Fairground Rides

Lesson Plan

Fairground Rides

- Recommended level – Years 5-6
- Time taken – 6 hours (including about 1 hour's design time)
- Pupils to work individually or in pairs
- Additional adult help is recommended
- Expectations – to complete working model fairground rides

Skills and Learning

STEM Links

- **S**cience: electrical circuits, air resistance and friction, pulleys
- **T**echnology: design products, use tools, mechanical systems, electrical systems
- **E**ngineering: designing rotating machinery, designing for safety
- **M**aths: drawing 2D shapes, measurement, speed, converting units.

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

Pupils should be taught to:

- construct a simple series electrical circuit, identifying and naming its basic parts
- recognise that a switch opens and closes a circuit
- recognise some common conductors and insulators, and associate metals with being good conductors
- use their circuits to create simple devices
- represent a simple circuit in a diagram using recognised symbols
- pupils should be taught about precautions for working safely with electricity

Science: Forces

Pupils should be taught to:

- identify the effects of air resistance and friction that act between moving surfaces
- recognize that some mechanisms including pulleys allow a smaller force to have a greater effect

Design and Technology

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.

Design and Technology: Make

- use a range of tools and equipment to perform practical tasks (for example cutting, shaping, joining and finishing) accurately
- select from and use a wide range of materials and components according to their functional properties and aesthetic qualities.

Design and Technology: Technical Knowledge

- understand and use mechanical systems in their products
- understand and use electrical systems in their products (for example series circuits incorporating switches and motors)

Mathematics

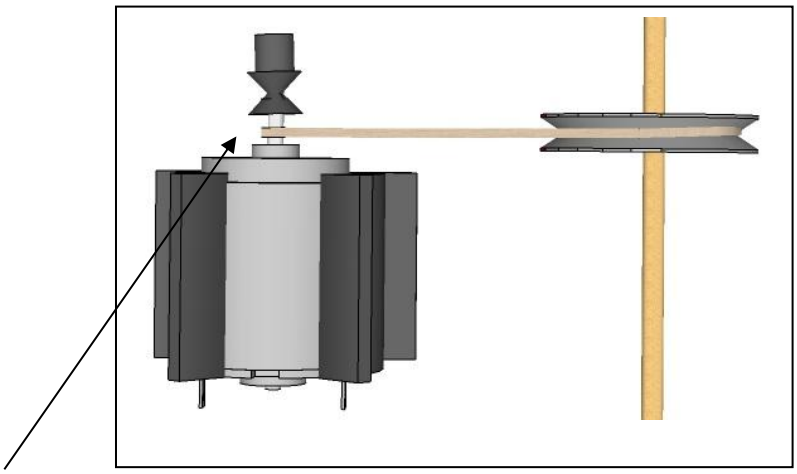
Pupils should be taught to:

- draw 2D shapes using given dimensions and angles
- record and compare time
- name parts of circles including radius, diameter and circumference
- convert between standard units of length and time

Resources

Parts included in class kit:

- 30 cardboard task boxes
- 100 54mm diameter wheels with 6mm hole
- 100 mixed diameter wheels with 5mm hole
- 1 pack of corrugated plastic sheet (10 coloured sheets 500mm x 500mm)
- 30 motors
- 30 motor mounts
- 30 battery holders
- 40 zinc chloride batteries
- 30 toggle switches
- 90 crocodile leads
- 120 plastic pulleys
- 100 cotton reels
- 50 lengths of 8mm square wood
- 40 lengths of 5mm diameter wooden rod
- 500 jumbo coloured lolly sticks
- 245g box of rubber bands
- 25 pack of sandpaper
- 30 motor pulleys (Note, the motor pulleys are not normally used for most fairground rides as they would cause the ride to rotate too quickly. However, they could be used as shown here to prevent the rubber band from coming off the motor shaft as it rotates.)



Check you have received the correct contents in your class kit. Try pushing the mixed diameter wheels and the pulleys 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 and pulleys are difficult to fit you can sandpaper down the end of the dowel slightly, and if they are slightly loose on the dowel you can glue them on). Check that the 54mm diameter wheels with the 6mm hole are very loose on the rod. Please let TTS know if there are any problems as soon as possible.

Associated resources:

- Fairground Rides Presentation – this is to be followed when running the activity in class.
- Fairground Rides worksheet & answers – the worksheet is to be printed out, one for each pupil. The answers are suggested ones for teacher reference only.
- Fairground Ride Design Sheet
- How to make a chair-o-plane instructions
- How to make a merry-go-round instructions
- How to make a Ferris wheel instructions

Tools and consumables (not included):

- Plenty of cable ties, e.g. 200 mm long x 2.5 mm wide
- Plenty of lightweight passengers, e.g. pine cones with googly eyes, pompoms with googly eyes, small soft toys, plastic minifigures, furry bugs, or the pupils can make figures out of cardboard
- You could provide additional wooden skewers and corrugated cardboard, e.g. if making lots of merry-go-rounds and Ferris wheels.
- Rulers
- Pencils
- Pencil sharpeners
- Blu Tack
- Calculators
- Pairs of compasses
- Protractors
- Large scissors
- Low melt glue guns and glue sticks. Note: High melt temperature glue guns should not be used by pupils, as they can cause nasty burns.
- Junior hacksaw
- Vice or bench hook
- Stop watch
- Secateurs (optional – to be used by adults only)
- A plastic bowl or similar is recommended for pupils to collect their electrical parts, to prevent them from rolling away and getting lost.

Preparation Needed:

Build a sample chair-o-plane to help the pupils understand how a rotating fairground works, and to explore any pitfalls. Instructions for building the chair-o-plane are given in the blog 'How to make a chair-o-plane'.

It is recommended that at least half the class make 'chair-o-plane' type of rides, because they are easier and require less material than other rides.

You could pre-cut two of the sheets of Corrugated plastic sheet into roughly 17 cm x 17 cm squares to use for chair-o-planes. You should get 9 squares from each sheet. This will prevent pupils wasting a lot of material by cutting from the middle instead of the edge of the sheet.

You could also pre-cut 18 shafts from the 5 mm wooden rod using secateurs to use for the chair-o-planes.

If making merry-go-rounds as shown in the blog, you can only get two merry-go-rounds (i.e. four squares) per sheet of corrugated plastic sheet (again it is better to pre-cut the squares to minimise wastage). Similarly, you would only expect to get two Ferris wheels per sheet. You could make much smaller merry-go-rounds using 17 cm x 17 cm squares if you need to save on material.

If you are making a lot of merry-go-round type rides you could use garden cane or wooden skewers for the outer poles to save on 5 mm wooden rod.

The pulleys can be a very tight fit on the 5 mm rod. You could use a 4.9 mm diameter drill or reamer to open up the holes so that they go on more easily. Alternatively, pupils can clamp the rod in the vice and use their weight to force the pulley down the rod. They need to remember to sharpen the end of the rod slightly to get the pulley to start going on. Also, they must clamp the rod near to the end where they are fitting the pulley; if they clamp it at the opposite end, they are likely to break the rod!

Vocabulary list:

- ***Pulley*** – a grooved wheel over which a drive belt can run.
- ***Drive belt*** – the belt which connects and transfers movement between two pulleys.
- ***Shaft*** – a rotating tool.
- ***Bearing*** – this holds the shaft in position whilst allowing it to rotate.
- ***Series circuit*** – a circuit with only one possible path for the current.
- ***Short circuit*** – an incorrect route in a circuit which misses out certain components and can cause the circuit to fail.

Risk Assessment:

Conduct a risk assessment before undertaking the activity. An example is given below – you can use this as a basis for your risk assessment:

Activity	Identified Hazard	Initial Risk Rating L/M/H	Control Measures	Controlled Risk Rating L/M/H
Use of glue guns	Burns	H	Pupils should be supervised by a responsible adult at all times when using the glue guns. Explain to pupils 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, pupils wear safety goggles when using glue guns.	M

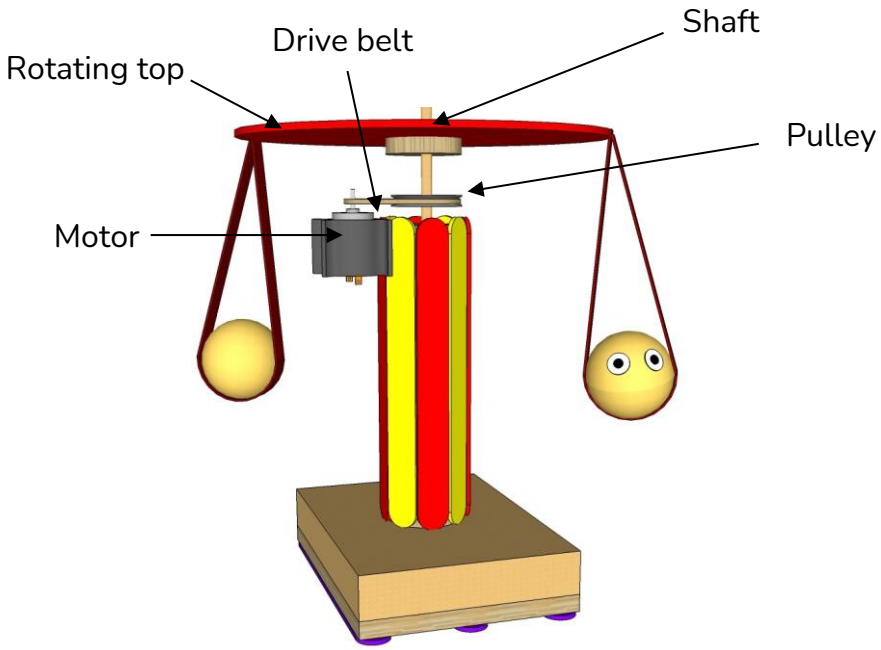
Use of scissors	Injury e.g. to fingers	M	Make the pupils aware of the dangers. Explain how to use the scissors safely. • Do not give out the scissors until after the safety briefing.	L
Use of secateurs	Severe injury e.g. to fingers	M	• **Do not** allow the pupils to use these. Only for use by responsible adults	L
Use of junior hacksaws	Injury e.g. to fingers	M	Make the pupils aware of the dangers. Explain how to use the hacksaws safely. Only use the hacksaws in combination with a vice or bench hook. • Do not give out the hacksaws until after the safety briefing.	L
Short-circuiting AA batteries	Burns, smoke inhalation	M	Only use zinc batteries (which do not get dangerously hot), not alkaline or rechargeable ones. Explain how to avoid short-circuiting the battery. • If the batteries get hot, the pupils should ask an adult to disconnect them immediately.	L
Use of cable ties	Cable tying fingers and cutting off blood supply	M	• Explain the dangers to the pupils. Cut cable ties off fingers immediately.	L
Passengers flying off rides and hitting someone	Bruising e.g. to eyes	M	Use lightweight passengers such as pompoms with googly eyes. • Make sure the passengers are firmly attached to the ride.	L
Running extension leads along floor for glue guns	Trip hazard	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	Electrocution hazard	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

Teacher notes – referring to the relevant numbered slides in the Fairground Rides Presentation

Slide 2	**Can you name these rides?** The rides shown are a roller coaster, merry-go-round, chair-o-plane and Ferris wheel.
Slide 3	**What makes them exciting?** Fairground rides are exciting because they offer speed, height, and unexpected movements that trigger adrenaline rushes. Bright lights, loud music, and the thrill of spinning, dropping, or looping create a sense of adventure. The anticipation, social experience, and momentary feeling of weightlessness add to the overall exhilaration and fun.
Slide 4	**How does a chair-o-plane work?** • The top and chairs move round in a circle. • The base and pillar stay still.
Slide 8	**Safety** • First ask the pupils to identify possible hazards and possible ways to reduce the risk. • Don't burn yourself with the glue gun. You could ask an adult to supervise the gluing station. • To avoid cutting yourself with the saw, use a vice or bench hook to hold the piece of wood you are cutting. • Be careful not to cut yourself with scissors. • Don't cable-tie your fingers. • Be careful not to cut yourself on the tape dispenser. • Toys could fly off the rides and hit you, perhaps in the eye. Use only lightweight toys, particularly on rides which go fast. Make sure the toys are attached firmly to the ride.

Slide 9

Identify the parts of a model chair-o-plane



Slide 10

What does the pulley system do?

- The animation on the slide shows how, using the pulley system, many turns of the motor give rise to fewer turns of the driven pulley (and hence the shaft).
- This gives higher torque ('turning force') and lower rotational speed.

Slide 11

How is the shaft supported?

- The bearings are wooden wheels with a 6mm diameter central hole. The shaft is 5mm diameter, so it should spin easily in the bearings.
- The wheel shown at the top of the shaft attached to the rotating top has a 5mm diameter hole. It is intended to fit tightly on the shaft and spin with it.
- When building their models, students will need to correctly identify which of the wooden wheels to use.

Slide 16

Identify the electrical parts

- You can hold up each part in turn and ask the pupils to name it.
- They are: motor, switch, battery and wires or crocodile leads.
- Point out the circuit symbol (shown below each component) which relates to each of the components.
- Explain that these are used to represent the components on a circuit diagram; they are much easier to draw than the actual components!

Slide 17

How the electric circuit works

Explain that the diagram on the right is the circuit diagram. It is a representation of a circuit and can be used when designing or trouble-shooting an electric circuit.

Slide 18

Avoid short circuits

- It is very common for pupils to accidentally short circuit their batteries whilst wiring up their circuits.
- Zinc chloride cells are provided in the class kit – these don't get too hot when short-circuited.
- If you need to replace your cells, be careful to buy zinc ones (e.g. the cheap ones from discount stores which say 'zinc' on them. Alkaline or rechargeable batteries should not be used as they can get very hot if short-circuited).
- Pupils often slide the plastic sleeves back when connecting their crocodile clips. You could ask them not to.
- If the sleeves have been pushed back, you can clip the crocodile clip onto a pencil as shown below, in order to slide the sleeve back on.

Slide 19

Connecting the crocodile clips

- Pupils often clip the crocodile leads onto the plastic insulation on the wires from the battery, instead of onto the metal ends.
- Pupils sometimes clip the crocodile leads onto the motor shaft instead of the motor contacts.
- Pupils sometimes clip the crocodile leads onto the switch toggle instead of the switch contacts.

Slide 20

Make your circuit

- You could ask pupils to come up and collect their parts in a small bowl, to save you having to hand them out.
- It is recommended for pupils to have three different coloured crocodile leads, as they are less likely to get them mixed up and create a short circuit.
- It is recommended to fit the motor in the mount at this stage, to prevent the motors from rolling off the table and getting lost.
- The reason for pushing the motors into the mounts from the end, instead of from above, is to avoid snapping the motor mount.
- It is a good idea to demonstrate how to connect up the circuit, including showing the pupils which way round to fit the cell.
- The flat end of the cell should be pushed up against the spring in the battery holder.
- Pupils could lay their components out in a triangle, then connect one wire from the switch to the motor, one from the motor to the battery and one from the battery to the switch.

Slide 21	**Some other examples of rotating fairground rides** • Two more examples of rotating fairground rides are shown here – a merry-go-round and a Ferris wheel. • Examples of how to mount the bearings in order to support the shaft are shown for these rides. • Hopefully, one of the three mounting arrangements for the bearings and shaft could be used for virtually any design of rotating fairground ride the students come up with.
Slide 23	**Plan your fairground ride** • A design sheet is provided for students to plan their fairground rides. • If they are all making chair-o-planes, it may not be necessary to plan the rides, as they can just follow the presentation. • If they decide to make a combination of chair-o-planes, merry-go-rounds and Ferris wheels, it might be useful to hand out instruction sheets to help the students work out what they will need for their fairground ride. • If they are designing their own fairground ride, they will need to work out for themselves what is needed from the materials available. It is recommended to check their designs to ensure they are feasible before they embark on making them. • It is also recommended to check that the total amount of materials needed for the designs does not exceed the amount of material you have available. For example, students may have to make smaller merry-go-rounds or Ferris wheels if large numbers of them decide to make these. • Alternatively, you could source additional materials such as wooden skewers and corrugated cardboard to enable the students to make more resource-heavy rides.
Slide 24	**Make the chair-o-plane base** • If students are making chair-o-planes, they can follow the instructions given on slides 24-33. • If students are making merry-go-rounds or Ferris wheels, they can follow the instruction sheets provided. • Alternatively, they can create their own designs of rotating fairground ride as per their plan.
Slide 25	**Make the chair-o-plane column - 1** Be careful not to get glue on the rod, as this will need to rotate. Also don't get glue in the hole.