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The Smallpeice Trust

ENGINEERING @SCHOOL

The Rubber Band Car Project

Year group: 3-6

smallpeice
Dare to imagine

#EngineeringAtSchool

RUBBER BAND CAR TEACHER GUIDANCE

This activity can be used as one of eight towards students obtaining the CREST Star or SuperStar Award.

What Is CREST?

CREST is a nationally recognised scheme for student-led project work in the STEM subjects (science, technology, engineering and maths).

CREST gives young people aged 5–19 the chance to choose their own subject and methodology when completing their hands-on investigation.

CREST provides activities and project ideas for a range of ages, group size and abilities. From off-the-shelf, one-hour long challenges through to large-scale, student-led projects of over 70 hours work or more, CREST can be done by anyone.

What is CREST Star and SuperStar?

Star and SuperStar levels are designed to be easy-to-run and low-cost for children typically aged 5-7 and 7-11 years. Children gain an Award by completing eight challenges.

You can download CREST Star and SuperStar passport templates for your students to track their progress once you create an account via

www.crestawards.org/crest-star

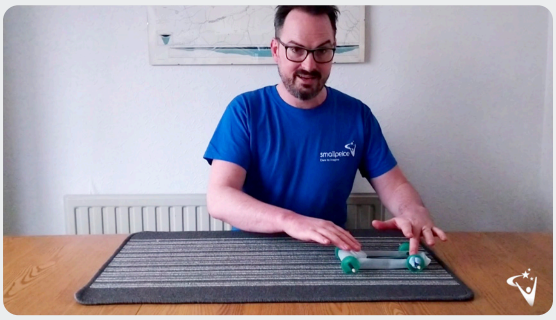
ENTRY FEE per child: £1 UK / £4 International*

Within four weeks of payment, you will receive certificates and fabric badges to give out to your class.

LENGTH OF LESSON: 1-2 HOURS

How to make your Rubber band Car:

https://bit.ly/2x9LfFo



LESSON OVERVIEW

The “Rubber Band Car” lesson explores the design of rubber band powered cars. Students work in teams of “engineers” to design and build their own rubber band cars out of everyday items. They test their rubber band cars, evaluate their results, and present to the class.

Learning Objectives

During this lesson, students will:

- Design and construct a rubber band car
- Measure distance and calculate velocity
- Test and refine their designs
- Communicate their design process and results

Learning Outcomes

- To consolidate the concept of speed
- To use “metres per second” (m/s) as the unit of speed
- To understand the efficient transfer of mechanical energy into kinetic potential energy and the interaction between energy and materials
- To design and build models by using different materials and to test selected functional characteristic of the model built with the chosen materials

Key Vocabulary:

FORCES, MOTION, ENERGY, TRANSPORT, SPEED/VELOCITY, MEASUREMENT, METRES

Curriculum links

SCIENCE KEY STAGE 2

- Working scientifically: asking relevant questions and using different types of scientific enquiries to answer them
- Working scientifically: setting up simple practical enquiries, comparative and fair tests
- Working scientifically: making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- Working scientifically: gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- Working scientifically: recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- Working scientifically: using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions

MATHS KEY STAGE 2

- Measure, compare, add and subtract lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml)
- Convert between different units of measure [for example, kilometre to metre; hour to minute]

DESIGN & TECHNOLOGY KEY STAGE 2

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at individuals or groups
- Generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design
- Select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately
- Apply their understanding of how to strengthen, stiffen and reinforce more complex structures

INTRODUCTION

Automotive Engineering

Explain to students that: Automotive engineers design the vehicles that we use for life, work, and play. They are involved in aspects of engineering design ranging from the initial design concept all the way to production. They design, test and refine vehicles for safety, style, comfort, handling, practicality, and customer needs. The work of automotive engineers falls into three basic categories: design, development and production.

Energy

Explain to students that: Energy is the ability to do work. All forms of energy fall into two basic categories: potential energy and kinetic energy. Potential energy is mechanical energy which is due to a body's position. It is also known as stored energy. A car at rest has potential energy. Kinetic energy is mechanical energy that is due to a body's motion. For a car to move, potential energy must be transformed into kinetic energy.

Newton's Laws of Motion (taught at key stage 3)

Explain to students that: Sir Isaac Newton was a brilliant mathematician, astronomer and physicist who was one of the most influential figures in human history. Newton studied a wide variety of phenomena during his lifetime, one of which included the motion of objects and systems. Based on his observations he formulated Three Laws of Motion. Newton's First Law – An object at rest will remain at rest and an object in motion will remain in motion at a constant speed unless acted on by an unbalanced force (such as friction or gravity). This is also known as the law of inertia. Newton's Second Law – An object's acceleration is directly proportional to the net force acting on it and inversely proportional to its mass. The direction of the acceleration is in the direction of the applied net force. Newton's Second Law can be expressed as: $F = ma$. Newton's Third Law – For every action there is an equal and opposite reaction.

What is a rubber band car?

Explain to students that: A rubber band is a really simple way to power a model car. By stretching a rubber band, you are turning your mechanical energy into elastic potential energy. When you let the car go, this is then turned back into mechanical energy as it turns the wheels, powering the car forward.

Rubber band car designs

Explain to students that: There are a huge variety of designs for rubber band cars. Usually they are made up of a chassis and two pairs of wheels connected by an axle. One axle should be connected to one end of a rubber band, the other connected to the chassis. That axle can then be rotated, wrapping the band around it, creating elastic potential energy. When the axle is let go, the car should race forward.

Materials

WHEELS:
bottle tops, cardboard circles, or even old CDs

AXLES:
chopsticks, straws, pencils, cocktail sticks

CHASSIS:
plastic bottle, lollypop sticks, pencils, cardboard (a toilet roll tube will do, although this may need reinforcing)

RUBBER BAND:
you can also use loom bands connected together

TAB ON THE REAR AXLE:
cardboard reinforced with tape, but a stronger one might be made using a small nail or screw

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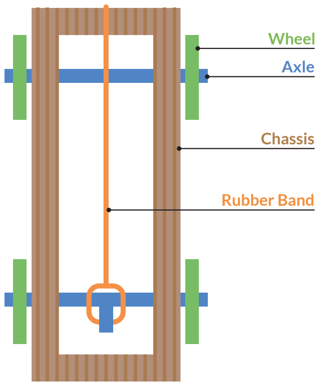
Attaching the parts together can be achieved with a glue gun ideally, but if you don't have one, tape will do.



MAIN ACTIVITY

1. Divide students into groups of 2-3 students, providing a set of materials per group.

2. Explain that students must develop a car powered by rubber bands from everyday items, and that the rubber band car must be able to travel in a straight line as far as possible. Rubber bands cannot be used to slingshot the cars.
   The car that can travel in a straight line for the greatest distance is the winner.

3. Ask students to develop a plan for their rubber band car. They will need to decide and agree on the materials they will use, write/draw their plan, and present their plan to the class.

4. Show students the student activity sheet and explain that they will need to follow the instructions to make their car.

5. Student groups next execute their plans and build their car using the materials they have chosen. They may need to rethink their plan, request other materials, or start again if the materials chosen are not working.

6. Next, teams will test their rubber band car.
   To ensure that the rubber band cars travel in a straight line.

7. Teams complete an evaluation / reflection worksheet, and present to the class.

PLENARY (QUESTIONS TO ASK STUDENTS)

1. **Did you succeed in creating a rubber band car? If so, how far did it travel? If not, why did it fail?**

2. **Did you negotiate any material trades with other teams? How did that process work for you?**

3. **What is the average speed your car achieved?**

4. **Did you decide to revise your original design or request additional materials while in the construction phase? Why?**

5. **If you could have had access to materials that were different than those provided, what would your team have requested? Why?**

6. **Do you think engineers have to adapt their original plans during the construction of systems or products? Why might they?**

7. **If you had to do it all over again, how would your planned design change? Why?**

8. **What designs or methods did you see other teams try that you thought worked well?**

9. **Do you think you would have been able to complete this project easier if you were working alone? Explain…**

FAQ'S

What if my cars wheels are spinning, but not moving?

A common problem once students build their car is that the wheels spin without moving the car forward. This happens when the wheels don't grip the surface well enough, in other words, there is not enough friction between the wheel and the floor. There are several ways to increase the friction force.

- We can increase the downwards force of the car. The downwards force is weight and is due to gravity and the mass of the car. We can't change the strength of gravity (unless we go to another planet), but we can increase the mass of the car. Try adding some bluetac or playdough to the wheels. Although a heavier car will not move as far from the same force (remember F=ma), so we need to balance this against the need for more friction. These kinds of considerations are typical of engineering.
- Alternatively, we can change the smoothness of either the wheel, or the surface. The simplest way is to run your car along carpet which leads to much more friction than a smooth floor. You could also investigate reducing the smoothness of your wheels. In real cars, tyres have tread, which is a pattern of grooves in the rubber, reducing the smoothness, increasing the friction between them and the road.