **Sellotape**
- **2x Flexi-straws**
- **Scissors**
- **Ruler**
- **Pencil**
- **Drawing Compass**
- **Small pattern for wheels**
- **2x 4mm dowel, 100mm long**

Please read the building tips first.

Procedure:

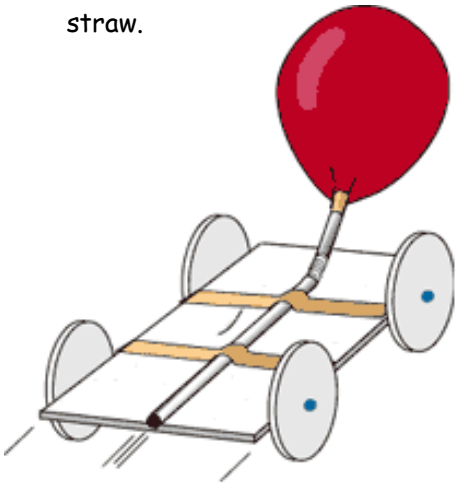
- Using the ruler, pencil and drawing compass, draw a rectangle 80mm x 200mm and four circles 80mm in diameter on the card. Cut out each piece being careful to make the wheels as round as possible.

- Cut one straw into 2x 75mm pieces. These will become axles bearings for the wheels. Tape the two pieces of the straw across the card one at each end. Check they are parallel
- Slide the two dowel axles through the straw bearings.
- Carefully pierce a hole in each wheel centre and push the wheels onto the dowel. You may need to secure them with tape

- Inflate the balloon a few times to stretch it out. Slip the nozzle over the end of the flexi-straw nearest the bend. Secure the nozzle to the straw with tape and seal it tight so that the balloon can be inflated by blowing through the straw.

- Tape the straw to the car as shown in the picture.

- Inflate the balloon and pinch the straw to keep the air from escaping. Set the car on a smooth surface and release the straw.



BLOODHOUND SSC

Bloodhound has a rocket and a jet engine. Study the top picture on the fourth page and show where the jet and the rocket are to be found.

A few tips for building the balloon BLOODHOUND

Body

I used corrugated cardboard cut from a cardboard box for the body as this provides a material stiff enough for the axle location. I also found sellotape or masking tape an excellent choice for all the sticking to be done!

Exhaust nozzle

You can use a flexi straw but you could experiment with art straws and the larger diameter straws for drinking milkshakes, easily obtained from a certain famous burger bar.

Take care that the nozzle does not become blocked (squashed) during the process of fastening it to the balloon

Test Bed

Rocket engines have to be tested. Sometimes they are fixed to a gantry and sometimes they are attached to a vehicle that runs along a track. It is a good idea to test the engine, particularly because it is difficult to make and attach the wheels. This at least will reveal that the rocket principle works! ...and give encouragement to continue.

Here I have simply set the rocket engine with attached body on some pencils or use the dowel axles. You can do this before attaching the straw axle bearings. If you have a sensitive 1 Newton spring balance you may be able to

attach the body to it and measure the thrust! Predict what the thrust should be. Can the balloon (on its own) take off vertically? If so, the thrust must be bigger than the weight of one balloon (about 2 g). Can the weight of one balloon be measured? Easy to measure a bag of 50 and then divide. My cheap kitchen balance has a sensitivity of 1 g and gives 2 g for one balloon (about 1/50 N) whereas 50 balloons weigh 75 g. Good example of how to improve accuracy and an opportunity to calculate. The principle can be applied elsewhere, for example, to calculate the thickness of sheet of paper by measuring the thickness of a pile of paper and divide by the number of sheets.

Setting the Scene for the Balloon BLOODHOUND.
(Teacher notes)

Release an inflated balloon across the room.

Why does the air come out of the balloon?
The stretched elastic wants to return to its original shape and so squeezes the air out.

Why does the balloon move?
The balloon exerts a force on the air and the air exerts an equal and opposite force on the balloon. If I pull the Newton meter with a force of 5 Newton the Newton meter exerts an equal and opposite force of 5 Newton on my hand.

Why is it erratic? (Not an easy question to answer)
When released the balloon is bound to have some rotation and the nozzle flaps around so that the force exerted by the air on the balloon is continually changing direction.

Can the balloon be harnessed to provide an engine?
It needs to be tied down to a body so that it can pull the body along.

What is the difference between a rocket and a jet?

Why would a balloon powered car be considered a rocket? (see the instruction sheet)

Discussion:

The Balloon rocket car is propelled along the floor according to the principle

stated in Isaac Newton's third law of motion: "For every action there is an opposite and equal reaction" The balloon pushes on the air, and the air pushes back on the balloon. Because the balloon is attached to the car, the balloon pulls the car along. The jet engine and rocket for BLOODHOUND SSC work on the same principle.

What factors affect the performance? How can it be made to go faster or further?

Try shortening to straw in the balloon nozzle. What effect does it have?

Rocket or Jet?
The difference between a rocket and a jet is that the rocket carries all its fuel on board. In outer space there is no oxygen to burn the fuel so a jet will not work as it gets its oxygen from the air through the intake at the front. Study the picture of bloodhound above and find the air intake for the jet.

Elements of design and enquiry. The engineering challenge.

The body can be designed and painted. The wheels can be painted. Some children could be encouraged to design their own wheels and bearings.

Different diameter straws can be investigated along with different sized wheels. The whole car could be weighed, what difference does this make? Two balloons and two nozzles? Can fair tests be carried? How can the tests be made as fair as possible?

The body needs measuring as do the wheels if they are to be made. If the circle is drawn with a template instead of using compasses the centre will have to be found. Either draw in two diameters or better, balance the wheel on a pin to find the centre of gravity.

Different weights can be placed on the body during the test bed stage to see the effect of trying to move different masses. When thinking about BLOODHOUND SSC remember that the more fuel on board the greater the mass and the more difficult it is to get the car to move.

The axles could be different lengths, wider at the back than the front. The wheels might be different sizes front and back. Will it make a difference? why or why not? I doubt this will make a difference here but children may relate this to real cars and dragsters.

The "measured mile" could be marked out (the car in the picture shot across my kitchen floor and frightened the life out of the dog, so be assured they can be made to work!) and children attempt to time the car and so calculate its speed over the "measured mile". If you have data

logging equipment and light gates you could attach a card to the body which interrupts the light beam.
You could film the car and use the frame speed to work out its speed.

Every Child Matters

There are opportunities for considering the cost of BLOODHOUND SSC, cost of the car, fuel, employing engineers to build, design and research. How much might it cost to transport BLOODHOUND SSC to a desert along with the support team. These things can be researched on the internet or the BLOODHOUND SSC site.

Children are using sharp pins, compasses and scissors. Balloons can be dangerous. The safety signs put on the balloon car will reinforce the idea of safety in an adult working environment.

Children could look on the BLOODHOUND SSC site to find the huge range of people in the team. Some attention could be given to Andy Green, the driver, who has to be extremely fit and mentally alert.

This is not a lesson plan. What is provided is the idea, an engineering challenge. Teachers will have to design their own plans and differentiate according to need. The opportunity for children to work as a team, (chief engineer, designer etc.) is there, with children building different parts. Some may be good at cutting out, others at design. However all children need to improve their skills whether it be manual dexterity, calculating, designing, measuring, planning, organising or assembling. Once built, the ownership is theirs along with whatever learning in science, maths and technology has taken place.

You, the teacher, will have to build one first. Only then will you find out what problems will confront your children.

Should you have difficulties please get in touch with us through the web-site.
Should you have success which needs to be celebrated then again please get in touch through the web-site.

More material will go up over the next year, but if you have devised your own BLOODHOUND SSC materials please send them in.