Marketing and branding

Influencers = people paid on social media to promote a product

Product placement = product put into a film or series or programme

Catch phrases = e.g. Nike 'just do it'

Branding = using colours/logos/styles

Celebrity endorsement = paying a celebrity to use/promote their product

GCSE
Design & Technology
Revision Booklet

You **CAN** do this, good luck!
from Mrs Dhami

Design ideas/iterations

Design strategies
= methods of creating design ideas

- Sketching
- CAD
- Prototyping
- Primary user designing
- Collaborative designing
- Focus group studies
- AI

Communication methods:

- Sketches
- Exploded diagrams (good for self assembly)
- CAD prototypes
- Physical prototypes
- AI
- VR/AR

Material properties

Hardness (soft)	**Impact resistance/ impact strength** (brittle)	**Durability** (not durable)
Ability to resist scratches and indentation	Ability to withstand sudden impact.	Ability to withstand wear and tear over **time.**
Styrofoam is very soft as can scratch easily.	Ceramics are very brittle. Polymers such as rubber are very impact resistant.	Metal pegs that do not rust are more durable than polymer ones that become brittle.

Form vs Function

Form = aesthetics: the way something looks

Function = the way something works

Is form or function more important?

Fashion clothes = **form** is often valued more.
Waterproofs/hiking clothes = **function** is often valued more.

You decide depending which product it is!

Design optimisation

= product design and development requires that engineers consider trade-offs between product attributes in the areas of cost, weight, manufacturability, quality and performance.

It is about determining how to arrive at the best overall design, making the right compromises and not sacrificing critical attributes like safety.

Global sustainable development

= meeting the needs of our generation without compromising the needs of future generations

Material properties

Strength to weight ratio	Strength	Thermal conductivity (thermal insulator)
Strength of an object in comparison to it's weight.	Ability to withstand forces that try to bend or break it.	Ability to allow heat to pass through.
Composites such as CFRP or GRP has excellent strength in comparison to their weight.	e.g. compressive strength = withstand squashing forces. Tensile strength = withstand stretching forces	Cool bags are thermal insulators.

Scales of production

One off: 1-2	Wedding dresses/cakes/tailored suits. Very expensive and require lots of skill!
Batch production: 10-100	Seasonal products e.g. Christmas decorations
Mass production: 1000's	Lots of identical objects e.g. nuts and bolts. High initial cost but cheap in long run.

Structural integrity

= ways to provide strength without using too much extra material.

Triangulation = used to reinforce structures/bridges/buildings

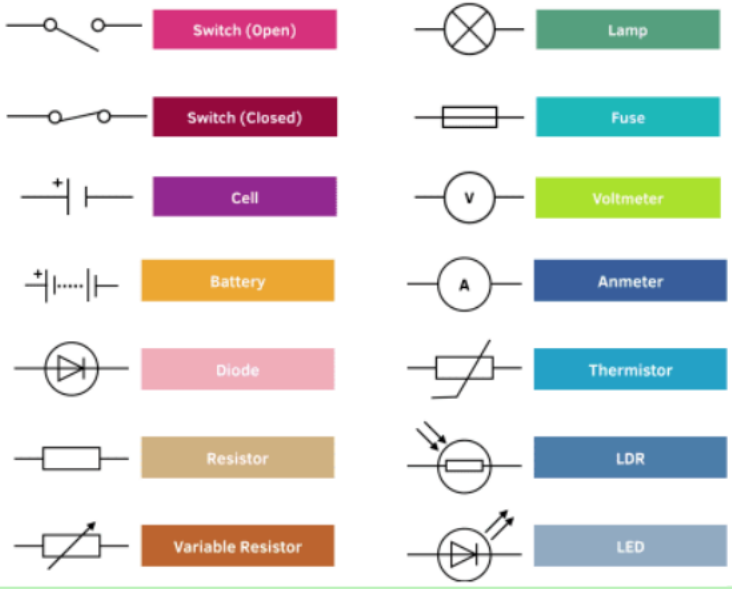
Boning (rigid parts inside clothing)
Darts (a sewn fold in fabric)
Layering (extra material e.g. collar/cuff)

Ribs and webbings inside boxes/cases
Ribs/lips on polymer single use cups.

Material properties

Elasticity (plasticity)	**Plasticity** (elasticity)	**Corrosion resistant** (not durable)
Ability to be stretched and return to original shape.	Ability to change shape when a force is applied.	Ability to withstand damage from air/water or chemicals.
Leggings, stretch to fit around legs.	HIPS in vacuum former.	These are not corrosion resistant: Rust on ferrous Timbers rot Polymers go brittle

Circuit symbols



Material properties

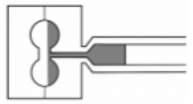
Absorbency	**Flammability** (fire resistant)	**Electrical conductivity** (electrical insulator)
Ability to soak up moisture.	Ability of a material to burn or ignite.	Ability to allow electricity to pass through.
Towels are made of cotton to soak up water.	Nomex is used because it has good fire resistance.	Copper for electrical wire.

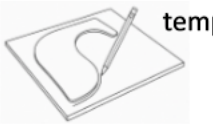
Material properties

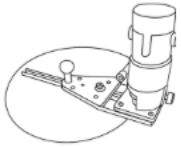
Density	Ductility	Malleability
The mass per unit volume.	Ability to be stretched out into **wires** without breaking (DUCK beak, remember?!)	Ability to be shaped into **large sheets** without cracking or bending (MALL, remember?!)
Balsa wood feels like Styrofoam – it has lower density than oak.	Electrical wiring uses copper that can be drawn out into long wires.	Aluminium rolled into sheets ready for cans.

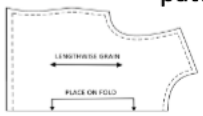
Production aids = help to increase the efficiency/repeatability/accuracy of manufacture


formers


moulds


templates


jigs


patterns


stops

Timber source = trees

Softwoods = trees that do not lose leaves
Pine/ cedar (natural oils, water resistant)

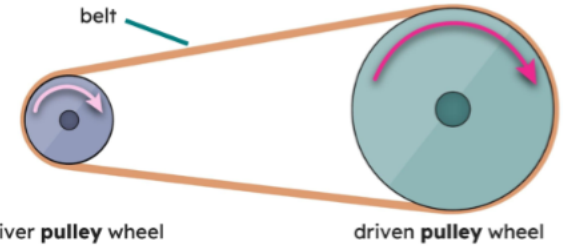
Hardwoods = trees that do lose leaves
Oak/ Balsa (lightweight)/ spruce (paper)/ teak (natural oils, water resistant)

Manufactured boards = made by humans
MDF (sawdust)/ Plywood (layers)/ chipboard (chips)

Electronics: flow diagram and components

input	process	output
Change in light/sound/movement e.g. microphone/switch	Brain of the system e.g. microcontroller such as microbit	Such as light/sound/movement e.g. buzzer/motor/speaker/LED

Pulley systems transmit rotary motion from a driver **pulley** wheel (starts the motion) to a driven **pulley** wheel through a belt.



The belt fits into a groove on the **pulley** wheels and motion is transferred through **friction**.

Crossing the belt makes the driver and driven **pulley** wheels turn in opposite directions.

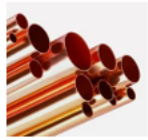
Metal source = ore

Ferrous = contain iron

Steel/ iron

Non ferrous = do not contain iron

Copper (conductor)/ aluminium (lightweight)/ brass (corrosion resistant)



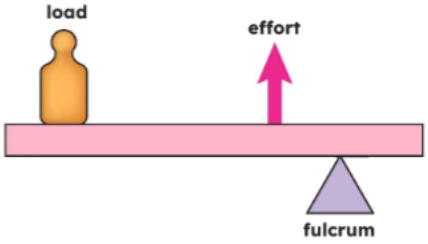
Alloys = a mixture of 2 or more metals

Brass/ stainless steel/solder

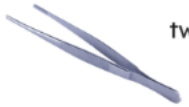
Levers

Class 3 lever

Effort is positioned anywhere between the **fulcrum** and the **load**.



Examples


tweezers


tongs

Third class levers are useful for tasks requiring control, accuracy and precision.

Polymers

Thermopolymers = can be heated and reshaped
HDPE (bottle tops)/ LDPE (bags)/ PVC (pipes)

Thermosetting polymers = cannot be reheated and reshaped
Silicone (flexible cup cake moulds)/ urea-formaldehyde (plug sockets and light switches)

Biopolymers = biodegradable polymers
PLA (3D printers and bags)/ potatopak/ biopol

Textiles

Synthetic = from crude oil
Polyester/ rip stop nylon

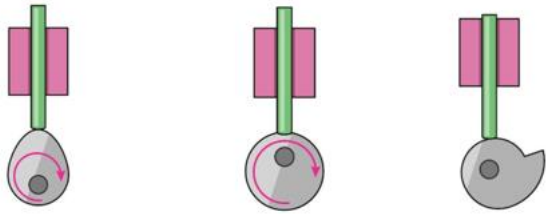
Natural fibres = from animals/plants
Cotton/wool/silk

Blended fibres = mix of different fibres

Technical textiles = made for performance not appearance
Kevlar/Nomex

Cams

= a mechanical component that converts rotary motion into linear motion



pear eccentric snail

Cams are often used in toys to create movement.

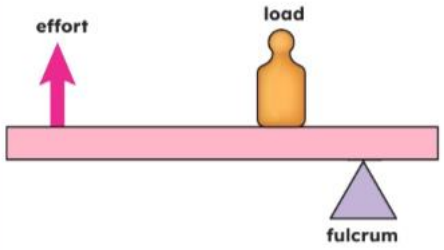
Thermopolymers

HDPE	**synthetic** from fossil fuels, lightweight, resistant to chemicals, high impact resistance, foodsafe	bottle tops, milk bottles
LDPE	**synthetic** from fossil fuels, lightweight, flexible, foodsafe	bin bags
PVC	**synthetic** weather resistant	uPVC doors PVC (plasticised) drain pipes

Levers

Class 2 lever

Load is positioned anywhere between the **fulcrum** and the **effort**.



Examples

wheelbarrow

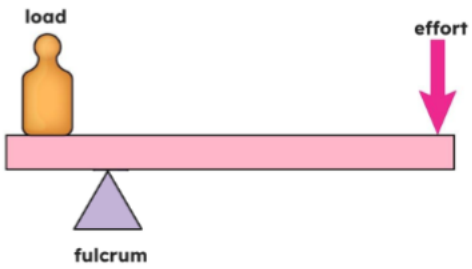
nutcracker

Second class levers are common in tools and machines designed to reduce the **effort** needed for heavy lifting or squeezing.

Levers

Class 1 lever

Fulcrum is positioned anywhere between the **load** and the **effort**.



Examples


see saw


opening tins


scissors

First class levers can provide a **mechanical advantage (MA)** by amplifying force.

Thermosetting polymers

silicone	foodsafe, grippy, soft, flexible	cup cake trays for oven, sealants, handle bar grips
melamine formaldehyde	heat and corrosion resistant	laminated kitchen worktops, light switches
epoxy resin	chemical resistant, brittle	adhesive Used in CFRP, GRP

Types of motion


rotary


oscillating

linear

Reciprocating (Up and down or side to side)

Smart materials

= respond to environment by changing properties.

thermochromic	Changes colour due to heat	Baby spoons and photo mugs
photochromic	Changes colour due to light	Glasses that change to sunglasses in UV
Shape memory alloys (SMA)	When heated remembers and goes back to original shape	SMA mattresses/pillows and glasses frames

Biopolymers

PLA	Low melting point. Made from corn starch/sugars, biodegradable.		3D printing, coffee cup lids
biopol	Made from vegetable starch, degrades naturally		Disposable drink cups and cutlery
potatopak	Made from potato starch, compostable		Food packaging
Shellac	Naturally occurring polymer secreted by lac bug. DOES NOT easily degrade.		Nail varnish/timber varnishes

Levers

Making the handle longer, increases the arm length from the **fulcrum**, which increases the **mechanical advantage (MA)**. This makes it easier to cut through the metal without increasing **effort**.

Smart materials

= respond to environment by changing properties.

hydrochromic	Changes colour due to water/moisture	Water colour in books/umbrellas with hydrochromic patterns
polymorph	Melts when heated and can be moulded by hand into any shape.	Orthopaedic aids
Bioconcrete Self healing material	Uses bacteria that react with water to 'heal' itself by producing limestone to fill any micro cracks.	Concrete

New and emerging technologies

New and emerging technologies have provided opportunities for **design decisions** to be more **inclusive:**

Assistive technologies for example, screen readers, reading pens, speech to text software and voice assists.

Augmented reality (AR) fitting rooms let you try on clothes or glasses virtually, making shopping more accessible for everyone.

Drones: New and emerging technologies

Drones are flying devices that can be controlled remotely or can fly on their own using software and sensors. Drones are not just used for hobbies:

aid delivery

assessing flood damage

rescue drones

Modern materials

= continually being developed through the invention of new or improved processes

kevlar 	Lightweight and extremely tough	Bullet proof vests
nomex 	Fire resistant	Fire fighters/astronaut clothing
fastskin 	mimics the skin of a shark giving a streamlining effect underwater and reducing drag (resistance).	Competitive swim clothing

AI: New and emerging technologies

AI is a type of technology that allows machines to think, learn, and make decisions like humans, such as:

- Chatbots, for example customer service bots that can answers questions.
- Image recognition, for example facial recognition in photos.
- Virtual assistants that can answer simple questions or perform tasks such as turning on music.
- Text to image AI that can produce or render design ideas.

New and emerging technologies can be used to improve safety without harming people in the process.

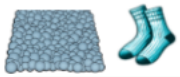
Composites

= two or more materials not chemically joined.

CFRP Carbon fibre reinforced polymer	Strong and lightweight, expensive, difficult to recycle	Helmets, sports equipment e.g. bikes 
GRP Glass reinforced polymer	Strength in many directions, expensive, difficult to recycle	Boats/canoes 
Laminates (if different materials)	Cheap in comparison to solid soft/hardwood tops due to cheap inner core	Table tops: desks, kitchen worktops 

Modern materials

= continually being developed through the invention of new or improved processes

PLA 	Low melting point, made from cornstarch	3D printer, disposable cups and compostable bags
microencapsulation 	Ability to release tiny bubbles of liquid or substances with wear.	antiseptic medical fabrics, sportswear, allergy control
teflon  	Water resistant/easy to remove stains/stops food sticking to pans	Coating on non stick pans, school uniform

Biometrics: New and emerging technologies

= uses unique body features for identification.

voice recognition

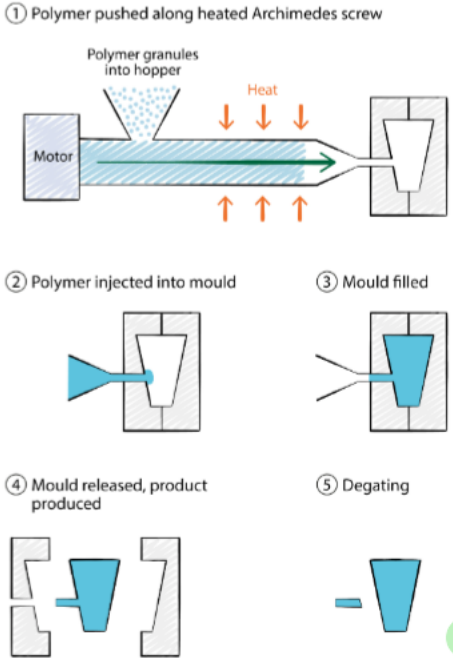
finger prints

iris or retina scan

facial recognition

Injection Moulding

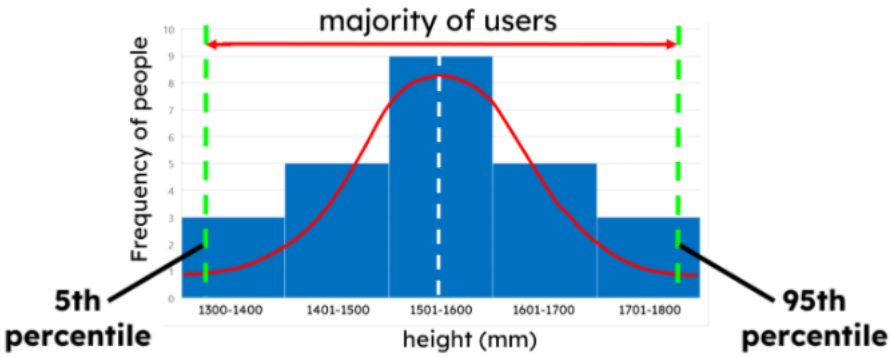
e.g.
Lego bricks
Pen lids



Ergonomics

= how we use anthropometric data to make a product more comfortable to use.

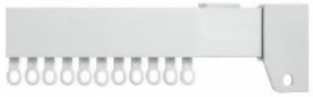
Anthropometrics

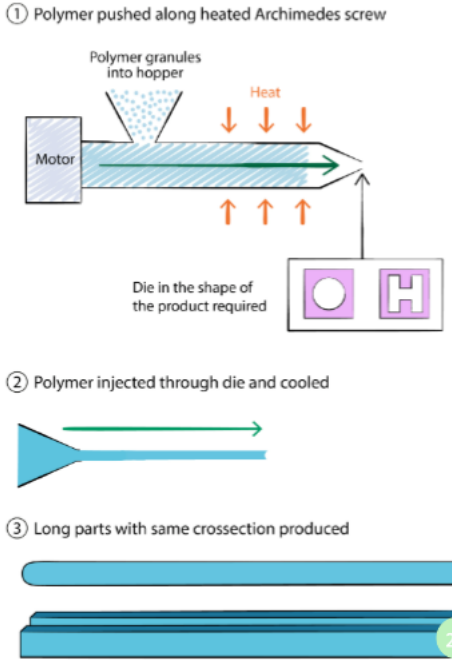


The **5th percentile** tell us the smallest 5% of measurements e.g. petite range.
The **95th percentile** tells us the largest 5% of measurements in the data set e.g. tall clothing range.

Extrusion

e.g.
Products with the **same cross section**
Curtain rails
Pipes





Fairtrade = ensures everyone is paid fairly and ensure good working conditions:

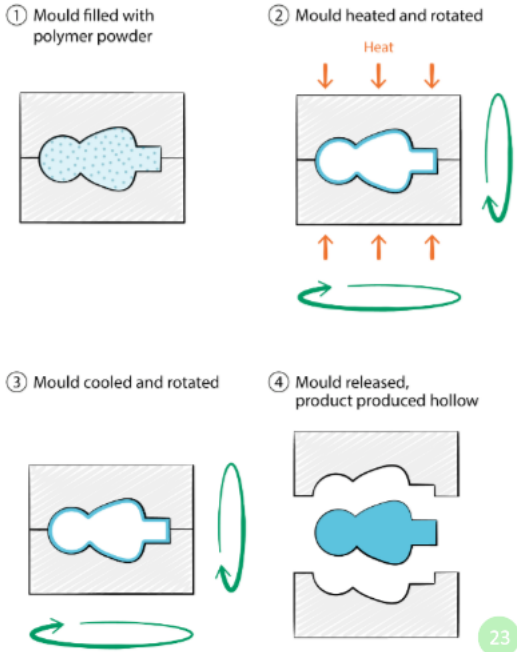
- **Fairtrade price** = ensures a minimum price
- **Fairtrade premium** = goes into the community

e.g. water pumps/education/storage facilities

Living income = the amount of money needed for a household to have a decent standard of living.

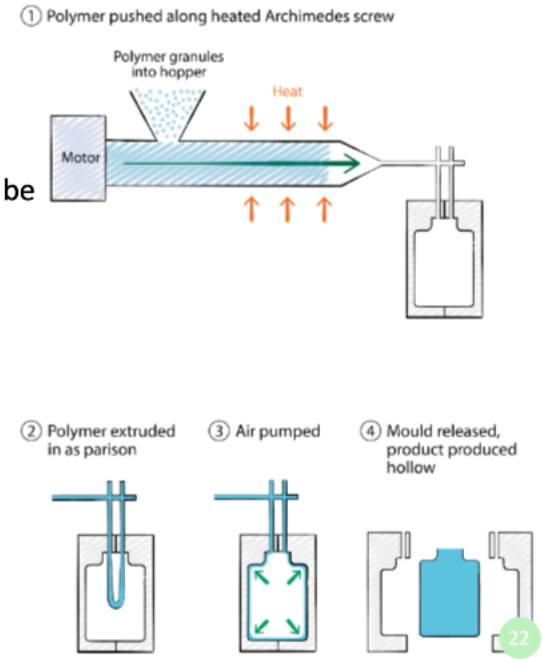
Rotational Moulding

e.g.
Hollow objects
Refuse/recycling bins
Garden toys



Blow moulding

e.g.
Hollow products (tend to be **smaller** than rotational moulded products
Bottles



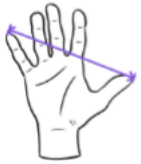
Anthropometrics

= measurements of the human body.

anthropometrics

means 'human'

means 'measure'


hand span

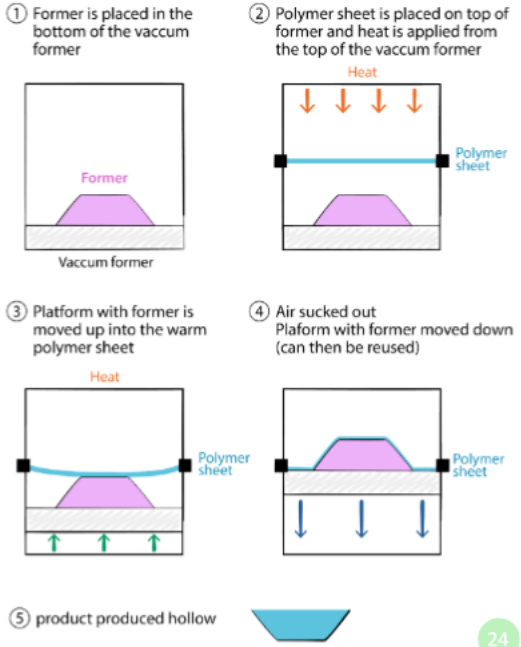

height


head circumference


grip strength

Vacuum Forming

e.g.
yoghurt pots



Life cycle assessment: design decisions

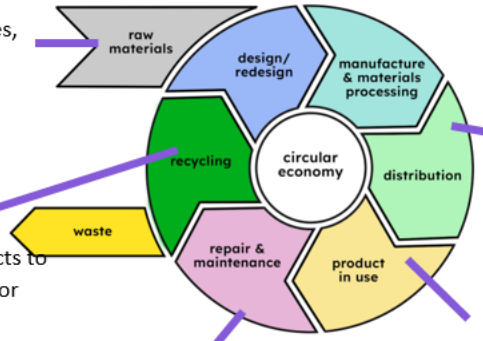
material choices, for example, biopolymers

enabling products to be dismantled for recycling or encouraging products to be passed on

using standardised parts and tools for repair

energy sources such as rechargeable batteries

ability to be flat packed/assembled/ stacked



Life cycle assessment

Life cycle assessment (LCA) is where the environmental impact is assessed at every single stage of the product's life cycle so that, through **design decisions**, the environmental impacts can be **reduced**.

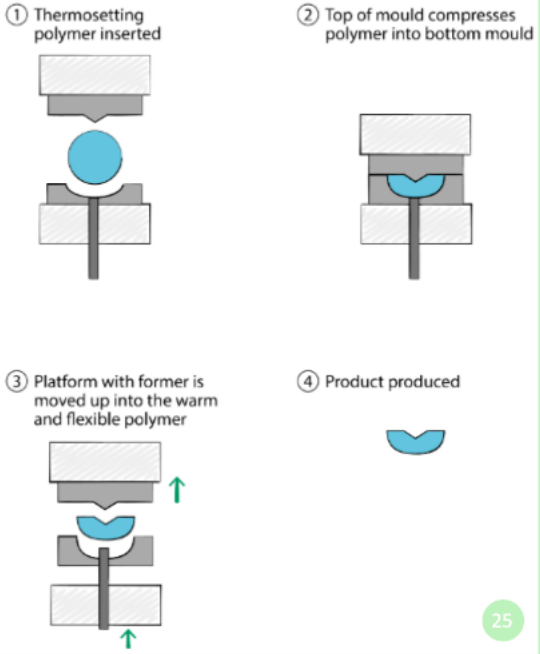
How do you carry out **LCA**?

You can assess the following at each stage:

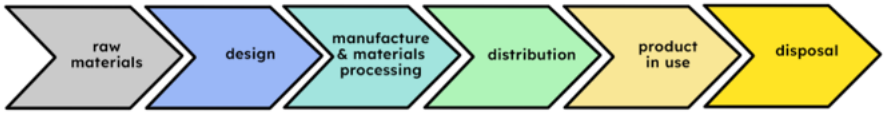
- source of energy
- amount of energy required
- amount of **carbon emissions**

Compression moulding

e.g.
Thermoset products
Light switch
Plug sockets



The linear economy



Products are **used once** and then **often thrown away**.

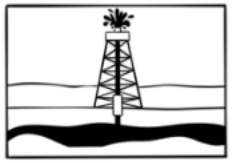

single use coffee cup


disposable nappy

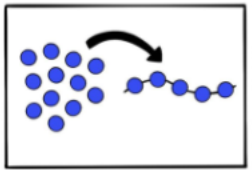

non-rechargeable battery


fast fashion

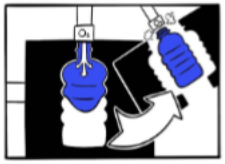
Polymers: source to stock forms


Oil drilling; to extract crude oil from the ground.


Fractional distillation; heat separates crude oil into fractions which are then **cracked** to produce **monomers** such as propene.


Polymerisation **process**; monomers are joined together to make polymer chains such as polypropylene.


Polymers are made into stock forms such as sheets/pellets/powder.

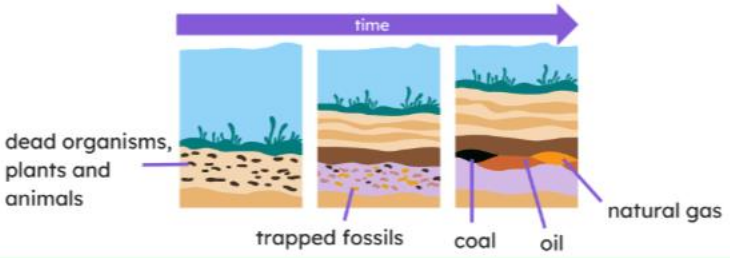

Stock forms undergo manufacturing processes.

Polymer sources

A **source** is where a material originally comes from.

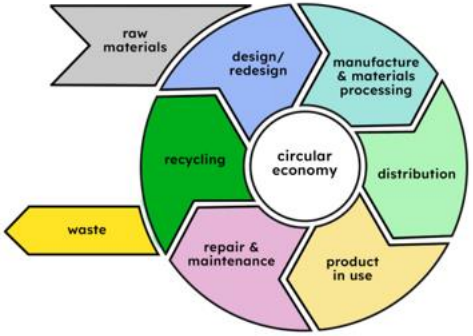
Polymers have two main **source** categories:

- **naturally occurring** (comes from nature; not made or altered by humans)
- **synthetic** (manufactured through chemical processes):



The circular economy

The **circular economy** can be defined as an economic system where products and materials are kept in circulation and **do not become waste**.




bags for life


encouraging clothes recycling


re-rechargeable ports


reusable nappies

Polymer stock forms


Rod (solid cylindrical): for example, dowels and handles.


Tube (hollow cylindrical): for example, piping and straws.


Sheet: for example, vacuum forming, packaging and signage.


Foam: for example, insulation, prototyping and packaging inserts.


Granules (small pellets): used in moulding **processes**, for example, injection moulding.


Filament (strands of polymer): for example, 3D printing.

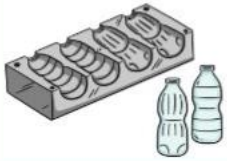

Powder (fine particles): used in coating or forming, for example, powder coating or rotational moulding.


Film: for example, packaging or decoration.

Polymer finishing processes

A fine, **abrasive polish** can be used to remove any scratches and give a shiny finish.

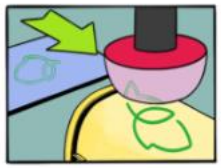
Buffer machine is a rotating polishing tool used to quickly smooth and shine the surface of polymers.



Texture/embossing/patterns/text can be included in the **surface of a mould** so that extra finishing is not required.

Polymer finishing processes

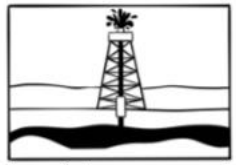

A **sublimation printer** and heat press can transfer vibrant, permanent **aesthetics** onto specially coated polymers (**surface preparation).**



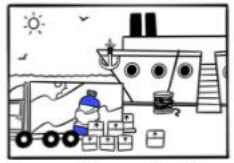
Pad printing is an industrial finishing method used to transfer images to larger products that may not have a flat surface such as refuse bins.


Vinyl cutters or CNC plotters cut vinyl stickers.

Sustainability and environmental impacts of polymers:

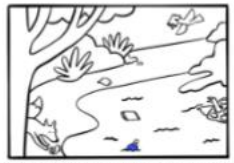


The refining **process** results in carbon emissions and air and water pollution. There is also the potential for oil spills and fires.

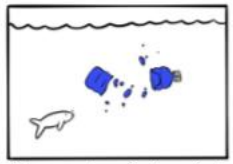


Transporting crude oil or polymers from far locations contributes to carbon emissions.

Single use polymers contribute to landfill and ocean pollution if not recycled.



Polymers can harm animals and their habitats.



Polymers break down into small parts creating microplastic pollution.

Some polymers can be difficult to separate for recycling e.g. laminates. Polymers mu[illegible] sorted.

Polymer finishing processes: additives

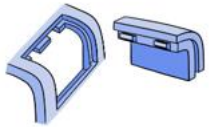
Stabilisers - protection against UV damage so that polymers do not turn brittle when outside. For example, uPVC window frames.

Pigments - add colour, reducing the need for painting. For example, children's toys.


Plasticisers - influence the **function** by creating flexibility. Rigid PVC pipe vs flexible PVC hosepipe.

Polymer joining

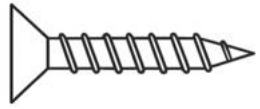
Snap fit: easy to open



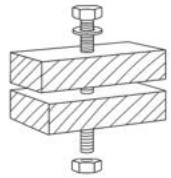
Snap fit: difficult to open

Rivets

Push fit



Screws



Nuts/bolts/washers

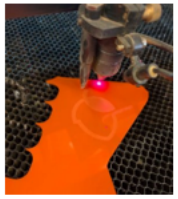
Standard components

= parts that have already been made.

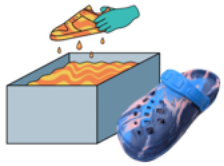
e.g. screws, nuts, bolts, washers, rivets, zips, buttons, hinges, electrical components, gears



Polymer finishing processes



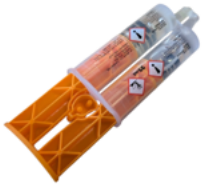
Laser engraving patterns/logos/symbols.



Hydro-dipping = a printed film floats on water and transfers its **aesthetic** pattern onto a polymer surface when the object is dipped.

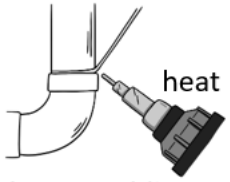
Over-moulding = one polymer is moulded over another to create a single part with multiple materials or textures such as a toothbrush.

Polymer joining



Epoxy resin (two – part)

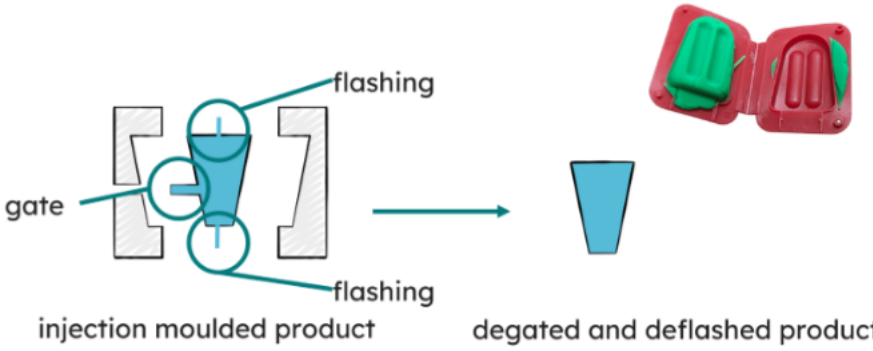
Hot glue/super glue



Polymer welding

Solvent welding: tensol cement

Polymer finishing processes



Gate = excess from point of 'injection' = **degating**

Flashing = excess between two-part mould = **deflashing**