



Crumble robotic vehicle

Lesson Plan

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Summary

Recommended level – Years 5-6

Time taken for basic activity – 4-6 hours

Time taken for extension activities - 4-6 hours

Pupils to work in groups of 3

Additional adult help is recommended

Expectation – each group to complete a computer controlled robotic vehicle

Associated resources:

Make a Crumble robotic vehicle blog

Crumble robotic vehicle PowerPoint

Crumble robotic vehicle worksheet

Crumble robotic vehicle worksheet – suggested answers

Crumble vehicle extension activities blog

Crumble vehicle extension activities PowerPoint

Crumble vehicle extension activities worksheet

Crumble vehicle extension activities worksheet – suggested answers

STEM Links

- Science: electrical circuits, forces, materials
- Technology: design & make process, mechanical systems, electrical systems, computing
- Engineering: integrated mechanical, electrical and control systems, troubleshooting
- Mathematics: drawing 2-D shapes, measurement

Curriculum Learning Objectives – it is recommended to cover these topics prior to the exercise so that the pupils are reinforcing their knowledge and understanding, rather than meeting the topics for the first time.

Science: Electricity (Year 6)

Pupils should be taught to:

- compare and give reasons for variations in how components function
- use recognised symbols when representing a simple circuit in a diagram

Pupils should construct simple series circuits to help them to answer questions about what happens when they try different components, for example bulbs and motors. They should learn how to represent a simple circuit in a diagram using recognised symbols.

Science: Forces (Year 5)

Pupils should be taught to:

- identify the effects of friction, that acts between moving surfaces

Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects. Pupils should explore the effects of pulleys and simple machines on movement.

Science: Materials (Year 5)

Pupils should be taught to:

- identify and compare the suitability of a variety of everyday materials for particular uses

Pupils should be encouraged to think about unusual and creative uses for everyday materials.

Design and Technology (Key Stage 2)

Through a variety of creative and practical activities, pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making.

When designing and making, pupils should be taught to:

Design and Technology: Design

- design innovative, functional, appealing products that are fit for purpose
- generate, develop, model and communicate their ideas

Design and Technology: Make

- select from and use a wide range of tools and equipment to perform practical tasks
- select from and use a wide range of materials and components according to their functional properties and aesthetic qualities

Design and Technology: Evaluate

- evaluate their ideas and products and consider the views of others to improve their work

Design and Technology: Technical knowledge

- understand and use mechanical systems in their products [for example pulleys]
- understand and use electrical systems in their products [for example series circuits incorporating bulbs and motors]
- apply their understanding of computing to program, monitor and control their products

Computing (Key Stage 2)

Pupils should be taught to:

- design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts
- use sequence, selection, and repetition in programs; work with variables and various forms of input and output
- use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs

Equipment needed

Parts included in class kit:

- 10 Crumble controllers
- 10 micro-USB cables
- 10 battery boxes
- 20 motors
- 20 motor mounts
- 100 crocodile leads
- 60 assorted plastic pulleys
- 10 motor pulleys
- 100 plastic wheels
- 30 coloured LEDs (light emitting diodes)
- 10 light sensors (phototransistors)
- 250 drinking straws
- 20 wooden rods
- 10 sheets of corrugated plastic
- 1 pack of rubber bands
- 200 cable ties

Check you have received the correct contents in your class kit. Try pushing the pulleys and wheels onto the wooden rod to check they fit tightly. (There can be a slight variation in the diameter of the dowel due to the wood's moisture content. If the wheels are slightly loose on the dowel you could glue them on. If the wheels and pulleys are too tight to go on you can sand the rod down a little.) Please let TTS know if there are any problems as soon as possible.

Tools and consumables needed (not included in class kit):

- 10 computers (Windows XP SP3 or newer, or Mac OS X 10.6 (64-bit) and above)
- 30 AA new cells (these are often called batteries)
- Rulers
- Marker pens
- Large scissors
- Pencil sharpeners
- Sandpaper
- Sharp pencils
- Double sided foam sticky tape heavy duty 1mm thick x 12mm wide – several rolls
- Secateurs for cutting wooden rod – **only for use by responsible adults**

For extension activities:

- Old mountain bike inner tube or long balloons or small balloons
- Lightweight passengers e.g. plastic figures or bugs
- Decorations e.g. self-adhesive gems
- Tape measure
- Masking tape or chalk
- Stopwatch
- Calculator
- Wooden ramp (a sheet of plywood without splinters will also work)
- Protractor
- Low melt glue guns and glue sticks **Note: Don't use high melt temperature glue guns.**

Risk Assessment

Conduct a risk assessment before undertaking the activity. A sample risk assessment is given below; you can use this as a starting point when writing your own. (L=low, M=medium, H=high)

Activity	Identified Hazard	Initial Risk Rating L/M/H	Control Measures	Controlled Risk Rating L/M/H
Use of glue guns	Burns	H	Children should be supervised by a responsible adult at all times when using the glue guns. Explain to children how to use the glue guns. Warn them that the ends are very hot. Use only low melt temperature glue guns. If burned hold under running water for ten minutes. Don't switch on the glue guns until after the safety briefing. In some schools children wear safety goggles when using glue guns.	M
Use of scissors	Injury e.g. to fingers	M	Make the children aware of the dangers. Do not give out the scissors until after the safety briefing.	L
Use of secateurs	Severe injury e.g. to fingers	M	Do not allow the children to use these. Only for use by responsible adults	L
Use of cable ties	Cable tying fingers and cutting off blood supply	M	Explain the dangers to the children. Cut cable ties off fingers immediately.	L
Running extension leads along floor for glue guns	Tripping	M	Avoid using extension leads if possible. Otherwise make sure extension leads are run where they cannot be tripped over.	L
Damaged extension leads or glue gun leads	Electric shock	H	Conduct a visual check of all electrical items before session to ensure the leads are undamaged. PAT test extension leads and glue guns regularly.	L

Preparation needed

- Use a craft knife and steel rule to cut some of the corrugated plastic sheets into 25 cm x 25 cm squares. You can get 4 of these from one sheet. You need 11 squares in a variety of colours, including the one for your sample vehicle.
- Build a sample vehicle to explore any pitfalls, and to demonstrate to the pupils what they will be making and how it works. Instructions are given in the 'Make a Crumble robotic vehicle' blog and the 'Crumble vehicle extension activities blog'. After cutting out your vehicle base from one of the squares of plastic, use it as a template to draw round on the remaining ten squares, making sure the corrugations are in the right orientation. Do this before you start attaching the components to it. Draw round it in fine marker pen so that the size of the copies is similar to the template.
- Use a craft knife and steel rule to cut out the slots in the ten marked out squares. If you don't have large, good quality scissors for the pupils to use then you could cut out the outline of the base for them as well.
- Use a pair of secateurs to cut 10 pieces of wooden rod 14 cm long for mounting the front wheels. Cut 20 pieces of wooden rod 16 cm long for mounting the rear wheels.
- Print out a copy of the worksheet for each group. This should be printed double-sided in colour on A4, then folded to make a booklet.
- Book the school hall for testing the vehicles. On the day set up a course for the vehicles to follow using masking tape or chalk. Make sure it is a straightforward course such as a large square, as it is hard to control the vehicles accurately. You could also set up a more complicated course to challenge the more advanced pupils.
- If you don't already have the Crumble software installed on your computers then install it as follows. Set up a destination folder called 'Crumble' on the computer where you want to install the software, e.g. on your Desktop. Download the Crumble software onto the computer from here: <https://redfernelectronics.co.uk/crumble/>. Double click on the downloaded file and run the set-up wizard. Click 'Next' then when asked where to install the Crumble software click 'Change...' and choose the destination folder you set up earlier. Navigate to the destination folder and double click on 'Crumble'. The window shown on the right should appear.
- As there are only 10 sets of Crumbles and other components you may need to dismantle your vehicle after demonstrating it so that the pupils can re-use the parts for their vehicles.
- Note that the PowerPoints which guide the pupils through the build process include teacher notes giving additional information and explanations. Read through and share this additional information with the pupils to help them complete their vehicles successfully.

