Kettlethorpe HIGH SCHOOL

GCSE DESIGN TECHNOLOGY

Y9 term 1 – categories of materials

Metals

Metals are classified into two groups: **ferrous** and **non-ferrous**.

Ferrous

- is found in the Earth's crust in rock known as haematite (iron ore)
- contains iron
- is usually magnetic
- will rust.

Non-ferrous

- is found in the Earth's crust in rock known as ore
- does not contain iron
- is not magnetic
- will not rust
- is malleable

Thermoplastics

Can be reshaped and softened when reheated
Can be recycled

Acrylic
It is resistant to weather conditions.

Polystyrene
Excellent moulding qualities. High density which is rigid and hard. Low density which is tough and flexible.

Polyethylene
The most common plastic in everyday life.

Thermosets

Cannot be reshaped once heated and set
Extremely strong and durable

Urea Formaldehyde – (UF)
Has properties of high hardness and high toughness, making it suitable for strong, knock-resistant fittings.

Melamine Formaldehyde – (MF)
Used for its hygienic qualities. It is an excellent insulator.

Phenol Formaldehyde – (PF)
Hard wearing and a good heat insulator

Common boards

Name	Appearance	Characteristics	Uses
Corrugated cardboard	Natural brown board finished with one or both sides with bonded paper	Strong, lightweight and rigid perpendicular to corrugations. Insulative and easily printed on.	Packaging, boxes and impact protection
Duplex board	Two layers of card bonded together, often with a white external layer	Stiff, lightweight with coatings to improve functionality	Often given a waxy coating and used for food and drinks containers
Foil lined board	White card, usually coated with aluminium foil on one side	Foil reflects heat and water and oil resistant coating enables food and liquid based products to be contained	Takeaway containers and lids, used to retain heat for longer
Foam core board	Smooth board surface on each side, foam and inner core with a limited range of colours and thicknesses	3-10mm thick, lightweight and rigid in all directions. Can crease and crack under pressure	Architectural models, model making / prototyping. Mounting and framing of photographs and art work
Ink Jet card	Brilliant white card treated with a smooth finish both matte and gloss	Treated to hold a high quality photographic image. Ink dries onto the surface to create deeper colours	High quality photographic images
Solid white board	High quality card, brilliant white smooth finish on both sides	Holds colour well, easily cut or creased	Greetings cards, packaging, hot foil stamping and embossing

How paper is produced
https://www.youtube.com/watch?v=jmgMdDH14sE

How metal is produced
https://www.youtube.com/watch?v=i6BIyQJZdTg

How timber is produced
https://www.youtube.com/watch?v=SwxinbpQ9B4&feature=youtu.be

How plastic is produced
https://www.youtube.com/watch?v=vfJDie6aU0k

Softwood

- comes from coniferous trees and is evergreen
- trees have needles rather than leaves
- is quick growing
- is generally less expensive than hardwood

Larch – Used for garden fences and patio decking.
Pine – Used for interior joinery and furniture.
Spruce –Used for interior furniture and stringed musical instruments.

Hardwood

- comes from deciduous trees and lose their leaves
- trees have broad leaves
- is slower growing than softwood
- is generally more expensive than softwood

Oak – Used for timber-framed buildings and high-quality furniture.
Beech – Used for children's wooden toys, benches,
Mahogany – Used for high-quality furniture.

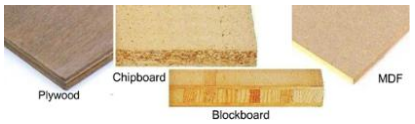
Manufactured timber

Laminated boards – several layers (veneers) of wood glued together.

- Plywood

Compressed boards – particles, chips or flakes of wood are glued together under pressure.

- MDF & Chipboard



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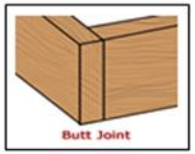
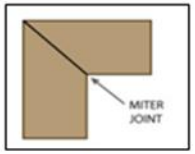
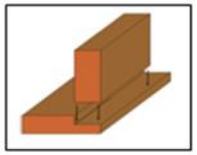
Y9 term 1 & 2 - eco designed speaker



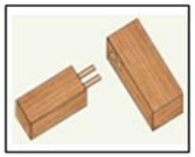
Butt joint



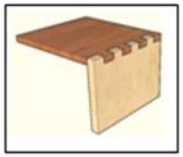
Mitre joint



Rebate joint



Dowel joint



Finger joint

The 6R's method of eco designing

REUSE – Take an existing product that becomes waste, and use the materials or parts for another purpose without changing its original form.

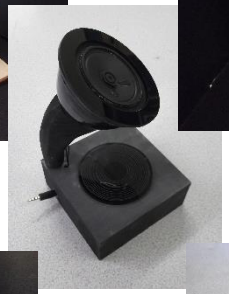
REFUSE – Don't use a material or buy a product if you think you don't need it or if its unsustainable.

REDUCE – Minimise the amount of material and energy you use

RETHINK – Ask whether we can sustain our current way of life and the way we design and make

REPAIR - When a product breaks down or does not function properly try to fix it.

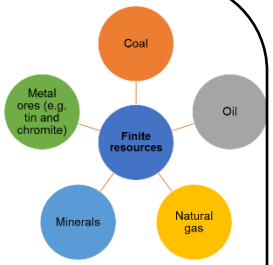
RECYCLE – Take an existing product that has become waste and reprocess the material to use in a new product.



Finite resources

A **finite resource** is a resource that does not renew itself quickly enough to meet the needs of future generations.

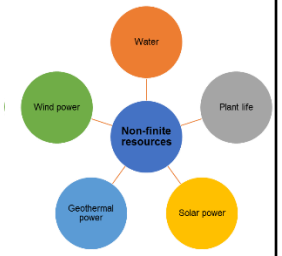
Once exhausted, there is no natural way to renew them.



Non-finite resources

A **non-finite resource** is a resource that can replenish quickly enough to meet current and future needs.

Technological advancements have allowed us to use these renewable resources more effectively, and to generate more energy from them. This helps to reduce our reliance on finite resources.



Sustainability

Sustainability is about meeting our own present-day needs without compromising the needs of future generations.

Designers need to think about the **life cycle** of a product and its environmental impact.

New technologies can be used to help us manufacture products more sustainably.

Sustainability videos

https://www.youtube.com/watch?v=B5NiTN0chj0&list=PLC1VCzU4q6og3DDpjLgAVE5HTn6xDJe2w&index=4

Electronic processes and how they work

INPUT → PROCESS → OUTPUT

The light sensor in the streetlight senses it has got dark and switches on the light:

INPUT: Light sensor → PROCESS: Switching → OUTPUT: Light

Systems diagrams are used to show the three elements in the system.

How Microcontrollers Work

https://www.youtube.com/watch?v=i_g1dD5fFLo&feature=youtu.be

Inputs

Input devices are electrical or mechanical sensors that use signals from the environment, such as light levels, temperature and pressure, and convert them into signals that can be passed into processing devices and components.

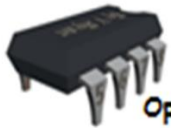
Switches

Light dependent resistor (LDR)

Thermistor (temperature sensor)

Processes

Electronic processes are often performed by **microcontrollers**. Microcontrollers are small computers within a single integrated circuit that contains a processor core, memory and programmable input and output capability.



Outputs

Output devices are the part of an electronic system that people are most aware of. The output can be, for example, light, sound or movement.

Lamp

LEDs

Loudspeaker

Buzzer

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Y9 term 3 - mechanics and forces

Linear motion

Moves in a straight line in one direction only

Rotary motion

Rotates around a central axis

Reciprocating motion

Moves back and forth or up and down along a straight line

Oscillating motion

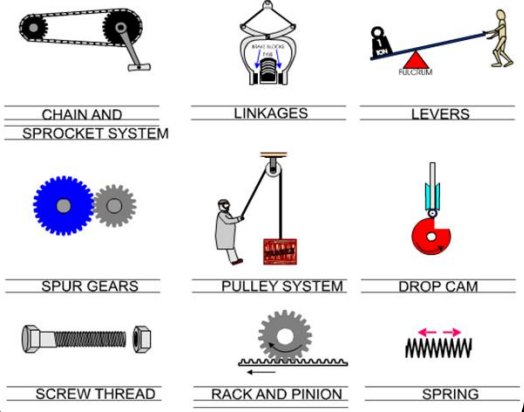
Moves back and forth along a curved line

Mechanisms

A **mechanism** is a device that changes an input motion into a different output mechanism.

It normally changes the amount of movement or the direction of movement in some way, to make a job easier to do.

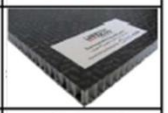
Examples of mechanisms are:



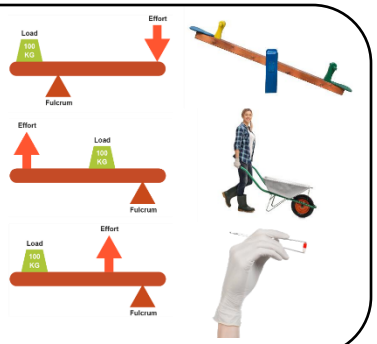
Mechanical Advantage

A mechanism is simply a device which takes an input motion and outputs a different motion. The point of a mechanism is to make the job easier to do.

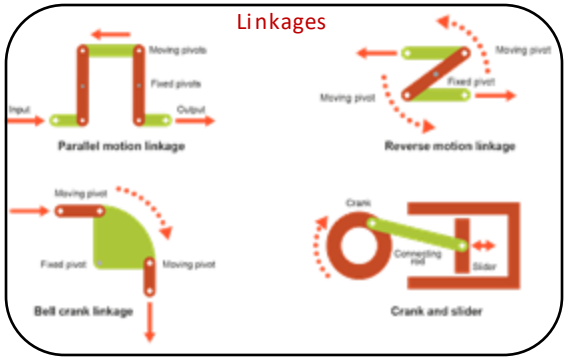
Levers provide <u>mechanical advantage</u>. This means that they allow you to move a large output load with a small effort.

Force	Description	Examples
Tension	Forces pulling in opposite directions.	
Compression	Forces that are trying to crush or shorten.	
Bending	Flexing force	
Torsion	Twisting force.	
Shear	A strain produced when an object is subjected to opposing forces.	

- First order
  - Class 1 lever
- Second order
  - Class 2 lever
- Third order
  - Class 3 lever



Linkages

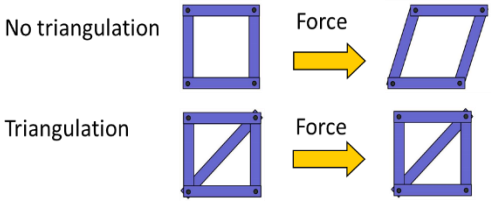


Videos links for the project

Strong structures
https://www.youtube.com/watch?v=mBHJtWbsiaA
Combining mechanisms
http://www.bbc.co.uk/learningzone/clips/combining-simple-mechanisms-to-form-a-complex-system/908.html

The triangle – making structures rigid

Unstable structures can sometimes be made more rigid by adding triangles to the shape.



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Y9 term 3 – modern and smart materials

Modern materials - are developed through the invention of new or improved processes, for example, as a result of 'man' made materials/ingredients or human intervention, in other words not naturally occurring changes. They are altered to perform a particular function.

Nanomaterials - are any material with tiny parts less than 100 nanometers in size.
This includes carbon nanotubes, fullerene an quantum dots. These materials exist on an atomic or molecular scale. Nanomaterials are used in sports equipment. to add strength without substantially increasing the weight.
Nanoparticles are also used in clothing such as socks, due to their antibacterial properties.
https://www.youtube.com/watch?v=EkRBr8BOakE

Smart material - is one that reacts to an external stimulus or input. This means that it can alter its functional or aesthetic properties in response to a changing environment. This group of materials can react to stimuli such as heat, pressure, moisture, stress, pH levels, light (including UV) and electricity.

https://www.youtube.com/watch?v=3Tp6IC_SXu0

Composite materials - are formed when two or more distinctly different materials are combined together to make a new material with improved properties.

Carbon fibre and glass reinforced fibre plastics are examples of composite materials a thermosetting plastic is combined with a matted or woven material to produce very lightweight and strong composites.
How It`s Made Fiberglass helmets
https://www.youtube.com/watch?v=C_Q0HQ7f4LU

Graphene

Graphene was developed in 2004, but is has been difficult to manufacture it reliably until recently.

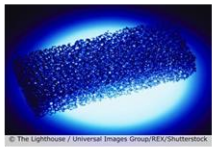
Its main properties are:
super capacitate
electroconductive
biodegradable
200 times stronger than steel
can take any shape
is ultra-lightweight.

Metal foams

Metal foams were developed in 2011. This material is like a metal sponge in texture and construction. It is made by passing gas through a liquid metal – this turns the metal into foam, which then sets to a solid.

Its main properties are:

- strong
- lightweight
- thermally conductive
- very porous
- good sound absorption
- excellent energy absorption.



Thermochromic pigments

These pigments react to a change in temperature.
A colour change can indicate that a particular temperature has been reached.
The pigments can be incorporated into a material, for example plastics, or applied to the surface as a paint.
Thermochromic pigments are quite often used in products such as babies' feeding spoons, to indicate if the food is too hot.

Photochromic pigments

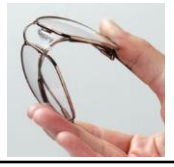
React to UV rays and creates a colour change in the material where the pigment is located.

Pigments are usually found in novelty items such as colour changing nail varnish, T shirts and vehicle spray paint etc.

Photochromic particles such as silver halides are found in sun glasses, and will darken the clear glass when exposed to UV light.

Shape memory alloys

Most materials have a memory and will want to spring back to their original shape.
Nitinol is the most common shape memory alloy. It is an alloy of nickel and titanium.
Nitinol is used in dental braces – the heat from the wearer causes the wire to shrink slightly.
It can also be used in surgical stents to expand blood vessels.
It will also respond to electrical current being passed through it – this will cause it to contract.



Glass fibre reinforced plastic - GRP

GRP is composed of strands of glass.
Each individual glass fibre is very fine with a small diameter, and they are woven to form a flexible fabric.
It has a high strength to weight ratio.
GRP is lightweight, corrosion resistant and chemical resistant.
It is used to make boat hulls, car body parts, storage tanks, seating, helmets etc.

Carbon fibre reinforced plastic -

CRP is formed from a cloth woven from individual strands.
CRP has a very high strength to weight ratio.
It has good tensile strength but not good compressive strength.
It is very expensive.
It is used in supercars and sports cars, top-end sports equipment, and is being developed for prosthetic uses.