SparkLab, Sciencentre

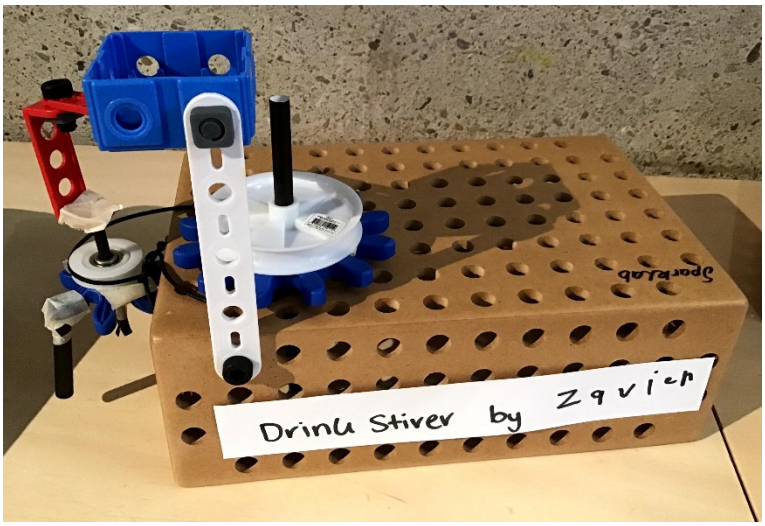
Maker Space: Spin cycle

The Challenge

Up, down and turn around! Construct a machine that uses spinning parts to make something move. How can you move something from a distance or in different ways? Who might use your machine and what will they need it to do?

Learning Outcomes

- Explore how spinning parts such as pulleys, gears, wheels and belts, some of which are simple machines, can be combined to interact with each other to perform a function. Working together they may be used to change the direction of movement or rotation, push or pull something, or transfer movement energy from one part to another.
- Gaining experience using and manipulating different materials to create a machine for a specific purpose.
- Draw connections between machines encountered in their daily lives and how they use spinning parts.
- Increase understanding and confidence of a design process; making and testing a design, observing areas of the design that need improvement, making a change and observing the impact of that change.
- Understanding that machines can be used help people perform tasks and it is important to design a machine to suits the user's needs.
- Feel and recognise success in implementing creative solutions to real world challenges.
- Express enjoyment in engaging in the challenge and sharing ideas and understandings.



Drink stirrer machine

Equipment

- Scissors
- Pencils
- Hole puncher
- Ruler

Design Materials

- Spinning parts, such as:
  - Gears, either bought or make your own
  - Wheels from toys or a hardware store
  - Cardboard tubes
  - Takeaway cups and lids
  - Rollers
  - Pulleys
- Cardboard boxes
- Fabric, elastic string or flexible plastic
- Paper
- Straws
- Rubber bands
- Sticky tape
- Rods or sticks

Optional materials

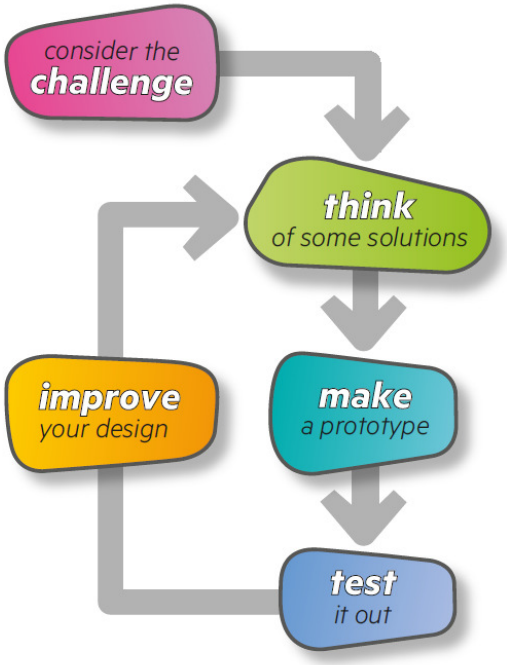
- Meccano or other construction material
- Toys or other spare parts to bring your machine to life.

Set-up steps

1. Make some holes in a box to attach your spinning parts.
2. Attach your spinning parts.
3. Connect the spinning parts so that they turn or move something.

Design process

This activity follows a design process. Below are some questions that will help at each stage of the process.



Think of some solutions

- What machines or devices have you seen before that have spinning parts, such as gears or wheels? Do all the gears and wheels move the same way? How might this change what you build?
- What ideas do you have for a design?
- Who might use this machine? What might they need or want this machine to do? (You might like to use scenarios to help inspire thinking such as '*build a machine that would be fun to ride at an amusement park*'.

Make a prototype

- What spinning parts do you think you should use? How will they work together?
- What sort of structure will you attach your spinning parts to? How do different structures change your design?
- How can you attach materials and parts to your gears and wheels? Does turning the gears and wheels make these new parts move?
- Does your machine move in a different way if you swapped one spinning part for a different sized one?
- What part of your design are you finding tricky to build?

Test it out

- What did you observe when you tested your machine?
- How well did the parts of your machine move? Did every part work in the way you predicted it would?
- Does your machine look and work the way you wanted it to? Has testing it given you any other ideas?
- What part of your design worked really well?

Improve your design

- How could you improve on your design? Are there any parts that could turn more smoothly or be more secure? Are there any other features or spinning parts that you think should be incorporated?
- What changes can you make so that your machine can spin a different object or turn it in a different way? How could you get your design to move something over a longer distance, around a corner, up high or spin in a different way?
- What ideas could you incorporate from someone else's design? Talk to a friend or search online.
- If you started again, what would you do differently? What would you do the same? How will you document your design to guide future projects?

Background information

People use **simple machines** to make it easier to perform work. Simple machines have few or no moving parts and modify the motion and the magnitude of a force applied to them in order to perform work. The total amount of work required stays the same. Simple machines can be combined to create **compound/complex machines** where forces are transferred from one part of the machine to another.

When an **axle** is fixed to a **wheel** so that they both rotate together, a small force applied to the wheel edge is converted to a larger force on the smaller axle. This effect can be reversed—applying a large force at the smaller axle results in a smaller force at the edge of the larger wheel with much greater rotational speed.

A **gear** is a wheel and axle with teeth. The teeth interlock with the teeth on other gears to change the size and direction of forces within a machine. They can be used to **change speed** (turning a larger gear connected to a smaller gear will make the smaller gear turn faster, or the reverse), **change force** (turning a smaller gear connected to a larger gear will make the larger gear rotate slowly but with more force, or the reverse) or change direction of motion (the second gear always turns in the opposite direction to the first). When many gears work together it is called a **transmission**. A chain could also be used to transfer force.

A **pulley** is a rope looped around one or more wheels, known as blocks. A pulley can be used to change the direction of a rope and reduce the amount of force needed to move an object. The more pulleys in a system, the less force required to move the object.

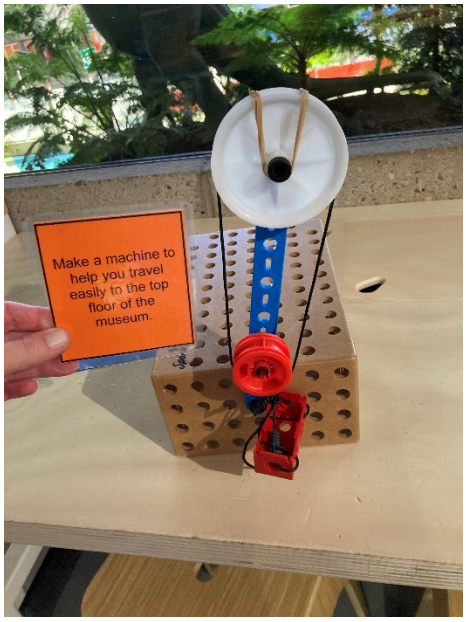
A **belt** is a loop of flexible material or string that connects wheels or pulleys. The friction between the surface of the wheels and the surface of the belt creates energy that propels the belt and its load forward. A **conveyor belt** is in essence just a wide belt used to carry something.

Key Search Terms: Simple or geared machines, wheel and axle, pulley system, mechanical advantage

Appendix

Detailed Set Up

1) Gather some spinning parts to use in your design. You can buy pre-made gears and wheels or try making your own. To make your own gears, try cutting out a gear pattern from cardboard or attaching paddle pop sticks to a lid. Cardboard tubes, repurposed cups and lids, toy or hardware store wheels, and cut out cardboard disks can make great wheels, pulleys or rollers.
2) Find a structure to attach your spinning parts to. A cardboard box, Meccano construction kits, and repurposed plastic containers can make good frames to build on.
3) Play around with where your will attach your spinning parts. If your structure doesn't have any holes to start with, make some to mount your spinning parts.
4) Use your constructing materials to bring your spinning parts to life!



Links to Australian Curriculum

Year	Science Curriculum
F	**Physical sciences** The way objects move depends on a variety of factors, including their size and shape (ACSSU005)
2	**Physical sciences** A push or a pull affects how an object moves or changes shape (ACSSU033).
4	**Chemical sciences** Natural and processed materials have a range of physical properties that can influence their use (ACSSU074). **Physical sciences** Forces can be exerted by one object on another through direct contact or from a distance (ACSSU076).

Year	Design and Technologies Curriculum
F-2	**Knowledge and understanding** Identify how people design and produce familiar products, services and environments and consider sustainability to meet personal and local community needs (ACTDEK001) Explore how technologies use forces to create movement in products (ACTDEK002) Explore the characteristics and properties of materials and components that are used to produce designed solutions (ACTDEK004) **Processes and production skills** Use personal preferences to evaluate the success of design ideas, processes and solutions including their care for environment (ACTDEP008).
3-4	**Knowledge and understanding** Investigate how forces and the properties of materials affect the behaviour of a product or system (ACTDEK011) Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (ACTDEK013) **Processes and production skills** Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to produce designed solutions (ACTDEP014)
5-6	**Knowledge and understanding** Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use (ACTDEK023) **Processes and production skills** Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions (ACTDEP024) Negotiate criteria for success that include sustainability to evaluate design ideas, processes and solutions (ACTDEP027)
7-8	**Knowledge and understanding** Analyse how motion, force and energy are used to manipulate and control electromechanical systems when designing simple, engineered solutions (ACTDEK031) Analyse ways to produce designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment (ACTDEK034) **Processes and production skills** Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas (ACTDEP035) Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions (ACTDEP037) Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability (ACTDEP038)