

eRally: Model Making

The following pages give some possible support materials that could be used selectively with the learners to help them with aspects of the challenge.

- 1) Ideas for assembling the model car
- 2) Ideas to help learners explore different types of transmissions
- 3) Ideas to help learners begin to think about how they could incorporate circuits into a model

Lesson Idea:

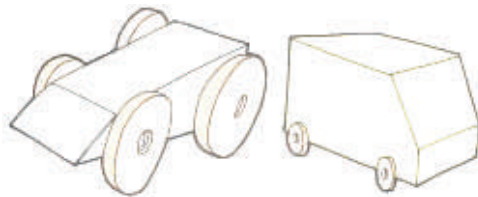
PROJECT OVERVIEW

Designing and Assembling a model car

Introduction:

Ideas on this page can be selectively used to help learners think about building a model car design after sketching up possible ideas.

- 1) The chassis: Learners should design and make their own chassis.
- 2) The body: Learners could design and make their own body
- 3) Transmission: Learners use a battery powered circuit to drive a motor that makes the model move).
- 4) Learners could incorporate other circuits (lighting).
- 5) Graphics: Pupils use manual graphics or computer aided graphics to enhance the aesthetics of their model car.
- 6) A key aspect of the challenge is safety and learner could consider incorporating a roll cage into the design



Stimulus:

Exemplar model cars

Circuit examples

Car chassis examples

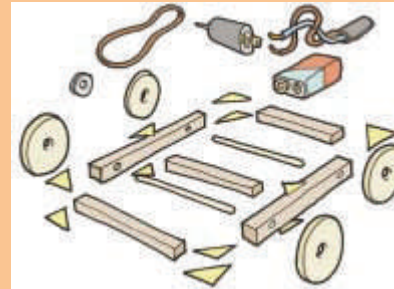
Graphics Examples

Car body examples

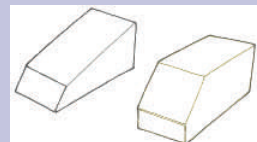
Task:

Learners are asked to design and make a model rally car. This is broken down into mini-projects to aid understanding and allow flexibility in teaching approaches.

The chassis part of the project allows learners to design and make a model that will hold/support a battery, a motor, axles, wheels, and some way of driving one axle from the motor.

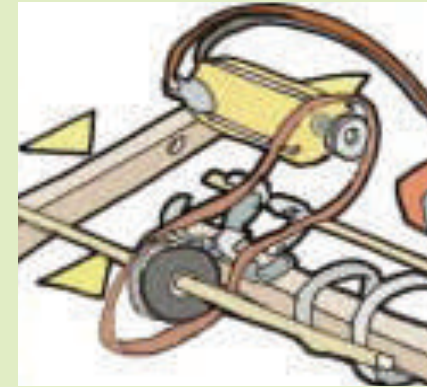


The body part of the project allows learners to design and make a car body that will fit onto the chassis they have made. The body will be formed using a simple surface development which can be drawn using manual graphics or C.A.G.

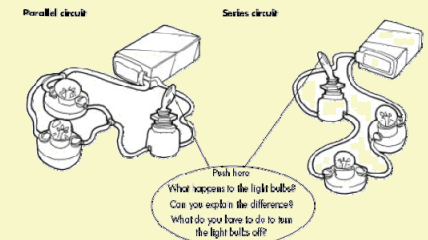


Learners can render the surface development prior to bending and sticking to shape or can use a desktop publishing program to design the graphics.

The transmission part of the project allows learners to design with given components. Learners should design a way of using the rotating output from an electric motor to drive the front or rear axle of the model.



There is scope here for learners to design and integrate some kind of lighting system onto the model. This could model, head-lights, tail-lights, indicators or aesthetic lighting.



Reflection:

Learners should evaluate each step of the project, discussing and deciding what went well and what could be improved with each part (chassis, body, drive system, electronics, lights, graphics)

Chassis Assembly— Wooden Model

Introduction

The task of teaching the design and manufacture of the chassis can be as managed or free as a teacher chooses. The design shown on the right is a suggestion, is easy to resource and should be easy for the majority of learners to manufacture. The most important outcome is for all learners to have a working chassis that allows the model to move under its own power.

Stimulus

Exemplar chassis's

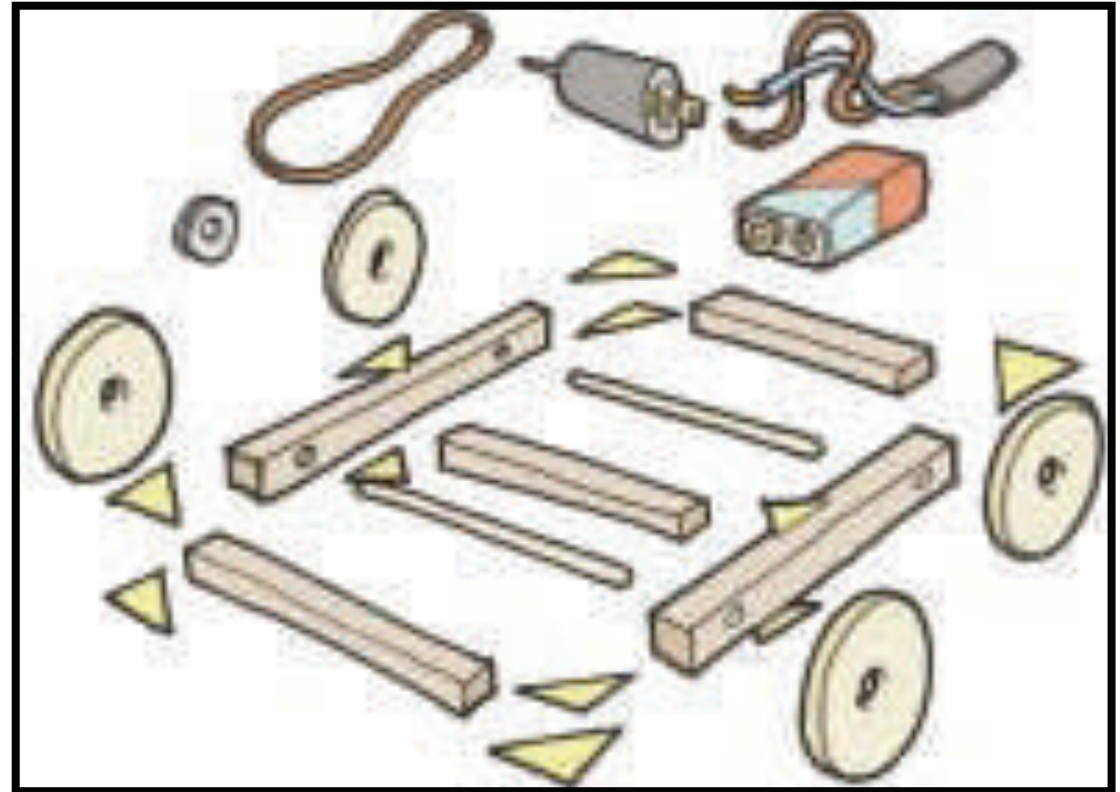
Examples of chassis from real applications (videos or photographs)

Task

The task could include learners learning parts of the design process, applying and learning terminology from the design process (such as primary and secondary functions, safety, ergonomics...). It could also be used to teach learners how to use basic hand/machine tools and assembly techniques.

The chassis should be sturdy enough to support the axles whilst they are being driven by the motor. The motor and battery must also be supported.

The chassis could also be a design task in itself. It could be made from materials other than wood, such as card, aluminium, plastic sheet, etc...



Reflection

Learners should reflect on problems they have come across in building the chassis. They should reflect and report on the affect of these problems on next steps (designing and building the body and lighting).

Discussion points: Length of elastic band and tension on elastic band, size of pulley wheels, diameter of axle, diameter of axle holes, securing the motor, shape of pulley wheel, how wheels are joined to axles.

Next Steps

Learners could now design and build a lighting circuit to attach to the model.

Learners design and make a body for the model (investigating a variety graphic communication techniques).

1. Mark and cut wood to length using a tenon saw or scroll saw. You will need two "*sides*", two "*ends*" and a "*cross brace*". The *cross brace* should be the same length as the *ends*. Lightly sand the *ends* of the wood to remove burr. Dimensions: Sides = 125mm in length, Ends to make width of chassis 55mm.

2. Mark the position of the holes in the *sides* and carefully drill two holes in each piece. The holes should be slightly bigger than the dowel used for the *axles* (by about 0.2mm). There may be a jig available to help you do this accurately.

3 a. Align *End* pieces with the end of the *sides* and place the *cross brace* half way along the length of the chassis.

3 b. Check that it goes together 'square' then glue it up using PVA or a hot glue gun. You may have access to a jig to make this easier. Make sure you put *rubber bands* around the *cross brace* before you glue it up (this will be used to hold on the *motor* and *battery*).

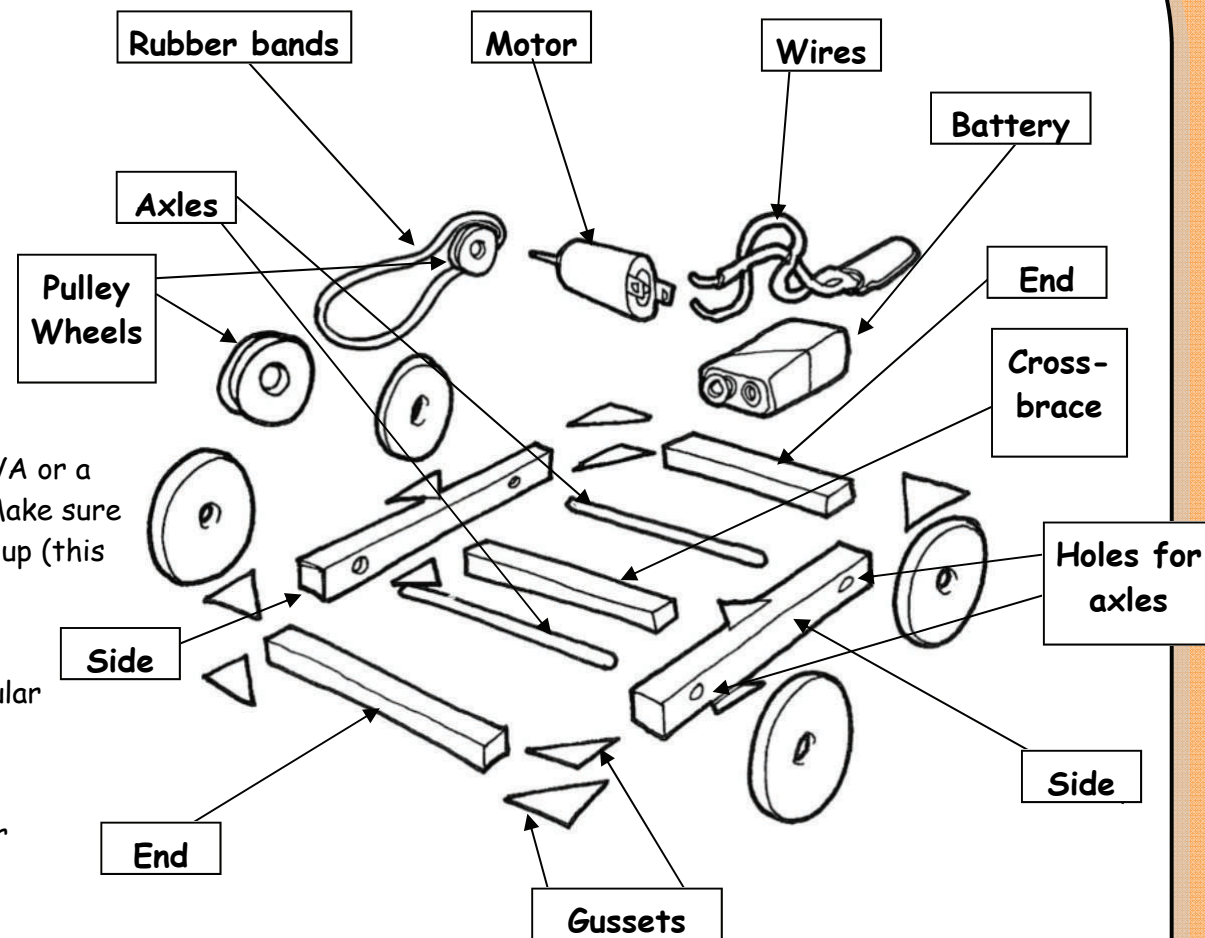
4. Once the glue on the wood has dried, use *gussets* (cut triangular pieces of card) to strengthen the structure.

5. Mount the *motor* and *battery* on the *cross brace* using rubber band/tape. Attach a *pulley wheel* to the *motor*.

6. Glue one *wheel* to one end of each *axle*. Slide into the *chassis* from one side. Before sliding them right through attach a *pulley wheel* to **one** *axle*. This will be the driven *axle*. Also loop a rubber band over the *pulley*. Finish by sliding the *axle* all the way through to the other side and glue on another *wheel*.

7. Loop the *rubber band* from the *pulley* at the *driven axle* to the pulley at the *motor*. Hook up your *battery* and enjoy.

This is a basic design. Changes can be made by adding switches, lighting circuits, larger/smaller pulley wheels, larger/smaller wheels, etc...



Body Design & Assembly— Graphics

Introduction

The body part of the project allows learners to design and make a car body that will fit onto the chassis they have made. The body will be formed using a simple surface development which can be drawn using manual graphics or C.A.G. A surface development is the 2D shape that is folded to make the 3D body from paper, card or some similar material.

Once the surface development has been drawn learners can be given the opportunity to render the surface using manual graphics or C.A.G. Learners can use this to learn skills relevant to Graphic Communication.

Stimulus

Exemplar surface developments with graphics

Exemplar surface developments without graphics

Templates for surface developments (see appendix)

Templates on C.A.G. package (i.e. Xara, Freehand, In-Design)

Task

Learners create a body to cover the chassis they have made. This can be easily differentiated through use of templates for body shapes and graphics through to allowing learners to design shapes and graphics on their own.



Reflection

Learners could display the surface development in the classroom, school or on Glow.

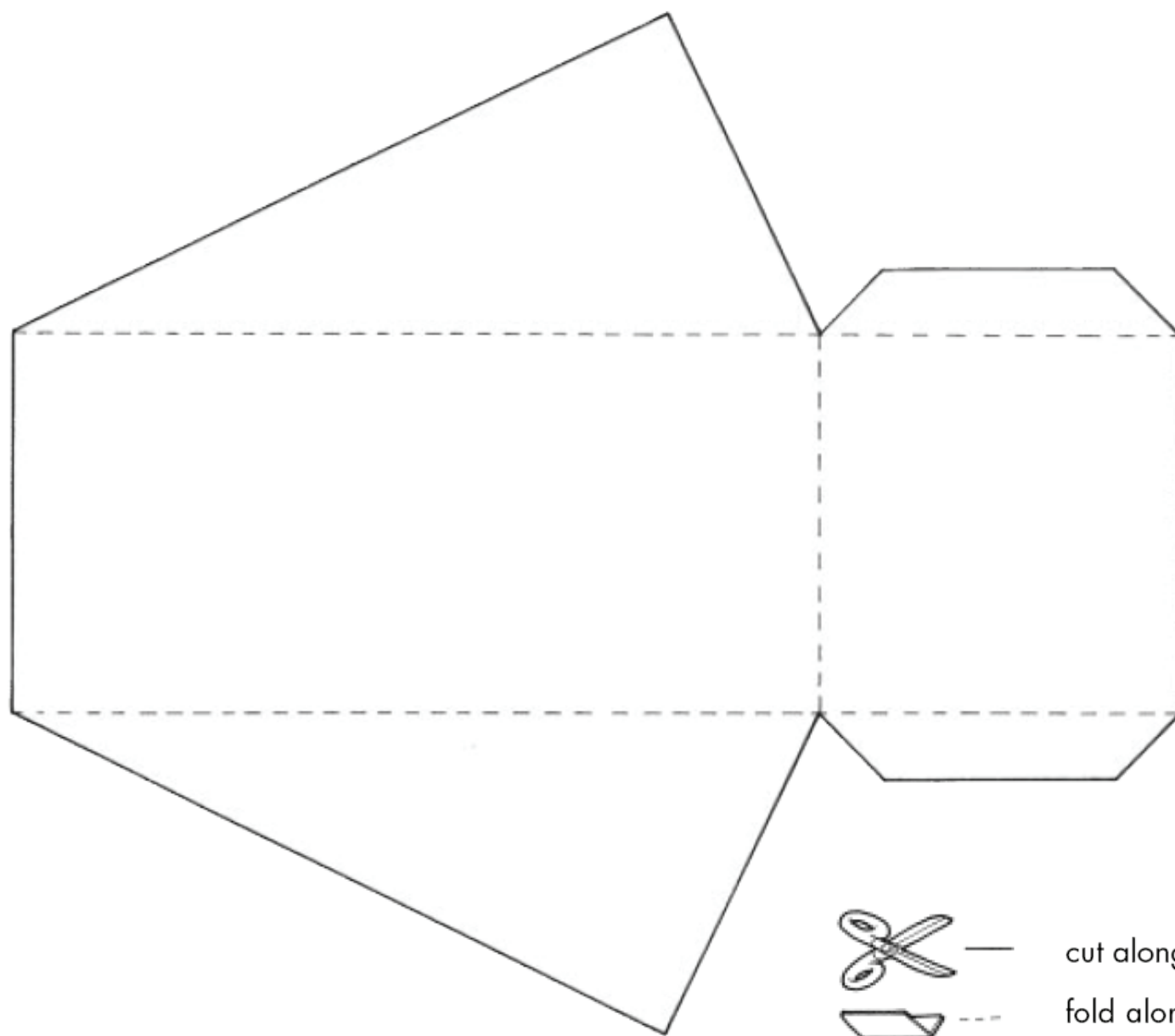
Learners could discuss/demonstrate their understanding of; drawing simple surface developments, using graphics (font, line, colour, shape) to enhance a product.

Next Steps

Learners could attach the body to the chassis in a range of ways but should bear in mind that they may have to remove the body to fix any problems with the chassis.

Worth exploring:

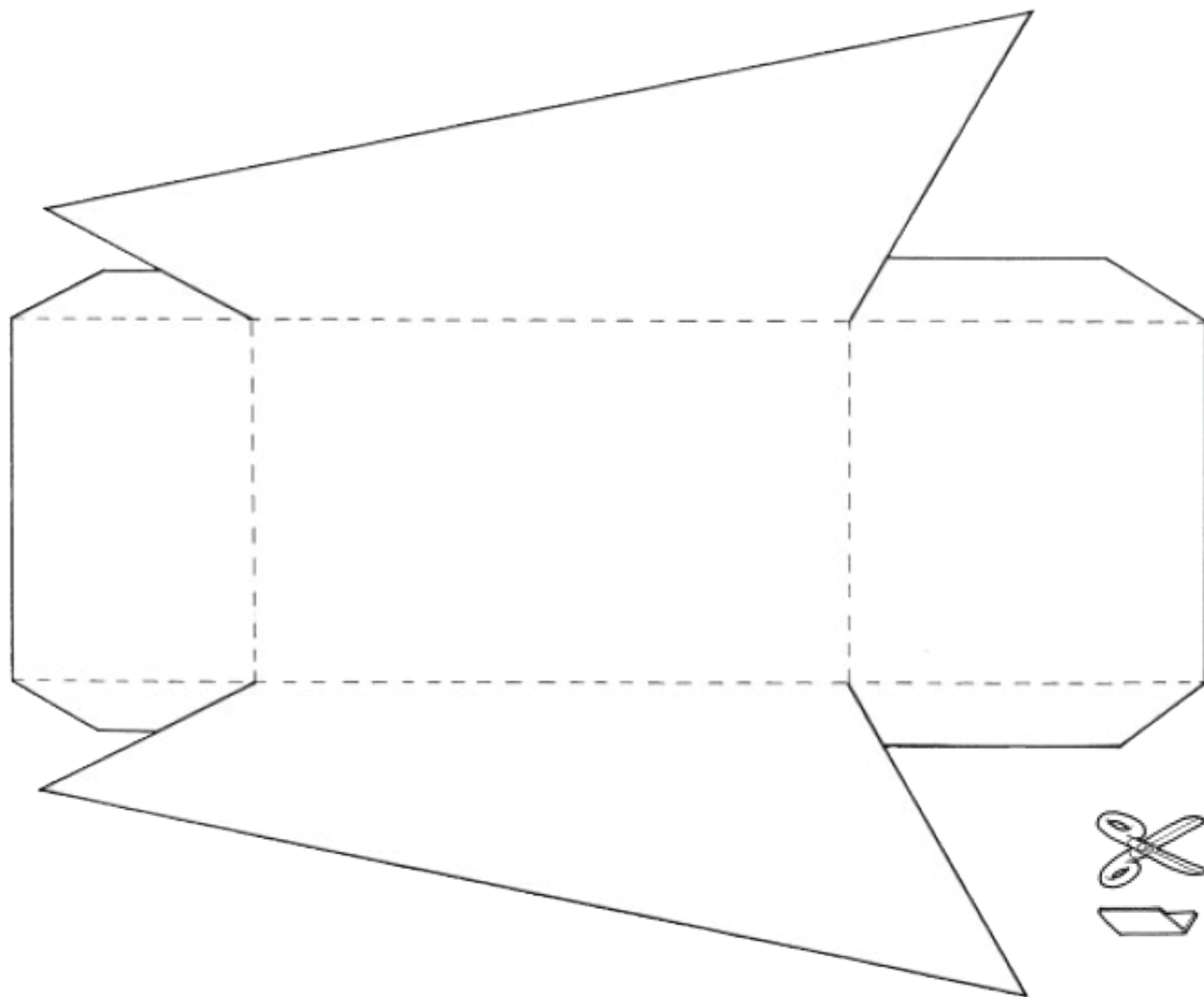
Discuss and record information regarding colour theory. Look at Primary, Secondary and Tertiary colours, harmony, contrast, tone and tint. Use this knowledge to explain why certain colours have been chosen.



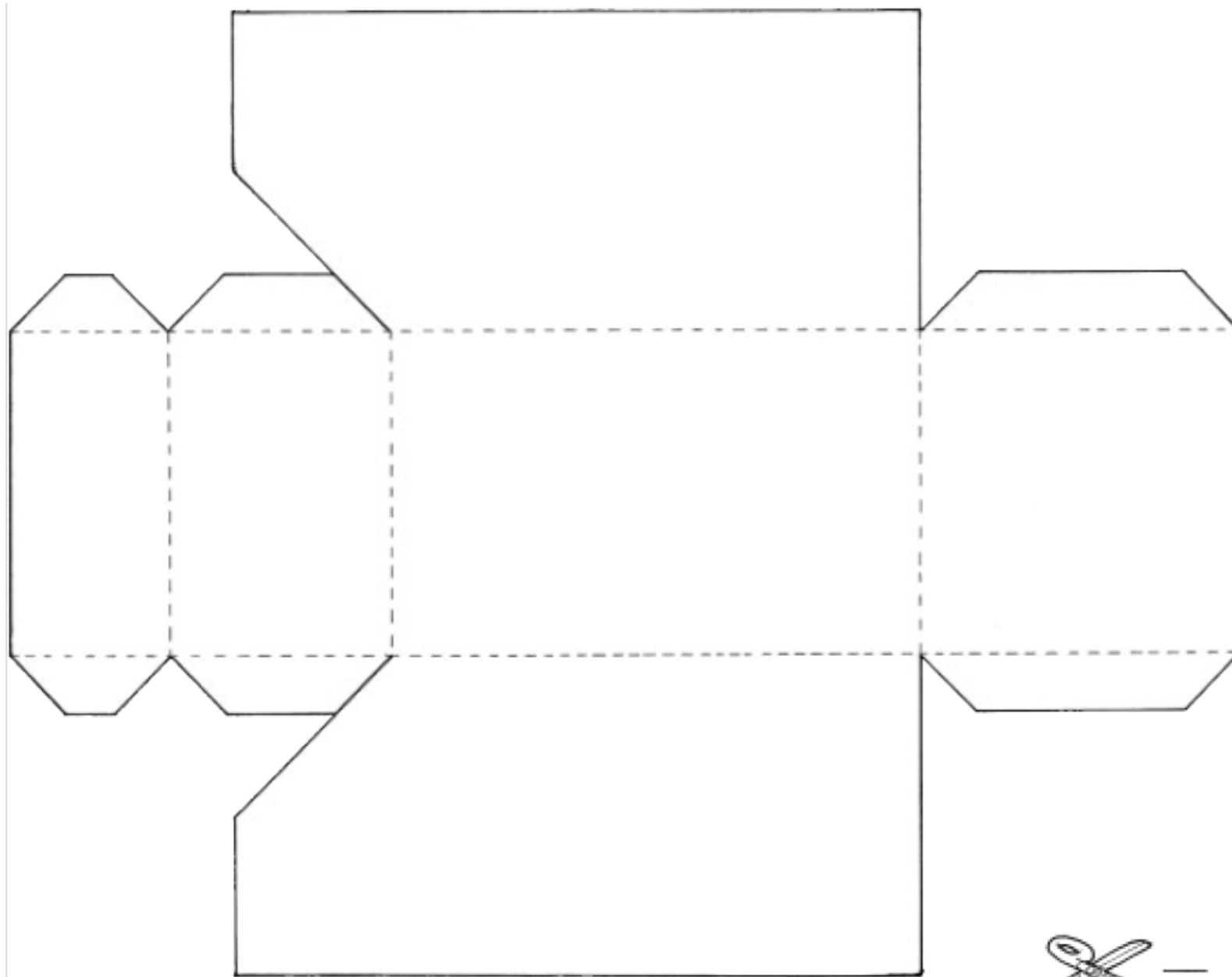
— cut along solid lines



- - - fold along dotted lines



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cut along solid lines



fold along dotted lines

Body Design & Assembly— Transmission

Introduction

The transmission in a vehicle is the drive train.

In this unit, pupils should be allowed to explore different methods of driving the wheels on the ground.. The power source is most likely a battery driving a motor. So, at a basic level, learners should work out the best way to use energy from the motor. Other energy sources can be explored (e.g. twisted elastic bands).

Opportunities to make connections to scientific principles of energy transfer and of different mechanical systems are provided by exploring the transmission. Learners should be able to critically explain why certain types of transmission are suitable whilst others aren't.

Stimulus

Models of different types of transmission (like gear train, pulleys systems, worm gears, bevel gears)

Fischer Technik mechanics kits

Switching work sheets

Completed models

Videos explaining real transmissions

Learner help card; Chassis Assembly

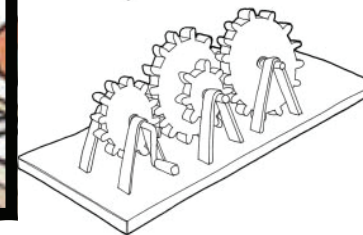
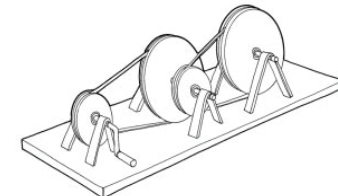
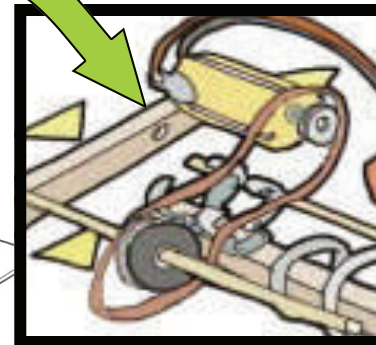
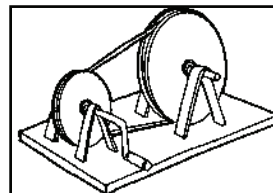
Simulation software: such as Yenka

Task

The main task is for learners to use wires and rubber bands to create the transmission. They should gain knowledge of electric circuits. There is scope to include soldering, adding different switching circuits perhaps for forward/backward motion, steering wheels, etc.

Learners should gain some understanding of energy transfers, specifically transferring energy from the chemicals in the battery to create electrical current and then to energy that turns the motor creating movement. There is also scope for learners to apply knowledge of kinetic and potential energy.

A good way to approach this task is for all learners to build a common simple transmission based on a pulley system. Attach the motor to the chassis, loop a rubber band around the pulley wheel on the motor and the other end around the pulley wheel on the axle. Once this is complete, teachers and learners can discuss/explore different ways to transfer energy from the motor to the axle.



Reflection

Learners should reflect on the application of known technology. Encourage report writing, poster presentations or video presentations of their models.

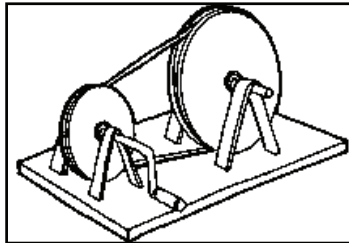
Next Steps

Learners use their model to explore circuits (specifically lighting), using the existing battery or an auxiliary battery.

Body Design & Assembly— Transmission (Help Sheet)

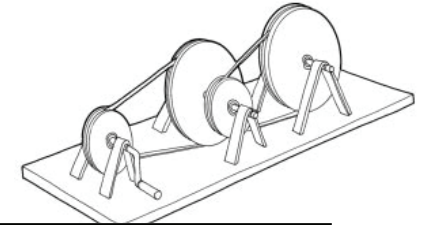
Task

A good way to approach this task is for all learners to build a common simple transmission based on a pulley system. Attach the motor to the chassis (using tape, a rubber band, glue, battery box), loop a rubber band around the pulley wheel on the motor and the other end around the pulley wheel on the axle. Once this is complete, teachers and learners can discuss/explore different ways to transfer energy from the motor to the axle.



Why is this type of mechanism suitable for use in this application?

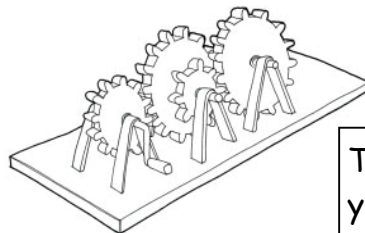
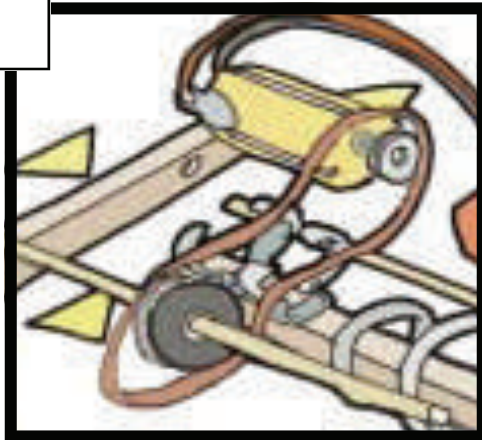
What would happen if the pulley wheel on the motor was made bigger?



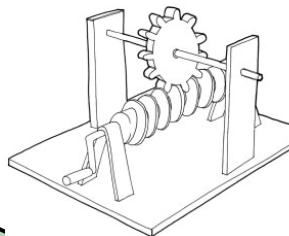
What would happen if the pulley wheel on the axle was made smaller?

What would happen if the pulley wheel on the axle was made bigger?

What would happen if the battery was changed for one with more or less potential?



This is a compound gear train. Why wouldn't you use it to drive the axle?



This is a worm gear. Why wouldn't you use it to drive the axle?
What mechanism in a car could this be used for?

Worth exploring:

You are using a battery to provide energy to the motor to drive the wheels. Discuss where energy transfers are taking place and how energy transfer takes place in each case.

Some models will move faster than others. Discuss why this is the case when all are using the same type of battery.

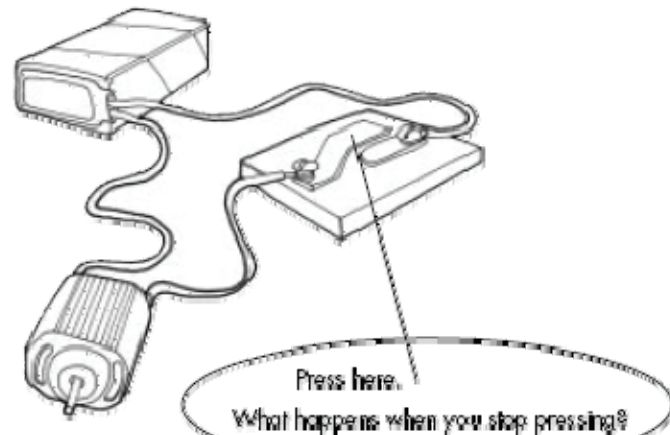
My buggy exploring technical systems:

This sheet shows simple representations of switching circuits that can be used with the model cars. For each, it would be possible for learners to explore using simulation software such as Yenka (Crocodile Clips).

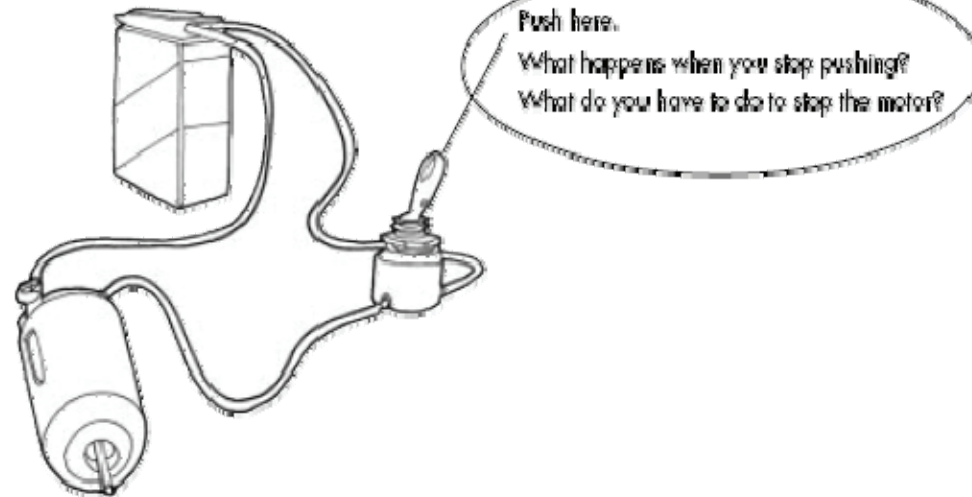
Once they have investigated the best type of switch they can then plan to incorporate it into their model.

Switches controlling motors

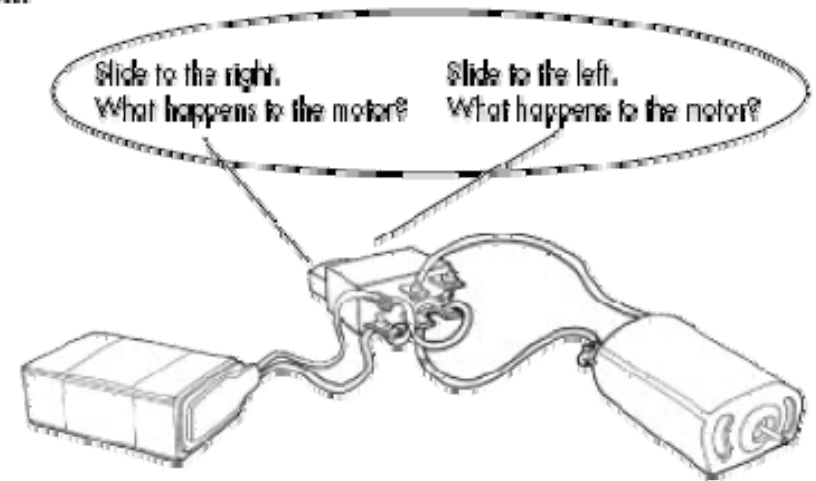
Push-to-make switch



Toggle on/off switch



Reversing switch



Worth exploring:

For each type of switch, discuss and record why the switch may be used in different situations.

- For example, a toggle on/off switch can be used to switch lights on and off because...

Design & Assembly— Lighting Circuits

Introduction

This part of the project allows pupils to explore electric lighting circuits as part of their model car. Lighting circuits can be planned or retro-fitted to models. Learners can be exposed to a wide range of experiences depending on available resources. For example a learner may build a fixed circuit, while another may be able to plan what they want having gained an understanding in the basics. The body of the car will have to be adapted to house lights. An auxiliary battery may have to be used to provide energy for the lights, though they may be powered by the battery used for the transmission.

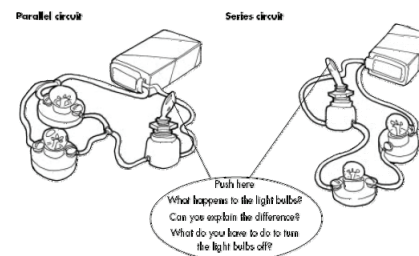
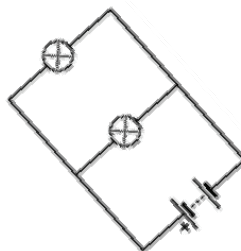
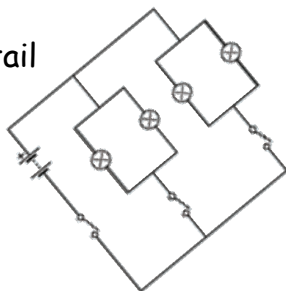
Stimulus

Model lighting circuits	Multimeter, or individual meters	Automotive lighting videos
Simulation software	Electric circuit information cards	Night rally videos

Task

Learners should make or design & make a lighting circuit for their models. They should be encouraged to experiment, but to base their experimentation on sound theory. For example, why use a parallel circuit for two headlights instead of a circuit in series, or how could front and rear lights be turned on simultaneously. As with the transmission unit of the project learners should gain an understanding of the types of switch that are suitable. Again, simulation is invaluable to augment building circuits. Learners should be given opportunity to discuss why they have chosen particular solutions.

Headlights and tail
-lights

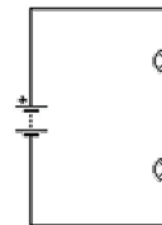


Reflection

Learners should report on the reasons for difficulties.

Learners could race their models in a lit environment and where the lights have been turned off.

Learners could report upon their learning in a range of ways and share pictures of the different stages of the learning journey and report upon things like skills that they have used, knowledge they have gained, improvements to the model. Glow offers a range of tools they could use such as Glow blogs and wikis.



building the circuit they used and on their success or