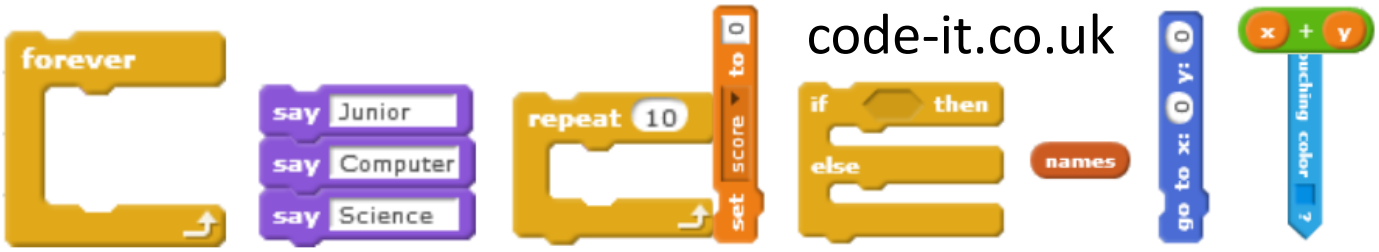

Crumble Buggy

Module Aim Design, build and program a moving programmable vehicle

Learning Path

1, Design → 2, Build → 3, Program

Optional Extensions: 3a, Headlights | 3b, Indicators | 3c, PIR Anti Theft

Computing National Curriculum

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**

Design & Technology National Curriculum

Technical knowledge

-**apply their understanding of how to strengthen, stiffen and reinforce more complex structures**

-**understand and use mechanical systems in their products** [for example, gears, pulleys, cams, levers and linkages]

-**understand and use electrical systems in their products** [for example, series circuits incorporating switches, bulbs, buzzers and motors]

-**apply their understanding of computing to program, monitor and control their products.**

Module Overview

There are quite a few decisions to make before embarking on this project.

Firstly do you want all your pupils designs to work or are you happy for them to learn through failure?

Would it be ok if some of their designs never worked?

Whilst in my ideal world pupils would learn from their failures many primary schools don't allocate enough time to DT for this to happen.

I suspect a steered path to success where they have choice about some elements but less choice over others is probably more realistic.

Are pupils going to take the electronics home with them?

Are you going to make more expensive vehicles with gears built into the motors which enable really accurate steering or vehicles the children gear for themselves that steer but are less precise in their movements.

You could also use a servo motor to steer as these move much slower.

Before we move onto planning we are going to consider types of models, costs, drawbacks and positive factors.

Year Group

-I have taught this successfully in Year 5 & 6. Whilst the base programming is not complex the addition of the DT elements adds more challenge

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Crumble Buggy 2

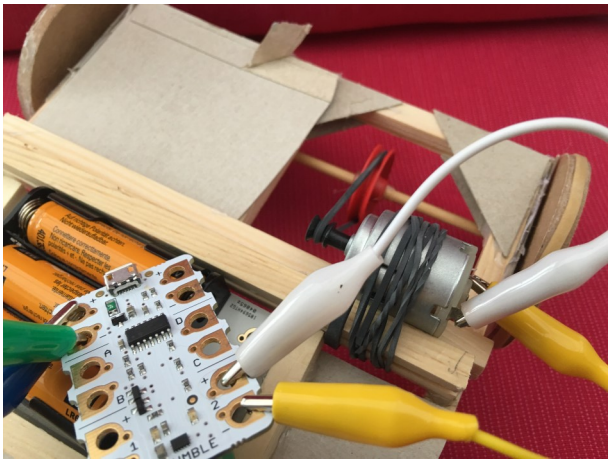
Option 1

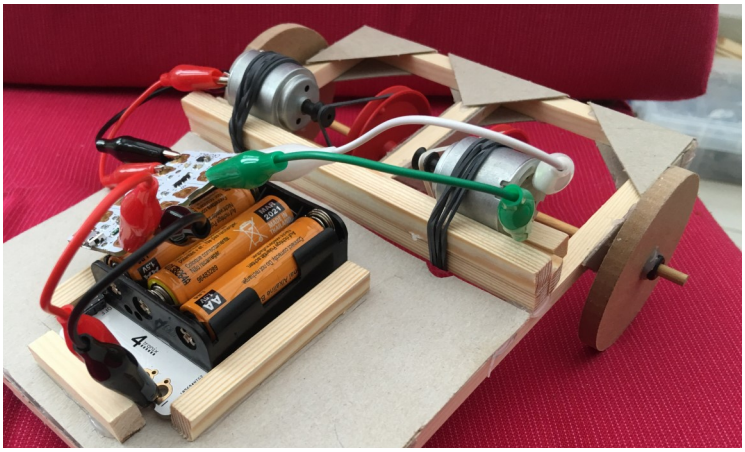
A classic two axle four wheel vehicle where one motor powers one axle. This is the simplest adaptation from the basic non programmable buggy.

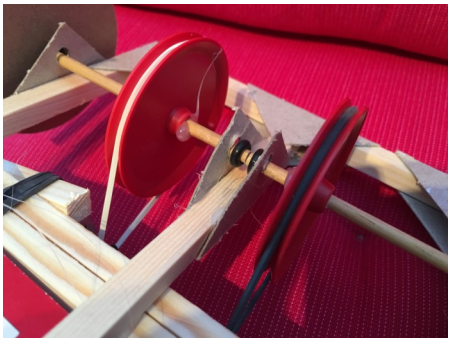
Costs crumble board £10, crocodile clips £3.75, usb cable £1.75, standard motor 72p, miniature pulley 20p, small or medium pulley 21p, Battery Pack £3.50 + 8mm spar, 4mm dowel, card triangles, wooden wheels, rubber bands, glue, rubber washers

Pros very easy to adapt from previous buggy creation, can look at gears, can swap crumble board and battery pack for a cheaper one to take home.

Cons can only go forward and backwards and fast and slow







Two separate axles secured to 4mm dowel via rubber washers.

Note the extra central 8mm spar to hold the card triangles

Option 2

Split rear axle where each wheel is powered separately. The front needs a small metal ball caster to allow the vehicle to turn on the spot. The addition of an extra motor allows steering and much more complex programming challenges.

Costs crumble board £10, crocodile clips £3.75, usb cable £1.75, 2x standard motor 72p each, 2x miniature pulley 20p each, 2x small or medium pulley 21p each, Battery Pack £3.50, Small metal ball caster £1.95 + 8mm spar, 4mm dowel, card triangles, wooden wheels, rubber bands, glue, rubber washers

Pros easy to adapt from previous buggy creation, can look at gears

Cons The motors are geared to run fast so steering can be tricky

The small metal ball caster is a must as it allows easy steering

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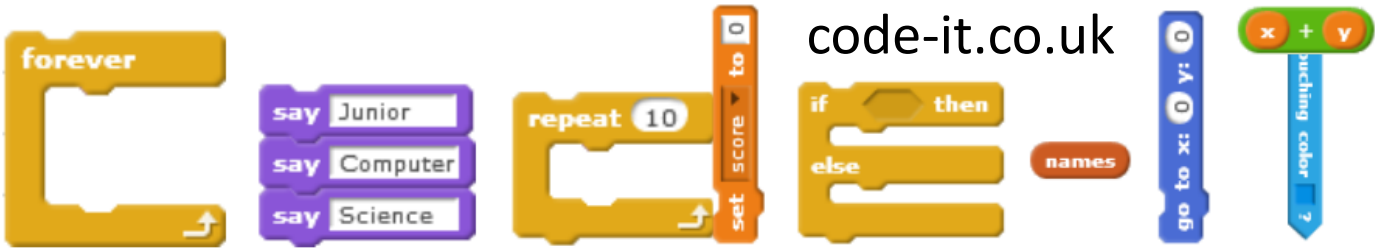

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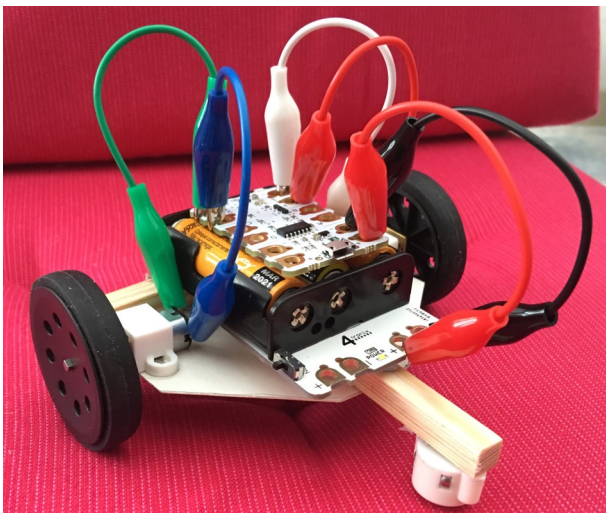
Crumble Buggy 3



Option 3

Split rear axle where each wheel is powered separately through a geared motor. The front needs a small metal ball caster to allow the vehicle to turn on the spot. The addition of an extra motor allows steering and much more complex programming challenges.

Costs crumble board £10, crocodile clips £3.75, usb cable £1.75, 2x Geared motor £5.70 with bracket 80rpm model Battery Pack £3.50, Small metal ball caster £1.95 + 8mm spar, 4mm dowel, card triangles, wooden wheels, glue, rubber washers

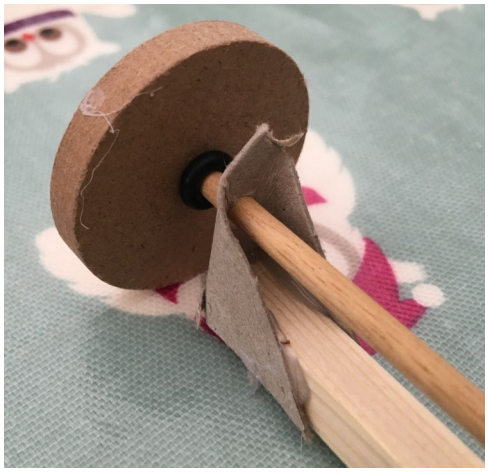
Pros very controllable

Cons as the gears are built in it is less easy to look at gears, more expensive

Possible Option 4

The rear axle is driven by a single standard motor as in option 4 but the front axle is steered by a go-cart principle using a servo motor.

I haven't tested this one fully but I include it to suggest that there are lots of other options all with their own challenges.



Servo motors are here £5.50 each

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Crumble Buggy 4

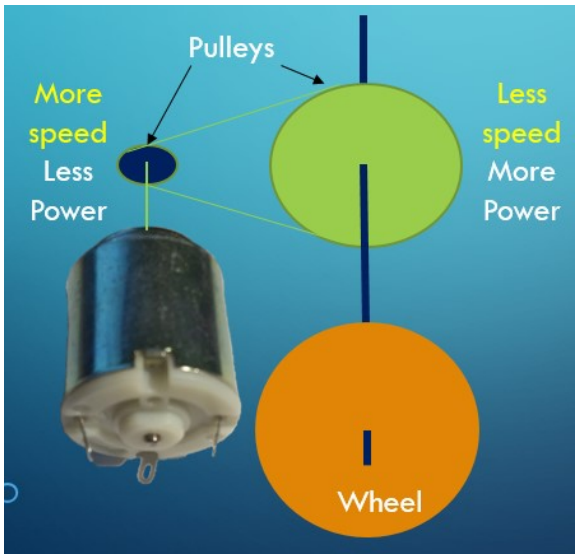
Design

Start by explaining that they are going to design make and program a moving vehicle.

Show them the materials that they are going to use for the project. I always find that it helps them to think through what they are going to make if they can see the materials.

You may wish to run through the materials, design specifications and reminders using one of the Power-Points available for each specific buggy type or adapt one to fit your project.

Don't allow anyone to start making until the vehicle until you have checked their design against the factors identified in the PowerPoints.



Gears are one of the considerations outlined in the PowerPoints

Make

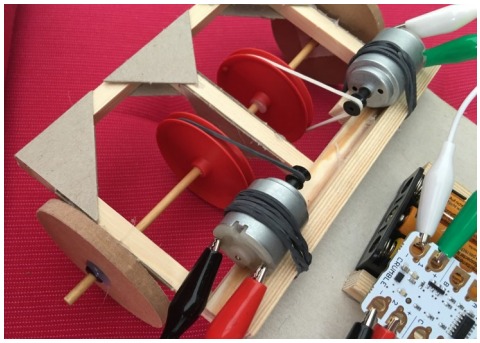
Make sure you go over all safety procedures for using materials especially saws and glue guns.

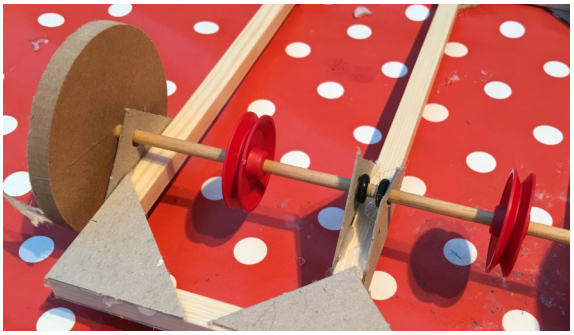
Remind them to measure carefully and mark around the wood not just on one face to help straight sawing

You may want to demo safe sawing if it has been awhile

Remind them that no electronic components should be near sawing or gluing

Supervise appropriately





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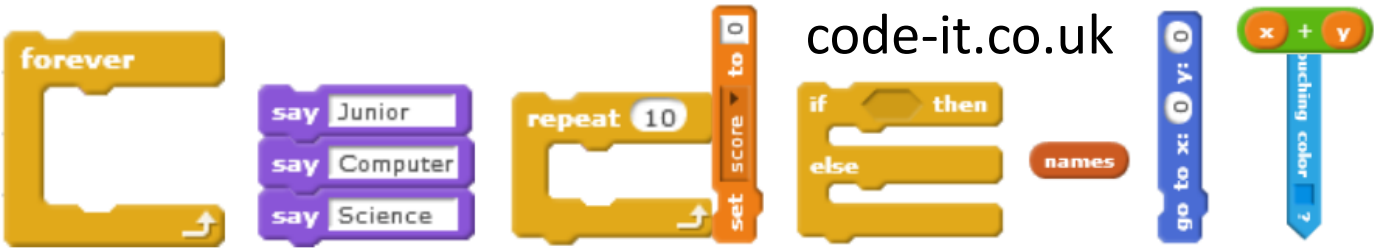

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Crumble Buggy 5

Program

Programming the motors is really easy and uses a Scratch like block based language.

Give them the
power maker card
motor maker card
Connection maker card

Challenge them to work out how it all connects. The cards also have example blocks to use.

Debugging Hints

Sometimes a motor will start up straight away if the last person has left the code stored on the board. This is normal they will replace this code when they press the green triangle when crumble board is wired up to the computer.

If you are using the newer battery packs with the power switch on the side (recommended) then make sure the switch is on to power the board. The board will still receive instructions if plugged into the USB but the motors won't work without the battery pack being switched on.

Check the wiring and remember you can easily short wires if the rubber covers are removed from the crocodile clips

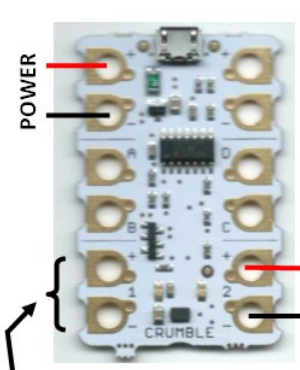
If using the geared motors the connects can be small and clips can easily slip off.

Remember you need to specify how long a motor stays on or off for using seconds or milliseconds.

Are the pulleys and wheels glued to the axle?

Make a single twist in the elastic band to increase the friction.

Is the elastic band tight enough?



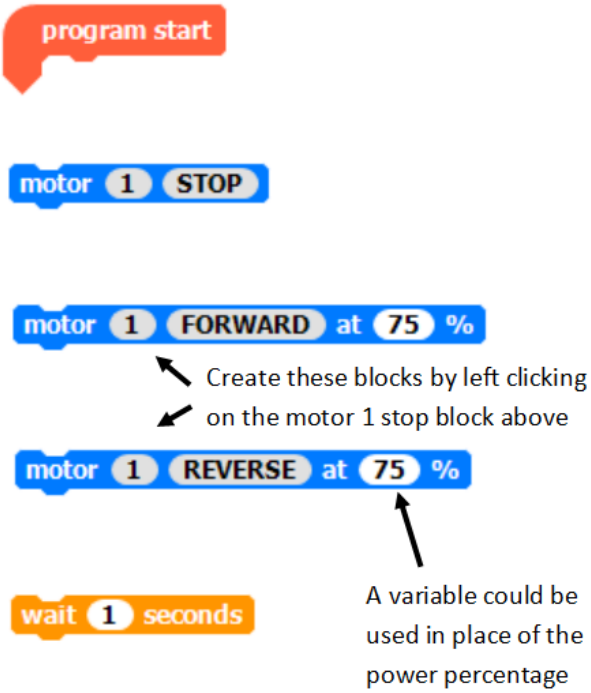
Motors need a battery plugged in to work

Motor 1 on the left

Motor 2 on the right

Up to two motors can be controlled with the crumble.

Motor connected to motor 2



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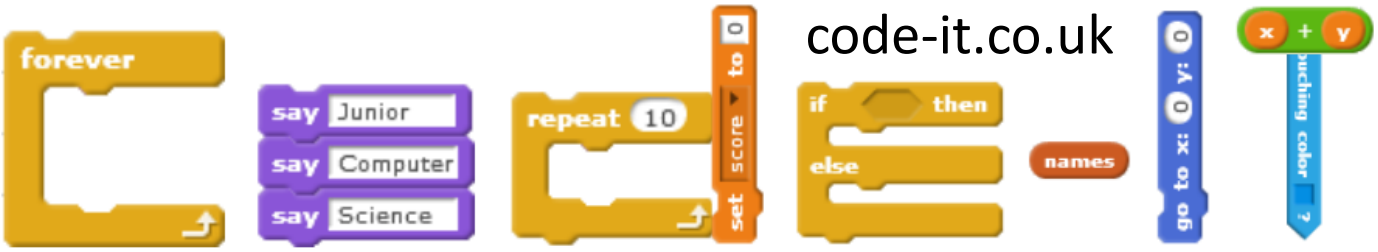


Crumble Buggy 6

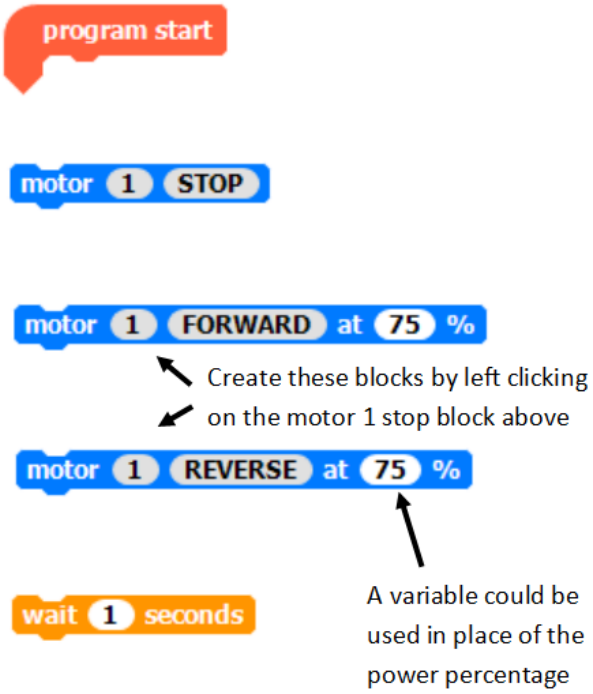
Programming Challenges

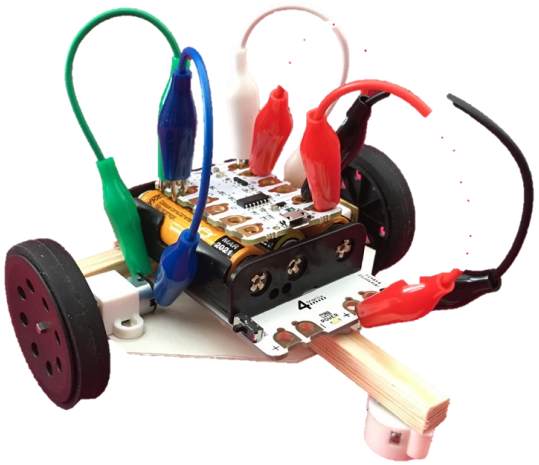
All buggy challenges

- Move
- Start and park in a marked square
- Cross two parallel lines three times
- Start slowly and speed up
- Start fast and slow down
- Start slowly speed up and then slow down and stop

Buggy 2 & 3 Additional challenges

- Navigate a basic marked track (masking Tape)
- Navigate a more complex track (masking tape)
- Robot buggy sumo place two buggys in the centre of a circle touching each other on command they are both turned on, teacher releases them at the same time. First buggy pushed out loses
- Add headlights (LEDS or Sparkles)
  - LED Card
  - Sparkle Cards
- Add indicators (LEDS or Sparkles) and program them to flash when turning
  - LED Card
  - Sparkle Cards
- Add a PIR sensor and buzzer and program an anti theft warning device when the vehicle is ap-proached
  - PIR Card





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