Air powered racer

A science challenge for National Science and Engineering Week 2010

Harness the power of air to move a vehicle. Who can make their car go the furthest? Your challenge is to build a car and then use a balloon to send it traveling as far as you can.

You will need to build the following:

A **body** - try disposable cups or maybe a Pringles tube. What about cardboard cereal boxes? You design can be as imaginative as you like depending on the equipment you have available. Can you build a body just using pieces of A4 paper?

Wheels - bottle tops, cut out cardboard, old CDs, spools for thread all work. But how many to use and where should you put them?

Axle - pencils, straws and skewers work well. How can you make it turn as easily as possible?

Engine - In this case, it will be a balloon. How will you fix it to your car? Can you control how the air is released? You are only allowed one normal sized balloon per vehicle.

Compressed air is being used by car designers as an emission-free alternative for cars in the future. Search online for “air powered cars” for more information. Did you know that air powered cars were prototyped in the middle of the 19th century well before the internal combustion engines we use today?

Vehicle emissions from traditional cars are responsible for producing thousands of tonnes of the greenhouse gas CO2 in the UK every year. Finding new ways to power our cars will be essential in the fight against climate change.

Real-life engineers battle with the same problems you will have in this challenge. How to make the most efficient and reliable vehicles possible. When you leave school perhaps you could find work designing new ways to power our cars?

Cars and lorries come in all different shapes and sizes. Can you make different air-powered models that represent different types of vehicle?

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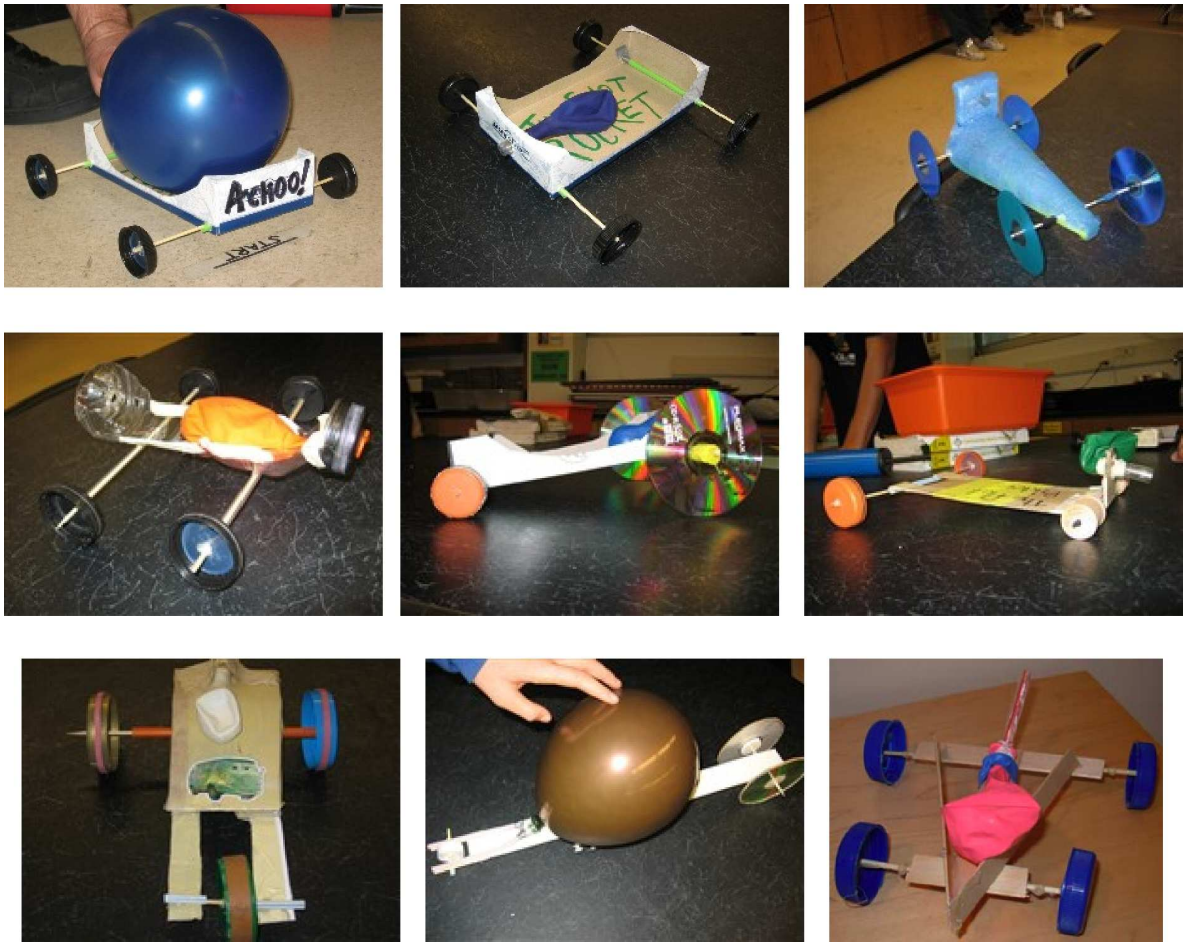
EXAMPLE CARS



THE SCIENCE

Forces are pushes, pulls and twists. Your car will be pushed along by the air in the balloon. Forces come in pairs. As the air is pushed backwards out of the balloon the car will go forwards.

Your balloon is a type of rocket, it is a chamber filled with pressurized gas. A small opening called a *nozzle* allows the air to escape, causing *thrust* that propels the rocket. You can demonstrate this when you blow up a balloon and let it go without tying it off. The balloon will fly through the air as all the air inside escapes.

A *Certificate of Participation* can be sent to your class if you tell us how you get on. Please email your school and class details and the distance travelled to aberdeenbranch@britishscienceassociation.org and we will compile a 'Board of Honour'. Send us your images of the winning vehicle too!

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NOTES FOR TEACHERS

This task has been designed with the maximum amount of flexibility so you can adapt the concept to fit into the needs of your teaching. It is possible to do this as a simple one-off hour-long activity or it could form part of an integrated project that could take a week. The challenge can be differentiated easily and has been piloted with P1 groups through to S4. By splitting parts of the challenge up there is opportunity to introduce many collaborative learning techniques.

There is no “right answer” to this challenge and you will be amazed at the variety of solutions your classes will come up with. There are however some common misconceptions that crop up and these can be best avoided by familiarising yourself with the key scientific concepts that this project investigates (see below).

The most important part of this challenge, whatever the age or stage of your children, is to let them design, create, test and adjust their own racers. It is unlikely that their first attempt will work and if it does there will always be ways to make it work better. It is by this circular process of idea-test-evaluate they will learn the most.

KEY SCIENTIFIC CONCEPTS

Forces (pushes, pulls and twists) change the speed, direction or the shape of objects. Some forces work directly (eg: a kick on a ball), others work over a distance (eg: gravity). Friction is a force that can occur between surfaces and between an object and the air (air resistance). By investigating how friction affects motion students can suggest ways to improve efficiency in moving objects. The further the car travels the more efficient it is.
http://www.ltscotland.org.uk/curriculumforexcellence/sciences/outcomes/forceselectricityandwaves/index.asp

CURRICULUM FOR EXCELLENCE LINKS

Science: Forces electricity and waves- forces Science: Materials- properties and their uses Science: Topical science	Maths: Number money and measure Maths: Shape position and movement Maths: Information Handling
Science: Planet Earth- energy sources and sustainability Technologies: ICT to enhance learning	Technologies: Technological developments in society Technologies: Craft, design, engineering and graphics

The challenge also attains multiple aspects of *Literacy*, *Numeracy* and *Health and Wellbeing.*

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HINTS AND TIPS

Remember that the children will learn the most by thinking up and testing out ideas themselves. If they work first time then they can always be improved. If they don't work first (or second, or third) time the process redesigning and retesting is ultimately what this challenge is all about.

For inspiration check out the pictures on the second page and here are some ideas that have worked for us.

The body - Your vehicle needs to have a body that is stiff enough not to sag and large enough to hold the balloon without tipping over. Cutting out the bottom of a cardboard cereal box gives you a good starting point. Otherwise the lid of a plastic sandwich box would also work well. But there is no limit to the potential bodies your students could create. Set them the challenge of only using (rolled up and sellotaped) pieces A4 paper. They will have to use these as struts to build a chassis for the vehicle.

Wheels - The smoother the wheels turn the better your car will run. The wheels can be cut out of stiff card, otherwise you can use anything that is round and able to roll. The wheels need to be attached to the car. They can be fixed with blu-tac, tape or hot glued onto a skewer, a straw or a pencil and then threaded through holes in the body.

Axle - A really efficient way to attach your wheels is by running them through a larger diameter tube fixed to the bottom of the body. This will give a stable attachment of your wheels to the car with less friction compared to running the wheels through holes in the body. A small straw turning inside a larger straw will work as would a skewer in a straw.

Engine - For the purposes of this challenge only one balloon will power the vehicle. The easiest way to do this is to have the balloon pointing backwards so as the air that escapes from the balloon it pushes the car forwards (like a rocket). It is possible to have the air that escapes from the balloon traveling in the same direction as the car will go. To do this your students will have to work out some mechanism that will turn the wheels as the air is blown from the balloon (think water wheel). *NB: It is not possible to fix a balloon to the body and then have that balloon blow air onto a sail that is also fixed to the body- it just won't work.*

If you push pieces of straw into the neck of the balloon then this will hold the balloon open so you can both blow into it and tape it to your vehicle. Your students can be encouraged to experiment with the speed that the air leaves the balloon. This can be adjusted by using either straws or by pushing the balloon through a hole. By varying the size of the hole you will vary the amount of and speed that the air leaves the balloon.

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