

Mechanics – Linkages and Levers

Linkages and levers in the real world



What is a linkage?

A linkage is joined to one or more levers to provide movement. A lever and a linkage combined creates a mechanism.

What is a linkage?

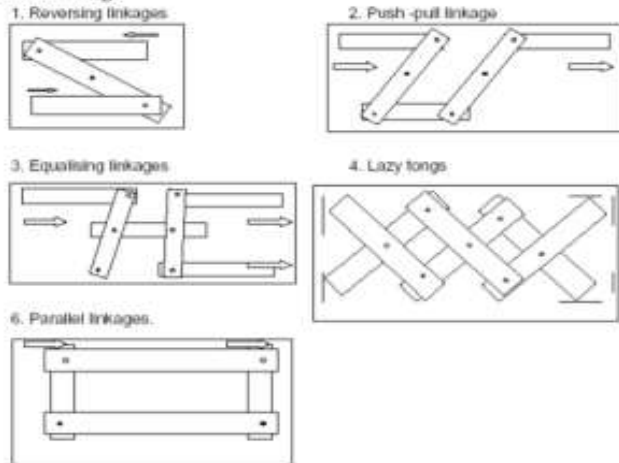


Key Vocabulary

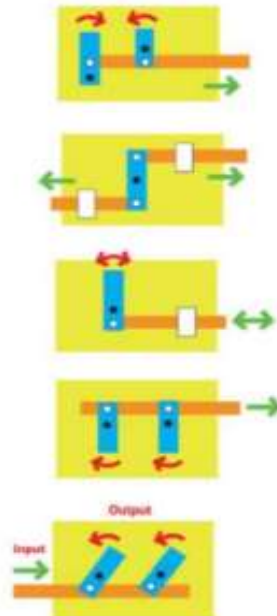
- Mechanism**-a device used to create movement.
- Lever**- a rigid bar that moves around a pivot.
- pivot**-
- loose pivot**-a paper fastener that joins two strips of card together.
- fixed pivot**-a paper fastener that joins
- system**- a set of related parts used to create an outcome.

Techniques

Levers and linkage



(Black dots-Fixed pivot & White dots-free pivots)



Useful Website and Hints

<https://www.twinkl.co.uk/resource/tp2-d-093-planit-dt-lks2-mechanical-posters-lesson-2-levers-and-linkages-lesson-pack>

<https://www.youtube.com/watch?v=0MYF8YCF2jQ>

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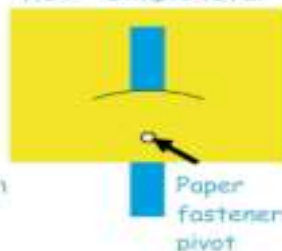
Mechanisms – Levers and Sliders 1: Initial understanding (see next slide for next stage in understanding)

Sliders and Levers in the real world



Mechanisms-Levers

KS1 - Simple lever



Levers can be used with or without a slot



A card strip is used as a lever. The fish and boat are glued to the lever which is used as a handle.

Key Vocabulary

Push: applying a force to move something away.

Pull: applying a force to move something closer.

slider: a knob or lever that is moved horizontally or vertically to control an object, such as the volume of a radio.

lever: a rigid bar resting on a pivot, used to move a heavy or firmly fixed load with one end when pressure is applied to the other.

fulcrum: the point against which a lever is placed to get a purchase, or on which it turns or is supported.

pivot: the central point, pin, or shaft on which a mechanism turns or oscillates.

slot: a long, narrow slit for something to be inserted e.g. a lever

Simple mechanisms move:



in a straight line



in a straight line, backwards and forwards



round and round

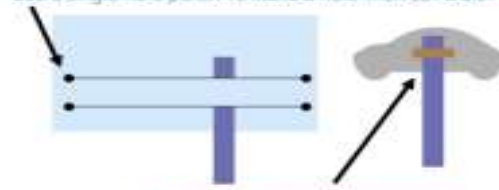


in a curve.

Mechanisms-Sliders

Sliders move from side to side and up and down

Use a single hole punch to make a hole then cut a slot



Staple or staple car onto card strip



Sticky fixers on back of card strip

A card strip could be used instead of cutting slots to allow movement



Walking tape



Rabbit moves up and down

Helpful Videos and Tips

<https://www.youtube.com/watch?v=n7dUtwejenQ>

https://www.youtube.com/watch?v=E8RA9Kw_laE

Mechanisms – Levers and Sliders 2: Initial understanding (see previous slide for prior knowledge)

Linkages and levers in the real world



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What is a linkage?



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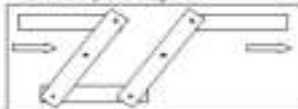
Techniques

Levers and linkage

1. Reversing linkages



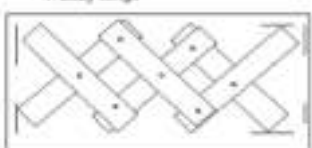
2. Push-pull linkage



3. Equalising linkages



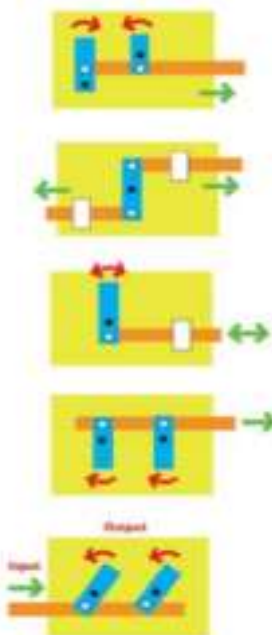
4. Lazy tongs



6. Parallel linkages



(Black dots-Fixed pivot & White dots-free pivots)



Useful Website and Hints

<https://www.twinkl.co.uk/resource/tp2-d-093-planit-dt-lks2-mechanical-posters-lesson-2-levers-and-linkages-lesson-pack>

<https://www.youtube.com/watch?v=0MYF8YCF2j>

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Mechanisms – Wheels and Axles

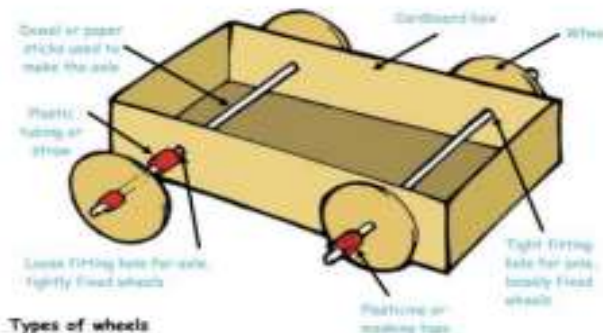
Wheels and Axles in the real world



Wheel and Axles



This is a simple machine with two circular wheels joined at the centre by a cylinder/rod (axle).



Types of wheels



Key Vocabulary

- mechanism:** a system of parts working together in a machine.
- wheel:** a circular object that revolves on an axle and is fixed below a vehicle or other object to so it can move easily over the ground.
- axle:** a rod that enables a wheel to rotate. The wheel can rotate freely on the axle or be fixed to, and turn with, the axle.
- chassis:** the frame or base on which a vehicle is built.
- axle holder:** the component through which an axle fits and rotates.
- fixed axle:** an axle which is fixed to the chassis. The wheels move alone.
- friction:** a force which is created when two things rub together.

Exploration

- Explore different size wheels
- How wheels move when the axle is not in the center of the wheel.
- Experiment with horizontal and diagonal axles to see how the wheels move.
- Learn about fixed and free axles.

Free axles-The axles move with the wheels. Loose fitting axle holder with tight fixed wheels.

Fixed axles- The axles are fixed to the chassis. The wheels move alone. Tight fitting axle holder with loose fitting wheels.

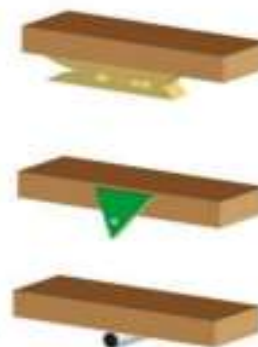
Mechanisms

Ways to hold free moving axles

Use pairs of clothes pegs glued with PVA to the underside of a box. Check the peg holes are large enough to allow axle to move freely. Make sure they are aligned carefully so the vehicle moves in a straight line when the wheel and axle mechanism is added.

Use card triangles with holes for the axle. Check the holes are large enough to allow the axle to move freely. Make sure opposite triangles are aligned carefully so the vehicle moves in a straight line when the wheel and axle mechanism is added.

Use large paper/plastic straws fixed with masking tape to the underside of a box. Check straws are positioned carefully so the vehicle will move in a straight line when the wheel and axle mechanism is added. Make sure the straw hole is large enough to allow the axle to move freely. The wheels must be fixed tightly to the axle.



Helpful Videos and Tips

<https://www.youtube.com/watch?v=vYoWCn5r3rQ>

<https://www.youtube.com/watch?v=ndT35aqDfAQ>

https://www.youtube.com/watch?v=Lpey_cCqS_I

Structures – Frame Structures

Frame Structures in the world today



Techniques for building frame structures

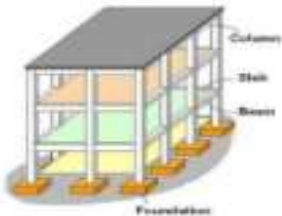


Key Vocabulary

- Compression** – the application of pressure to squeeze an object.
- Strut** – a part of a structure under compression.
- Tension** – a force pulling on a material or structure.
- Tie** – a part of a structure under tension.
- Triangulation** – the use of triangular shapes to strengthen a structure.
- Frame structure** – a structure made from thin components e.g. tent frame.
- Cross Sectional** - a drawing that shows a cut- away portion of the object to show the inside/plane view of the 3D object.

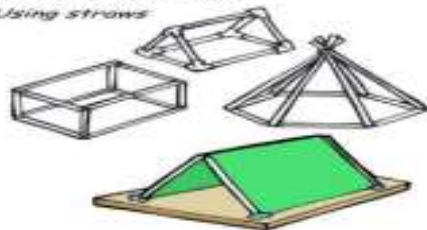
Frame Structures

A Frame structure is a structure that combines beams, columns and slabs to resist heavy load.

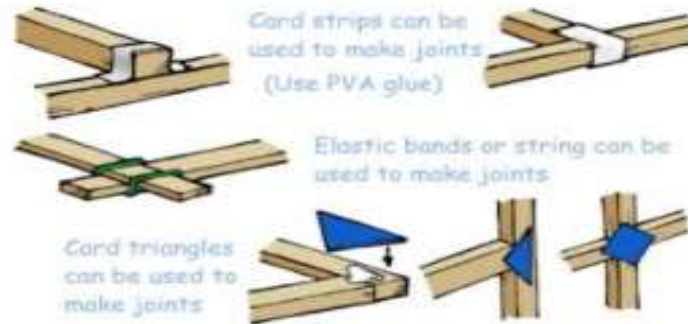


Make small scale frame structures using straws, pipe cleaners and dowels.

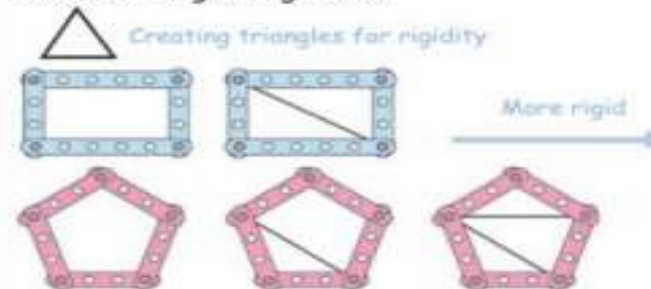
Using straws



Joining thin sectioned pieces of wood



Understanding triangulation



Useful Website and Hints

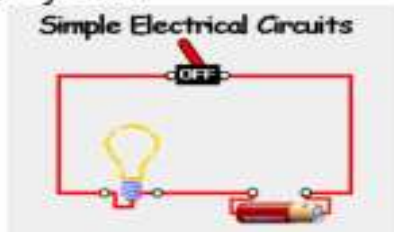
<https://www.youtube.com/watch?v=mBHjtWbsiaA>

Electrical Systems – simple circuits and switches

Electr

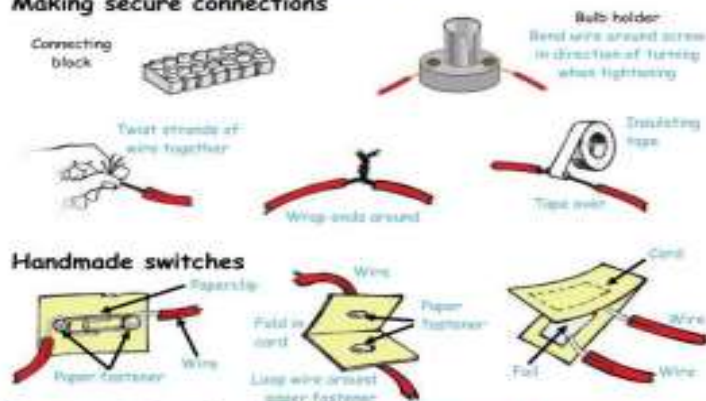


Electrical System



An electric power system is a network of electrical components deployed to supply, transfer, and use electric power.

Making secure connections



Handmade switches



Key Vocabulary

Circuit – path through which electricity passes.

Conductor – a material which allows an electric current to pass through it.

Insulator – a material which does not easily allow electric current to pass through it.

Prototype – a model made to test whether a design will work.

Push-to-break switch – a switch turned off by pressing it.

Push-to-make switch – a switch turned on by pressing it.

Toggle switch – a switch operated when a lever is pressed.

Output devices - components that produce an outcome e.g. bulbs and buzzers.

Input devices - components that are used to control an electrical circuit e.g. switches.

Switches

Commercial switches



Push-to-break switch

The switch is off while the button is pushed, but returns to its 'on' position when button is released.



Push-to-make switch

When you push, the electricity flows through the circuit, but when you release it the circuit is broken and the switch is off.



To understand how these systems work you will need to look inside electrical games and disassemble them, before putting them back together again.

Wires



Explore wires, insulation and teach the children different ways to strip the wires, reconnect them and insulate them.

Useful Website and Hints

<https://www.youtube.com/watch?v=m6Dk6YY8pN8>

Textiles: templates and joining

Templates and Joining in the real world



Templates and Joining



embroidery

Three alternative ways of using templates and simple pattern pieces



Use clear sticky tape to position patterns on fabric. Cut around the pattern.

Use soft cloth patch or soft white crepe to show around the pattern prior to cutting out.

Use pins to secure the pattern on the fabric. Cut around pattern.



sewing inside out

Key Vocabulary

Appliqué - to attach a decorative fabric item onto another piece of fabric by gluing and/or sewing.

Embroider - to decorate fabric with stitches.

Fray - to unravel or become worn at the edge.

Glove puppet - a glove puppet fits over the hand, and the fingers operate its head and arms.

Prototype - a model which allows children to try out ideas using cheaper materials and temporary joints.

Seam - a row of stitches joining two pieces of fabric.

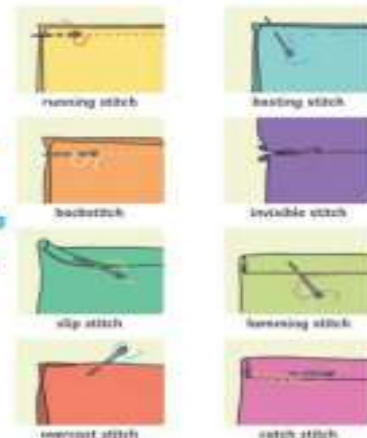
Sew - to join pieces of fabric with stitches.

Template - a shape drawn to assist in cutting out shapes.

Running/blanket/back/basting/catch stitches-different types of stitches

Explore different ways to fasten fabrics- gluing, sewing (teach different stitches), stapling, fasteners, velcro, pins, safety pins. Try this on different fabrics beginning with felt and progressing to other examples. Teach them ways to conserve fabric for sustainability purposes.

Exploring and evaluating joining techniques



Helpful Videos and Tips

<https://www.redtedart.com/basic-hand-stitches-beginners/>

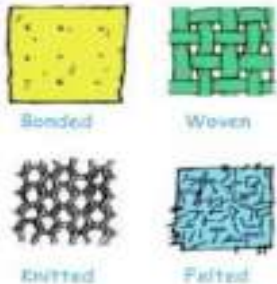
On this site there are small videos that demonstrate the different stitches.

Textiles-2D form to 3D

Fabric examples-2D to 3D

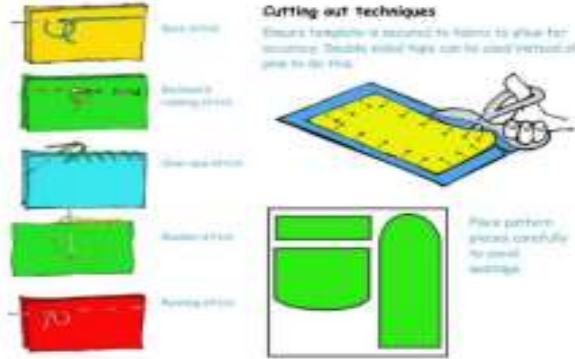


To move children's learning on, as enhancement activities, children could research into different types of fabrics and how they are constructed. They could carry out tests to check e.g. strength, waterproofness or flexibility to ensure their chosen fabric can be used to create a product that meets the needs of user and is fit for purpose.



Textiles

Teaching aids - joining techniques



The seam allowance is the area between the fabric edge and the stitching line between two or more pieces of material being sewn together.



Without the seam allowance, the seam could not exist as the stitches would fall out.

Helpful websites

<https://www.youtube.com/watch?v=1FknfUmFPX8>

<https://www.youtube.com/watch?v=qmD9vpo5Fso>

<https://www.youtube.com/watch?v=sjHm8CL9WDA>

Key Vocabulary

Appliqué – means 'applied' - describes method of stitching/gluing patches onto fabric (originally to mend holes in worn clothes) to provide decoration.

Pattern/Template - a shape drawn to exact shape and size and used to assist cutting out.

Seam - a line of stitching that joins pieces of fabrics together.

Seam Allowance - extra fabric allowed for joining together - usually 1.5cm.

Prototype – a model that is made to test whether a design will work.

Aesthetics - the way in which the product looks with the nature and expression of beauty.

Decorative Techniques



Embroidery stitches e.g. cross-stitch



Appliqué by gluing or stitching

Possible fastenings



Buttons



Velcro

Structures – Freestanding structures

Freestanding structures in the world

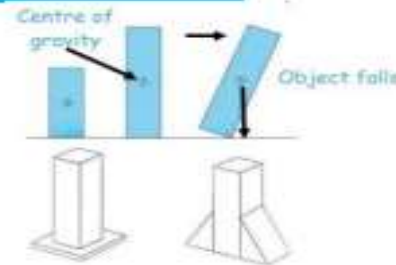
Burj Khalifa (in



A **freestanding structure** is a structure that stands on its own foundation or base without attachment to anything else.

As a freestanding structure becomes taller its centre of gravity rises. Stability in a structure can generally be increased by making the base wider, making the base heavier or adding buttresses.

Ask the children to build and explore a variety of freestanding structures through focused tasks. Use a range of construction kits.



Key Vocabulary

- Frame structure** – a structure made from thin components e.g. tent frame.
- Shell structure** – a hollow structure with a thin outer covering.
- Stability** – in relation to a freestanding structure, the extent to which it is likely to fall over if a force is applied.
- Buttress** – a structure added to a wall, tower or framework to make it more stable and/or reinforce it.
- Brick bonding** – arranging bricks in a wall to improve the performance of the structure or improve its appearance.
- Prototype** – First 3-D representation of a product.

Helpful Videos and Tips

https://www.teachengineering.org/activities/view/duk_tower_tech_act
(building a paper tower that is sturdy)

<https://www.youtube.com/watch?v=sXD6VQbjuUA>
(3D images of the top 30 tallest free standing buildings)

<https://www.youtube.com/watch?v=qFZGmHbJLSM>
(building a bridge from paper)

Techniques for assembling freestanding structures



Show children how to join sheet materials and reclaimed boxes together using different tapes and glue.



Photo: Peter Smith, Association

Now bend one piece of card and use it as an arch. How does this affect the strength of your bridge?



Technical knowledge and understanding

Build walls with these different patterns. Tip away the centre brick in the bottom row of each wall in turn. What happens? Which wall is the strongest?



Textiles- Templates and Joining

Templates and Joining in the real world



Templates and Joining



embroidery

Three alternative ways of using templates and simple pattern pieces

Thin Card



Use clear sticky tape to position pattern on fabric. Cut around the pattern.

Thin Card



Use soft chalk pencil or soft white crayon to draw around the pattern prior to cutting out.

Paper



Use pins to secure the pattern on the fabric. Cut around pattern.



sewing inside out

Key Vocabulary

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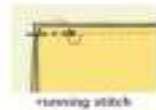
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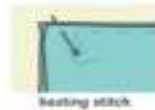
Running/blanket/back/basting/catch stitches-different types of stitches

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Exploring and evaluating joining techniques



running stitch



basting stitch



backstitch



invisible stitch



slip stitch



basting stitch



overcast stitch



catch stitch



Helpful Videos and Tips

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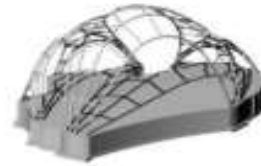
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Structures – Shell Structures

Shell structures

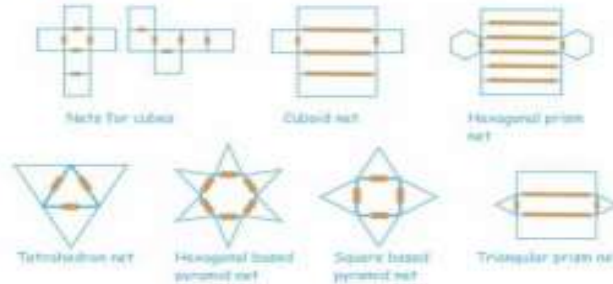


Shell Structures



A shell structure is a hollow structure made from a thin outer layer. Many buildings use a shell structure including the O2 and Shard.

Children explore and evaluate 3D shapes- they flat pack and assemble different structures including:



Key Vocabulary

- cuboid:** a solid 3D shape with rectangular sides.
- face:** a flat surface of a geometric shape.
- edge:** where two surfaces meet at an angle.
- net:** the flat or opened-out shape of an object such as a box.
- prism:** A prism is a 3D shape with flat sides. The 2 ends are an equal shape and size. The cross-section is identical.
- scoring:** cutting a line or mark into sheet material to make it easier to fold.
- vertex:** used to refer to the corners of a solid geometric shape, where edges meet.
- CAD (Computer Aided Design):** the use of computers to help in the creation, modification, analysis, or optimization of a design.

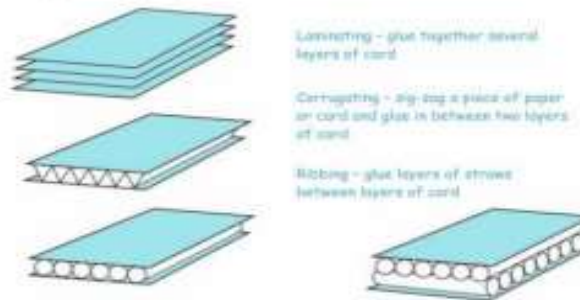
Experiment by creating 3D nets without computer aided design (CAD) by simply drawing the faces, cutting them out, using tabs and assembling them.

Explore CAD and the benefits of it in terms of creating an accurate shell structure.



Explore how to provide strength and structure:

Stiffening and strengthening sheet materials:



3 Rs- Reduce, Reuse, Recycle

Within this topic the importance of sustainability in product design and manufacturing can be explored. The importance of designers to consider the impact of mass production of products on the environment and the need to consider the use of materials:



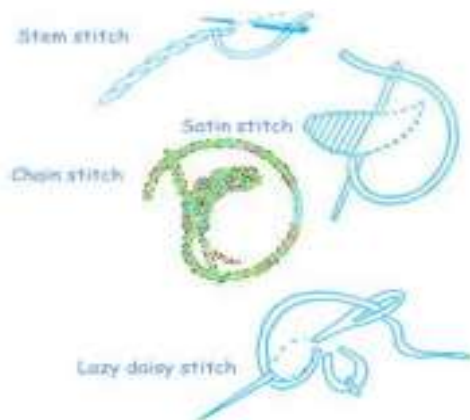
Textiles-Combining different fabric shapes

Textiles that combine different fabric shapes



Stitches

Children can use different stitches to decorate their products.



Tie Dye fabrics can be combined with an applique to customise a design.



Use different fastenings to add detail e.g. buttons or toggles to a cushion



Using eyelets with fabric can be used for decorative purposes but also be functional.

Embroidery can be used for embellishment- water soluble stabiliser can be drawn and sewn on. It then dissolves when soaked in water.



Key Vocabulary

tie dye-to produce patterns in (a garment or piece of cloth) by tying parts of it to shield it from the dye.

applique-ornamental needlework in which pieces of fabric are sewn or stuck on to a larger piece to form a picture or pattern.

embroidery- is the craft of decorating fabric or other materials using a needle to apply thread or yarn.

pattern or template-a shape drawn to exact shape and size to assist in cutting out.

seam allowance-extra fabric allowed for joining together.

tacking-large stitches to hold pieces of fabric together temporarily.

working drawing-a drawing that contains all information and detail to make a product but updated as changes are made.

Useful Website and Hints

<https://www.youtube.com/watch?v=5q46MkwH7iE>

<https://www.youtube.com/watch?v=XBadLUHL6E>

(How to tie dye in 3 different ways)

<https://camimade.com/how-to-use-a-sewing-pattern-5-basic-things-to-know-about-sewing-patterns/>

(How to use a sewing pattern)

Mechanisms - Gears

Pulleys and Gears in the world today



Gears-Gears are toothed wheels that lock together and turn one another. The wheels are usually different sizes so that one gear speeds up to slow down the next gear. Gears are also used to change the direction of movement.

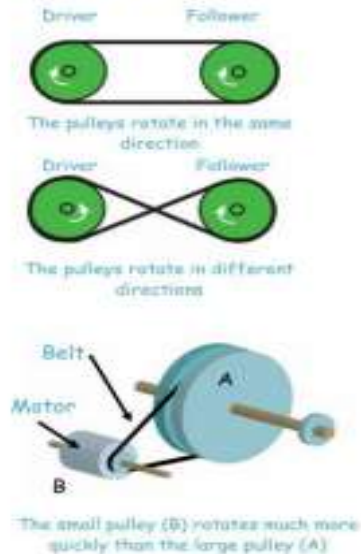
Using construction kits, ask children to explore gear ratios using combinations of two gears e.g.

No. teeth	Ratio
8, 16	2:1
8, 40	5:1
8, 24	3:1
40, 40	1:1

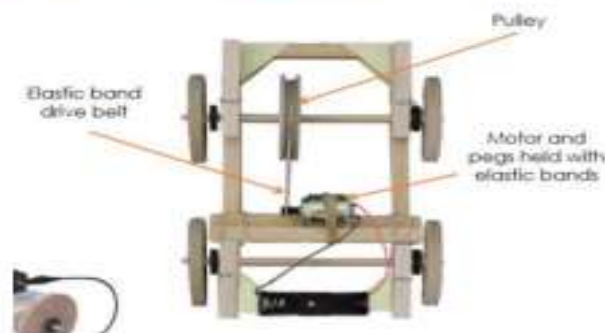
Key Vocabulary

- Drive belt** – the belt which connects and transfers movement between two pulleys.
- Gearing up or down** – changing the rotational speed of a product by the use of pulleys or gears. When a small pulley or gear is used to drive a larger one the rotational speed is reduced and the product has been geared down.
- Mechanical system** - a set of related parts or components used to create movement.
- Driver** – the gear or pulley that provides the input movement to the system.
- Follower** - the gear or pulley that provides the output movement to the system.
- Mesh** – the point where two gears join together and transfer movement.
- Motor spindle** – the rod on the end of the motor onto which a gear or pulley is attached.

Pulley-Pulleys do not touch but the wheels are joined by a drive belt. They can be used to change the speed, direction or force of a movement.



Making simple pulleys



Useful Website and Hints

- <https://www.youtube.com/watch?v=5amir8BpfHM>
- <https://www.youtube.com/watch?v=r3Ru1zZjvug>
- https://www.youtube.com/watch?v=odpsm3ybP_sA

