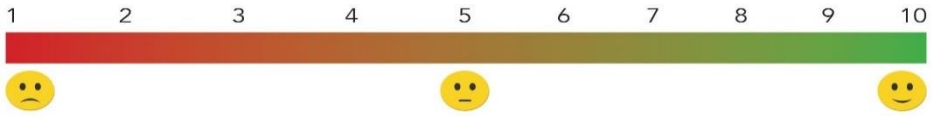
Bishop Chadwick
Catholic Education Trust

KS5 DESIGN TECHNOLOGY Knowledge Organiser

A Level DT

NAME:			
CLASS:		**TEACHER:**	

Target Grade		WAG	Mod 1	Mod 2	Mod 3
Confidence Gauge					

MODULE REVIEW CLOSING THE LOOP	WWW	EBI
MODULE 1		
MODULE 2		
MODULE 3		
MODULE 4		
MODULE 5		
MODULE 6		

Intent, Implementation and Impact in KS5 Technology

Our Mission Statement:

'We aim to use an iterative and explorative design cycle to empower students to become creative and critical thinkers. To find solutions to everyday problems that meet users' needs and make the world a better environment for all in an inclusive way.'

What this means in your lessons:

- ***An iterative and explorative design cycle***

We want you to try to always be improving your ideas and looking for new solutions.

- ***Creative and critical thinkers***

We want you to think outside the box and challenge the ordinary designs you see every day.

- ***Solutions to everyday problems***

We want you to be the people who solve the challenges the world is facing through your new thoughts and exciting ideas.

- ***Meet users' needs***

We want you to think about what your users need every step of the way so your design is 'human centred.'

- ***Make the world a better environment***

We want you to help protect and improve the world for future generations to come.

- ***In an inclusive way***

We want you to design with an awareness of the challenges and barriers your customers may have.

Course Structure KS5 Design Technology

AQA A Level Design Technology

Paper 1

What's assessed

Technical principles

How it's assessed

- Written exam: 2 hours and 30 minutes
- 120 marks
- 30% of A-level

Questions

Mixture of short answer and extended response.

50% Exam
(2.5 hrs + 1.5 hrs)
Technical principles + Designing and Making Principles

Paper 2

What's assessed

Designing and making principles

How it's assessed

- Written exam: 1 hour and 30 minutes
- 80 marks
- 20% of A-level

Questions

Mixture of short answer and extended response questions.

Section A:

- Product Analysis: 30 marks
- Up to 6 short answer questions based on visual stimulus of product(s).

Section B:

- Commercial manufacture: 50 marks
- Mixture of short and extended response questions

Non-exam assessment (NEA)

What's assessed

Practical application of technical principles, designing and making principles.

How it's assessed

- Substantial design and make project
- 100 marks
- 50% of A-level

Evidence

Written or digital design portfolio and photographic evidence of final prototype.

50% NEA
Design and Make project with a design portfolio and manufacturing skills.

Learning Journey 12-13 Design Technology

Read like a designer…

Year 12: ***Mortal Engines*** **Philip Reeve**
How to Fail at Almost Everything and Still Win Big **Scott Adams**
How Do Wings Work? **Holger Babinsky**

Year 13: ***Cats' Paws and Catapults: Mechanical Worlds of Nature and People*** **Steven Vogel**
Structures – or Why Things Don't Fall Down **J.E. Gordon**
The Design of Everyday Things **Don Norman**

Orientation from GCSE to A level
Materials and their applications

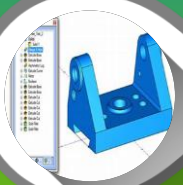
Research
Product analysis
Performance characteristics of materials
Questionnaires and the importance of 3rd party feedback

Design
Client
Accuracy in design
Design for manufacture and Environment
Enhancement of materials
Computer aided design

Development
Modern and industrial commercial practise
Digital design and manufacture
Enterprise/marketing in the development off products

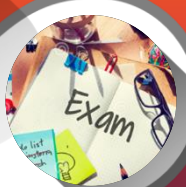
Manufacture
Manufacture and project management
Computer aided manufacture
Scales of production

Revision
Design cycle principles
Product and materials impact
Manufacturing Techniques





Careers Links

Year 12: Cognitive thinking, problem-solving critical thinking, expert and creative solutions, use systems and technology. Communicating, working collaboratively, negotiating and influencing, self-presentation

Year 13: self-management, adaptability and resilience, self-monitoring and development, learn independently, research actively and methodically, analytical and problem-solving skills.

Impact
How technology and cultural changes can influence design
Responsible designing
Health & safety
Selecting appropriate tools, materials and processes

Testing
Prototypes
Working models
Client analysis
Modification

Evaluation
Analysis of production cycle
Feasibility studies
Product improvements
Modern manufacturing systems

Exams
Product Design Paper1 (Technical principles)
Product Design Paper 2 (Design and making principles)

On to university, apprenticeship or employment…

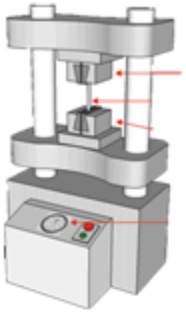
Content KS5 Design Technology

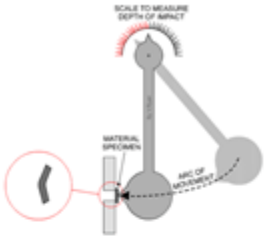
Theory
Materials and their applications
Testing materials
Performance characteristics of materials: papers/boards, composites, polymers, woods, smart materials, metals
How technology and cultural changes can impact on the work of designers
Selecting appropriate tools, equipment and processes.
Accuracy in design and manufacture.
Design for manufacture.
Enhancement of materials.
Forming, redistribution and addition processes – wood, metal, polymers
Joining methods, adhesives and fixings along with the use of jigs and fixtures.
The use of finishes – paper/board, polymers.
Modern and industrial commercial practice
Digital design & manufacture.
The requirements for product design and development.
Health and safety.
Design for manufacturing, maintenance, repair and disposal.
Enterprise /marketing in the development of products.
Design communication.
Technology and cultural changes
Design theory.
Responsible design.
National and international standards in product design.
Protecting designs and intellectual property.
Feasibility studies.
Modern manufacturing systems.

NEA
Problem/brief.
Research plan.
Research
Product Analysis and Disassembly of an Existing product.
Initial sketch ideas
Questionnaire/analysis.
Client/Environment/Scenario
Research Analysis
ISR
Design Ideas
Modelling
Development, Testing and manufacturing of Ideas.
Manufacture and development write up
Manufacturing Specification
Manufacturing plan
Manufacture of Product
Modifications
Evaluation
Client Evaluation

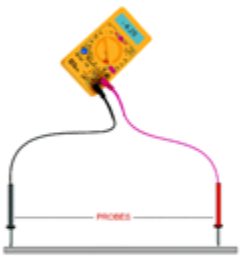
Knowledge Organiser: KS5 Design Technology

Technical Principles: Investigating and Testing Materials

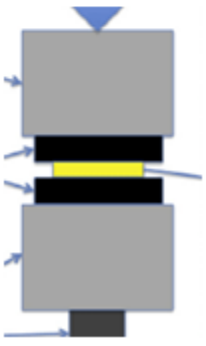
Testing Type	Diagram
Tensile Strength (Ability to resist stretching/pulling forces)	
A tensometer holds a piece of material in clamps and one clamp moves, stretching the piece out.	

Testing Type	Diagram
Toughness (Ability to resist impact force without fracturing)	
Izod impact test has a piece of material held vertically as a pendulum is released and swings at it. The material the absorbs the most impact is the toughest and gives the least pendulum swing	

Testing Type	Diagram
Corrosion Testing (How well a material can resist corrosion)	
Materials are placed in a controlled lab environment, exposed to conditions for a certain amount of time. Then visually inspected for corrosion	

Testing Type	Diagram
Electrical Conductivity (How easily the flow of electrical current passes through a material)	
Probes are places on material, and the distance between them measured. Then the resistance is measured with a multimeter. The higher the resistance the lower the conductivity	

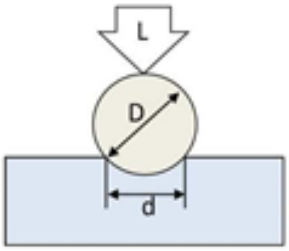
Testing Type	Diagram
Malleability and Ductility (to be able to withstand deformation and being drawn out without cracking)	
A material is placed in a vending machine and held at both ends. A mandrel or plunger then bends the material to an angle. Cracks on the outside indicate ductility and inside indicated malleability	

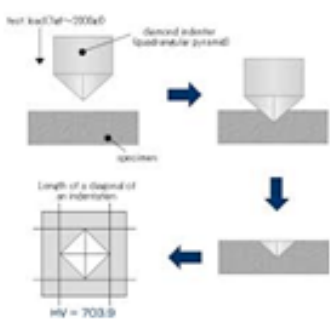
Testing Type	Diagram
Thermal Conductivity (How easily heat passes through a material)	
A square shaped material is placed between two temperature plates. The temperature is increased and sensors on the surface of the material record the rate of conductivity	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Investigating and Testing Materials

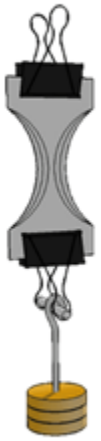
Testing Type	Diagram
Hardness (Ability to resist abrasive wear, indentation and scratching)	
Rockwell Test A diamond indenter is applied to the material. This happens twice and the depth between the first and second applications are measured	

Testing Type	Diagram
Hardness (Ability to resist abrasive wear, indentation and scratching)	
Brinell Test A standard size steel ball is forced into the surface and the diameter of the indent in the surface is measured	

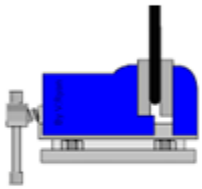
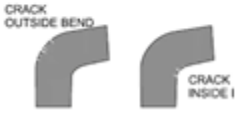
Testing Type	Diagram
Hardness (Ability to resist abrasive wear, indentation and scratching)	
Vickers Pyramid Test Used for very hard materials. A diamond square-based pyramid is used to indent the surface. Then the indent is measureed	

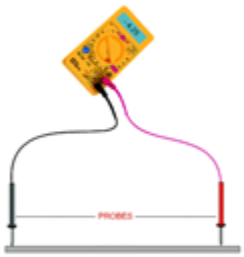
Knowledge Organiser: KS5 Design Technology

Technical Principles: Material testing in the workshop

Testing Type	Diagram
Tensile Strength (Ability to resist stretching/pulling forces)	
Samples of the material are clamped from the top and weights added to the bottom. The less stretch the more tensile strength the material has. This can be checked using ruler.	

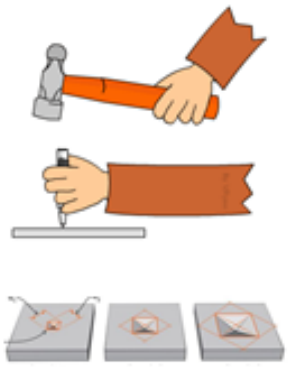
Testing Type	Diagram
Thermal Conductivity (How easily heat passes through a material)	
Light a Bunsen burner under one side of the material and place a thermometer at the other. Record, with a timer, how long it takes for the material to reach a set temperature. The shorter the time the more conductive it is	

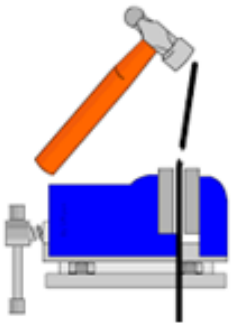
Testing Type	Diagram
Malleability and Ductility (to be able to withstand deformation and being drawn out without cracking)	 
A material is placed in a vice and bent to 90 degrees. If the outside cracks it shows a lack of ductility. If the inside cracks it indicates a lack of malleability	

Testing Type	Diagram
Electrical Conductivity (How easily the flow of electrical current passes through a material)	
Probes are places on material, and the distance between them measured. Then the resistance is measured with a multimeter. The higher the resistance the lower the conductivity	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Material testing in the workshop

Testing Type	Diagram
Hardness (Ability to resist abrasive wear, indentation and scratching)	
A material is placed on a flat surface and a dot/centre punched is hit with a hammer on top of it. The bigger the indent the less hard it is.	

Testing Type	Diagram
Toughness (Ability to resist impact force without fracturing)	
A material is placed in a vice and hit with a hammer. The tougher a material is, the less damage it will show. If the material snaps or breaks it is more brittle.	

Testing Type	Diagram
Corrosion Testing (How well a material can resist corrosion)	
Materials are placed in an outside area, exposed to weather for a certain amount of time. Then visually inspected for corrosion	

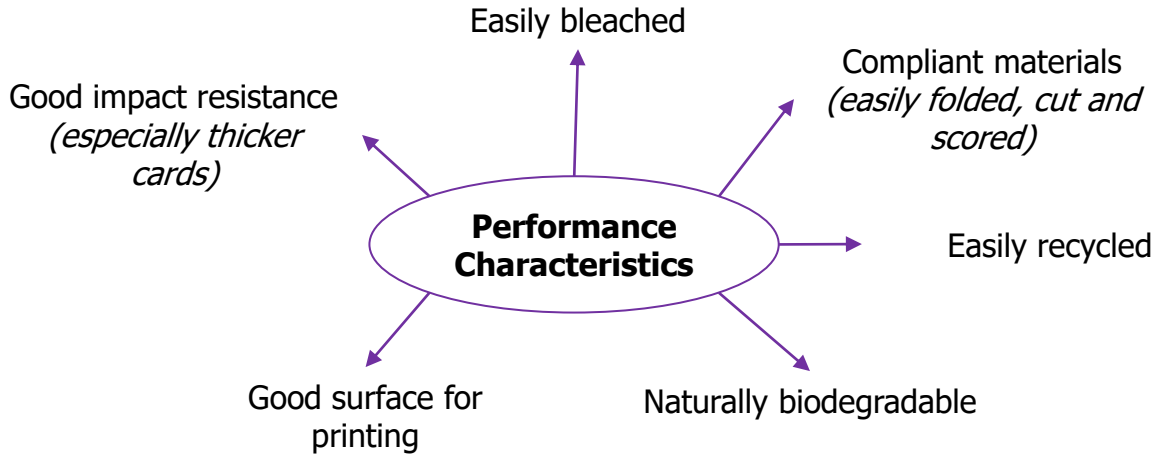
Knowledge Organiser: KS5 Design Technology

Technical Principles: Papers and Boards

Paper or Board	Key info	Uses/ Examples
Cartridge Paper	Thick white paper, completely opaque and more expensive than photocopy paper	Sketching, ink drawings
Layout Paper	Light, semi-translucent, good for blending inks and artist markers	Sketching, drawing and some tracing
Tracing Paper	Translucent paper, slightly thicker than layout paper	Copying images
Corrugated Cardboard	Strong but light. Rigid triangles of card sandwiched between a top and bottom layer	Outer packaging, food packaging
Bleached Card	Chemically treated to brighten the surface. Suitable for high-quality printing	Greeting Cards, high-Quality Packaging
Mount Board	Made from cotton fibres that have been compressed. Very rigid.	Modelling
Duplex Board	Light card with white outside layers. Waxy coating can be added	Cheap packaging. If waxy coating is applied, can be used for food
Foil-lined Board	White card coated with a thin aluminium layer. Foil is great for insulation and water resistance	Takeaway containers
Solid White Board	High-quality white card with a smooth finish. Stiff and holds colours well	Greetings cards, packaging and advertising
Metal Effect Card	High quality card with thin metal effect layer. Can be embossed	Gift Packaging
Moulded Paper Pulp	Recycled paper pulp moulded and dried into specific shape.	Eco-friendly Packaging

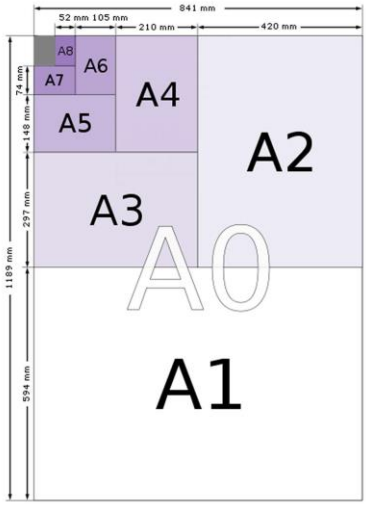
Knowledge Organiser: KS5 Design Technology

Technical Principles: Papers and Boards



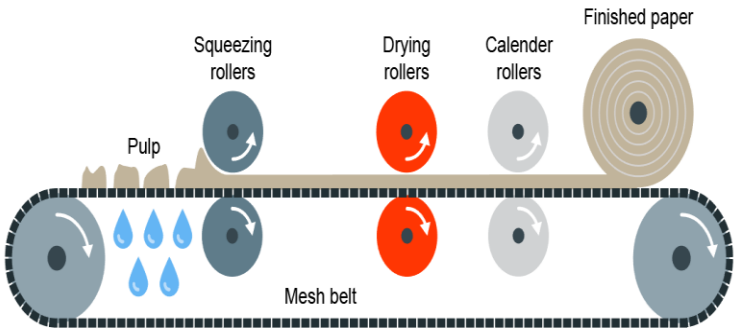
Stock Forms

Stock Forms for paper range from A0 to A8. They can also be available in rolls after being **primary processed.** Paper thickness is in **grams per square metre (gsm)**



Primary Processing

Paper is made by first making pulp. Pulp is a mix of tree fibres and water. This is cooked and bleached white, and adding any other additives.
The pulp is then drained and goes through **Calendering** where the pulp is drained and goes through rollers to convert it to its stock forms



Knowledge Organiser: KS5 Design Technology

Technical Principles: Polymers

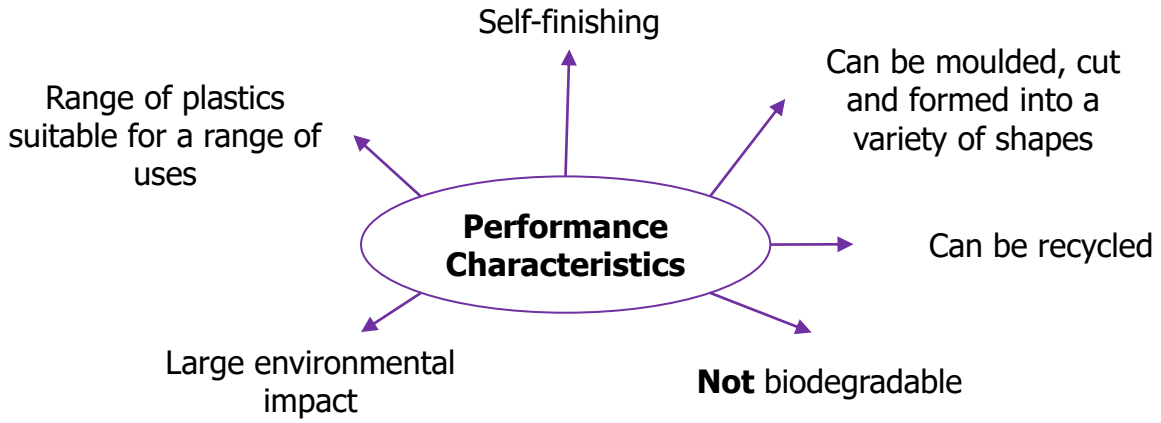
Thermoplastics are ones that can be reheated and reshaped an infinite amount of times, and can be recycled		
Polymer	**Key info**	**Uses/ Examples**
PET	Easily **blow moulded,** food safe and easily recycled	Bottles, packaging, etc.
PVC	Flexible, tough, easily **extruded**	Pipes, tape, hard hats
HIPS	Flexible, lightweight, food safe and easily **vacuum formed**	Containers and yoghurt pots
Acrylic (PMMA)	Tough, brittle, easily scratched	Car lights, baths, displays/ signs
LDPE	Tough, good chemical resistance and low rigidity	Carrier bags, food wrap film, squeezy bottles
HDPE	Weather-proof, good chemical resistance, tough	Chemical drums, toys, buckets, bowls
ABS	Tough, good impact strength and durable	Rigid luggage, control cases and handsets
uPVC	Rigid, tough and good chemical resistance	Window frames, doors and pipes

Thermosets form rigid cross-links when heated, so cannot be reheated or reshaped. This makes them incredibly heat resistant and not recyclable		
Polymer	**Key info**	**Uses/ Examples**
Melamine Formaldehyde	Food safe, hygienic, hard and brittle	Kitchenware and work surfaces
Urea Formaldehyde	Good insulator, hard and brittle	Electrical casings, buttons and handles
Polyester Resin	Strong, heat resistant, can be transparent	Coatings, casings
Epoxy Resin	Rigid, clear and tough	Adhesives and encapsulation of electrical components

Knowledge Organiser: KS5 Design Technology

Technical Principles: Polymers

Elastomers can be deformed under pressure and return to its original shape		
Polymer	**Key info**	**Uses/ Examples**
Natural Rubber	High tensile strength, electrical insulator and low elongation	Tyres, tubes and balloons
Butadiene Rubber	Tough, wear and thermal resistance against friction and good insulation	Shoe soles, conveyer belts, water and pneumatic hoses
Neoprene	Good thermal resistance, abrasion resistance and excellent weather resistance	Wetsuits, laptop cases and door seals
Silicone	Good flexibility, good thermal resistance and weather resistance	Flexible trays and baking moulds and fridge seals



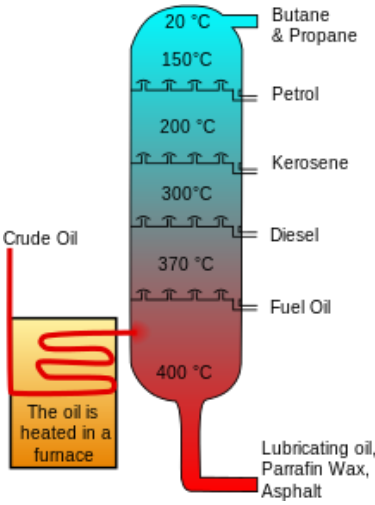
Stock Forms

Stock Forms for polymers include; **granules, sheets, films, rods, tubes, foams and powders**

Primary Processing

Plastic is made by **Crude oil** is extracted from the earth and then processes into different types of fuels, etc. This is called **Fractional Distillation**

A process called **Cracking** then converts the large hydrocarbon molecules into plastics



Knowledge Organiser: KS5 Design Technology

Technical Principles: Woods and Boards

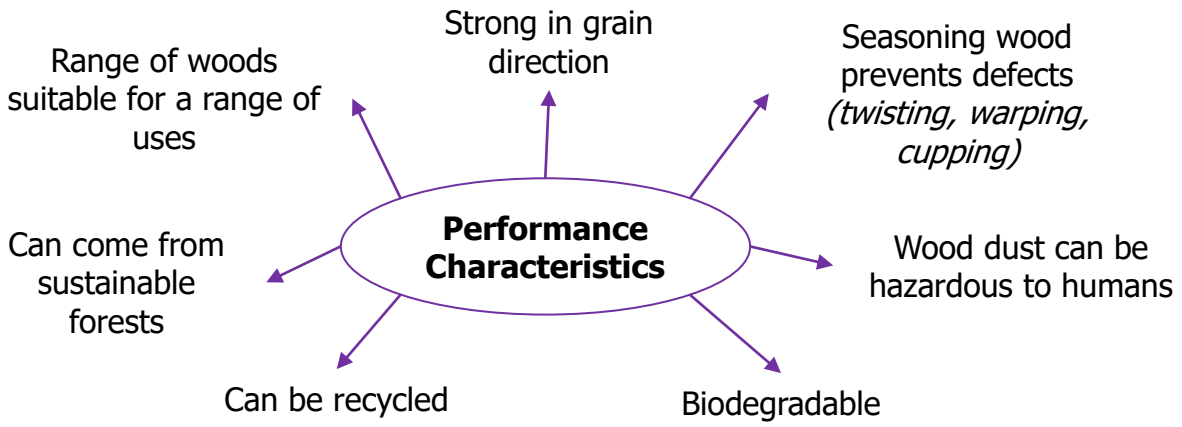
Manufactured Boards are man-made using a mixture of natural timbers and adhesives		
Board	**Key info**	**Uses/ Examples**
Plywood	Thin layers of wood are placed at 90 degrees from each other and glued. These angles prevents warping and helps strength	Indoor furniture, floorboards
Aeroply	Plywood made from birch. Thin and lightweight. Easy to bend.	Jewellery, gliders and furniture
Flexi-ply	The two outer layer of the plywood are made from open-grained timber, allowing it to flex.	Laminated furniture and curved panels
Chipboard	Wood chips compressed with resin	Kitchen units, shelving and flat-pack furniture
MDF	Compressed wood dust/fibres with resin	Model making and furniture

Hardwoods come from **deciduous** trees. These trees loose their leaves, and stop growing, in winter and produce fruit and flowers in spring.		
Hardwood	**Key info**	**Uses/ Examples**
Oak	Hard, tough and good weather resistance. Attractive grain.	Furniture, flooring, joinery
Ash	Tough, attractive grain and open grain makes it more flexible	Ladders, tools and laminating
Mahogany	Easily worked, durable, high quality finish	High-end furniture
Teak	Hard, tough and natural oils resist moisture, acids and alkaline	Outdoor furniture, lab benches
Birch	Hard, close grained and resistant to warping	Furniture, indoor panelling and veneers
Beech	Fine finish, tough and durable	Toys, furniture and veneers

Knowledge Organiser: KS5 Design Technology

Technical Principles: Woods and Boards

Softwoods come from coniferous trees. These trees are **evergreen** and grow all year round. They usually have thin spikey leaves and produce nuts		
Softwoods	**Key info**	**Uses/ Examples**
Pine	Light, easy to work with but can split	Cheap furniture, construction and decking
Spruce	Easy to work with, high stiffness but can decay quickly	Furniture, musical instruments and construction
Larch	Durable, tough, good water resistance and finishes well	Furniture, flooring and used outdoors
Cedar	Acidic nature causes metal corrosion, low density and rot and insect resistant	Exterior cladding, sheds and greenhouses



Stock Forms

Stock Forms for woods include sheets, boards, dowels and mouldings.

As well as Rough Sawn, Planed all round (PAR) and Planed Square Edge (PSE)

Primary Processing

Woods are cut from trees, which are debarked and sawn into planks. The planks are then seasoned (in a kiln in the open air)

Knowledge Organiser: KS5 Design Technology

Technical Principles: Metals

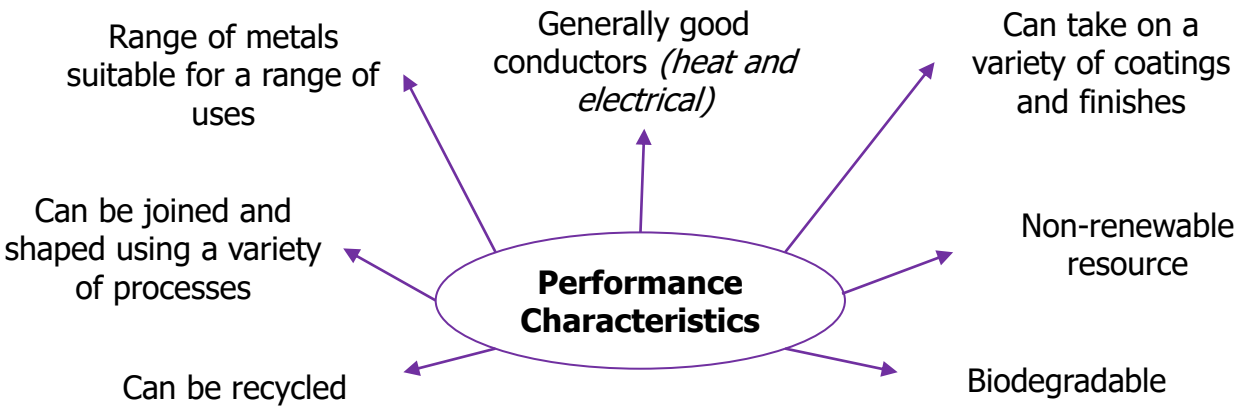
Alloys are mixtures of two or more metals, in order to get the best properties of both		
Name	**Key info**	**Uses/ Examples**
Brass	Malleable and easy to cast	Musical instruments, plumbing
Stainless Steel	Doesn't rust, hard and smooth	Cutlery, medical tools, etc
High Speed Steel	Hard, tough, highly resistant to frictional heat	Tool blades, drill bits, milling cutters
Bronze	Tough, corrosion resistant and can be cast	Statues, coins and bearings
Pewter	Malleable, low melting point and casts well	Jewellery, goblets, decorative items

Non-Ferrous Metals are metals that **do not contain iron**, so **are not** magnetic and will tarnish		
Name	**Key info**	**Uses/ Examples**
Aluminium	Light, high strength to weight ratio and ductile	Pots, pans, cars, cans
Copper	Ductile, malleable and good conductor	Plumbing supplies and cables
Tin	Soft, malleable and good conductor	Used as a protective coating
Titanium	Hard, good strength to weight ratio and high corrosion resistance	Hip replacements, golf clubs and aircraft
Gold	Malleable, ductile and corrosion resistant	Jewellery, electronic components
Silver	Malleable, ductile and can be soldered	Jewellery, cutlery and plating other metals

Knowledge Organiser: KS5 Design Technology

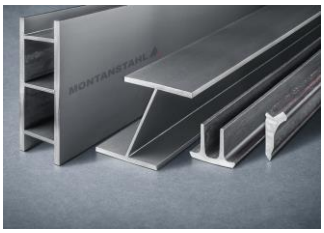
Technical Principles: Metals

Ferrous Metals are metals that contain **iron**, so are magnetic and will rust		
Name	**Key info**	**Uses/ Examples**
Low Carbon Steel	Tough and ductile and easily machined and welded	Construction, screws, cars
High Carbon Steel	Hard and wears well	Tools, blades and knives
Cast Iron	Hard but brittle. Easily cast but hard to machine	Pots, pans, vices
Medium Carbon Steel	Less ductile, malleable and tough	Springs and gardening tools



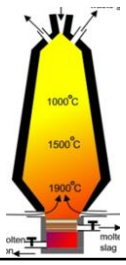
Stock Forms

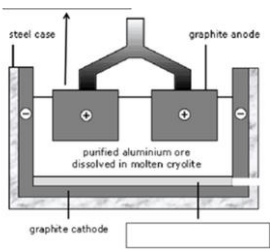
Stock Forms for metals include; sheets, plates, bars, tubes and structural angular shapes.



Primary Processing

Metals are processed from ores in the ground. then go through an extraction process. This happens by putting the ore in a **blast furnace**. The metal is then separated from the waste material.
However, aluminium is processed differently, through **electrolytic processing**

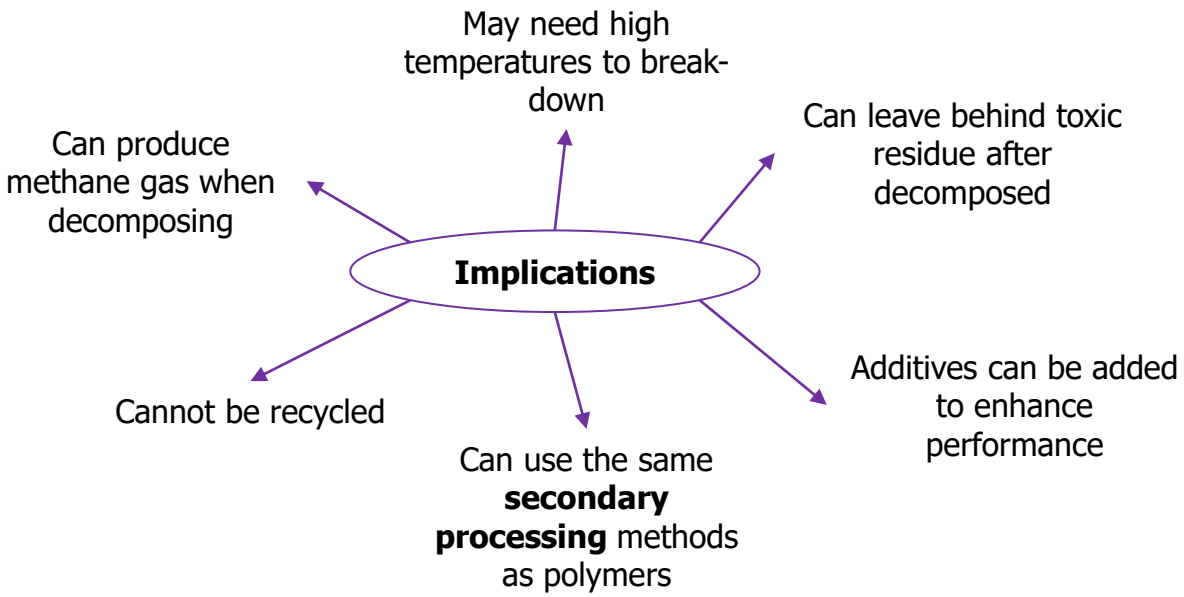




Knowledge Organiser: KS5 Design Technology

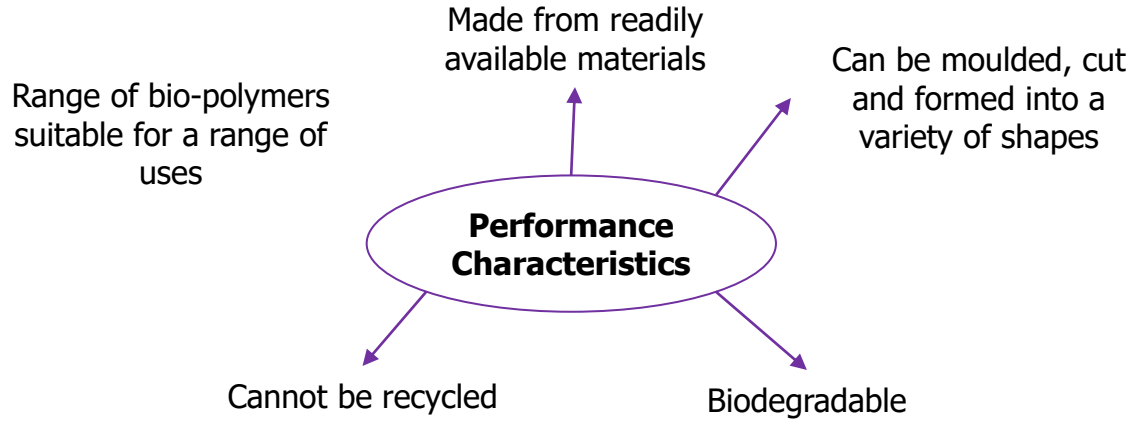
Technical Principles: Biodegradable Polymers

Biodegradable Polymers are polymer alternatives. There are two categories – **Natural and Synthetic**		
Name	**Key info**	**Uses/ Examples**
Corn Starch Polymer	Natural bio-polymer. Made from high-starch vegetables	Packaging, cutlery and disposable crookery
Potatopak	Natural bio-polymer. Made from potato starch	Single-use bowls, trays and serviettes
Biopol (PHB)	Natural bio-polymer. Made from bacteria. Can be added to thermoplastics to promote degradation	Carrier bags, pill coverings, nappies and surgical stitches
PLA	Synthetic bio-polymer. Made from corn kernels or cane sugar.	Packaging, single-use bottles, 3D-printing and nappies
PHA	Natural bio-polymer. Made from bacteria. Fully compostable	Packaging, medical patches, screws and bone plates.
Lactide	Synthetic bio-polymer. Fully compostable and water soluble.	Slow-release medication, bone repair fixings and detergent sachets
Glycolide	Synthetic bio-polymer. Fully compostable.	Food film, bags and bin bags

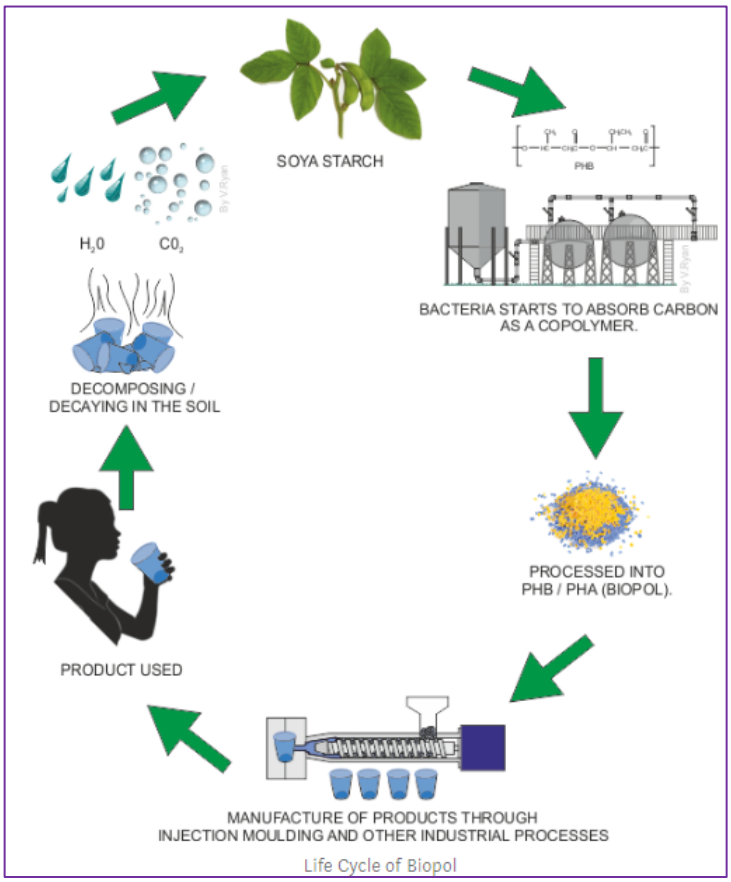


Knowledge Organiser: KS5 Design Technology

Technical Principles: Biodegradable Polymers



Stock Forms
Stock Forms for polymers include; **granules, sheets, films, rods, tubes, foams and powders**



Knowledge Organiser: KS5 Design Technology

Technical Principles: Composites

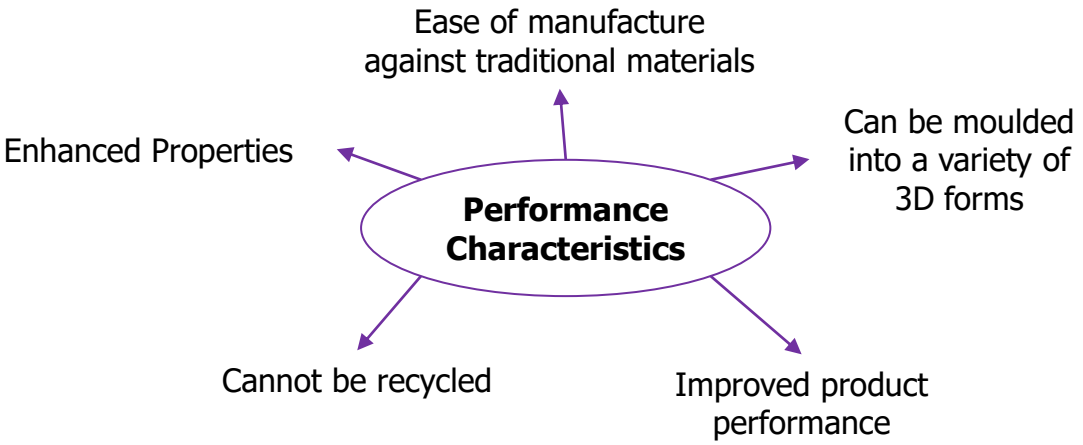
Composite Materials are a mix of two or more different materials, making a material with enhanced properties		
Name	**Key info**	**Uses/ Examples**
CFRP	Lightweight, corrosion resistant and good compressive strength	Sports equipment, racing car bodies and prosthetics
GRP	Lightweight, corrosion resistant, tough and good compressive strength	Boat hulls, kayak shells and sports car bodies
Tungsten Carbide	Hard, tough and resistant to high temperatures	Cutting tools and kitchen knives
Aluminium Composite Board	Lightweight, rigid, malleable and sound insulation	Sound-proofing panels in cars, buildings and boats
Concrete	High compression strength, low tensile strength and easy to mould	Pathways, driveways and building foundations
Reinforced Concrete	High compressive and tensile strength, fire resistant	Buildings, retaining walls
Fibre Cement	Lighter than reinforced concrete, hard, tough and good at low temps	Pathways, complex geometric shapes and suspended floors
Engineered Wood	Good aesthetics, lighter than concrete alternatives and fire resistant	Beams, bridges, decking and room beams

Smart Materials change in response to external stimuli e.g. light, heat, moisture, etc		
Name	**Key info**	**Uses/ Examples**
SMAs	Returns to its original shape, in reaction to heat	Braces and glasses
Thermochromic Pigment	Change colour in reaction to heat	Kettles, baby bottles, etc
Phosphorescent Pigment	Absorbs light during the day and 're-emits' it when dark	Exit signs, 'glow in the dark' products
Photochromic Pigment	Change colour in reaction to light	Colour changing glasses, windows, etc
Electro-luminescent Wire	Thin copper wire in a phosphorescent material, that glows in response to an alternating current	Glow bracelets, outdoor decorative lighting
Piezoelectrical Material	Gives off a small electric charge when deformed.	Airbag sensors, musical greetings cards and pressure sensors

Knowledge Organiser: KS5 Design Technology

Technical Principles: Modern Materials

Modern Materials are ones that have recently been developed		
Name	**Key info**	**Uses/ Examples**
Kevlar	A woven polymer with a high strength to weight ratio.	Bullet-proof vests, tyres, helmets, etc
Precious Metal Clay	Works like ceramic clay but hard once fired in a kiln. Inexpensive compared to precious metals	Decorative items and jewellery
High-Density Modelling Foam	Lightweight, easy to work with and sands easily	3D modelling and prototyping
Polymorph	Granules that once exposed to hot water, become a modelling material (like a dough or clay)	Modelling and repairs



Knowledge Organiser: KS5 Design Technology

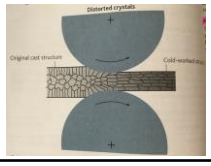
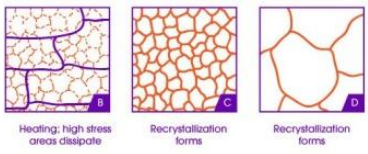
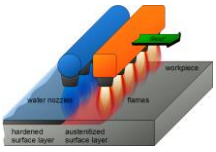
Technical Principles: Enhancing materials

Plastic Enhancements	
Additive	**Purpose**
Lubricants	Reduces the viscosity of molten polymers, making them less “sticky”. This allows the moulding temp to be lowered, saving energy
Thermal Antioxidants	Prevents the polymer oxidising or discolouring from excessive heat during processing
Pigments	Mixed with the molten polymer to give it colour
Anti-statics	Reduces the likelihood of the polymer building up static charge
Flame Retardants	Reduces the likelihood of combustion or the spread of fire
Plasticisers	Allows polymers to become less hard and brittle at normal temperature use. Also help polymers form more easily at higher temperatures
Fillers	Used to ‘bulk’ out the polymer, meaning less is required. Some fillers can help increase the thermal conductivity of the polymer
Biodegradable Plasticisers	Makes the polymer more flexible, softer and easier to break down
Bio-Patch Additives	Oxy-degradable, photodegradable and hydro-degradable additives help reduce degradation time
Antioxidants	Helps reduce deterioration of the polymer when exposed to oxygen. Helps prevent brittleness, cracks and discolouration.
UV Light Stabilisers	Prevents the polymer from being broken down by sunlight. UV can cause discolouration and brittleness.

Knowledge Organiser: KS5 Design Technology

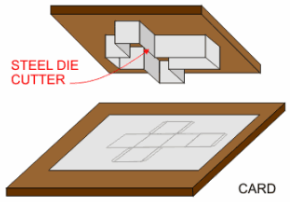
Technical Principles: Enhancing materials

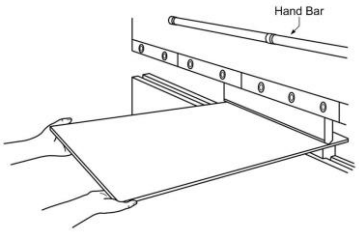
Wood Enhancements	
Method	**Purpose**
Resins and Laminations	Used in engineering wood to enhance the properties of useful parts of trees. E.g. Chipboard made from compressing wood chips with resin and then laminated
Resin with fire retardants	Resin is impregnated with fire-retardant cladding
Laminations	Veneers are laminated on to the board surface to enhance the aesthetics
Preservatives	Protects woods from fungal attack and insects
Pigments	Added to preservatives to give different coloured shades to enhance aesthetics
Fire-retardant Preservatives	Use to pressure treat wood. This can make it harder and more resistant to high-wear situations
Modified Natural Polysaccharide	Wood is impregnated to cure within the wood cell structure. Used to increase hardness, toughness and stability
SCL and LVL	Layering strands (SCL) or veneers (LVL) of wood with resin, pressing and heat curing them to produce a stable wood billet

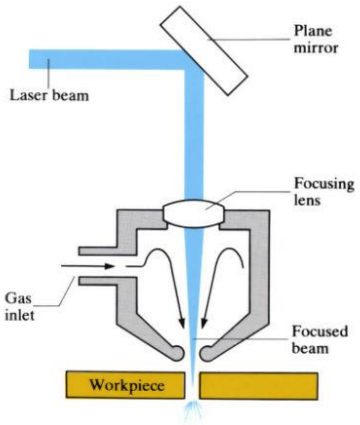
Metal Enhancements		
Heat Treatment	**Purpose**	**Diagram**
Work Hardening	'Cold Working' e.g. bending, hammering or rolling. Crystals in the metals are distorted and changed. Leading to improved tensile strength and hardness. However, can become less ductile. Effects can be removed by annealing	
Annealing	Metal is heated and then cooled very slowly, allowing the metal crystals to grow and slowly move into place This is to make work-hardened metal easier to work with by making it less brittle and more ductile	
Case Hardening	Used for hardening the surface of steels. This produce an outer casing of hardness, improved wear and resistance to indentation. While to core keeps the "softer" properties.	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Paper Processes

Wasting Process	Diagram
Die Cutting and Creasing	
Steel cutting dies and creasing rules are used to cut out the net shape.	

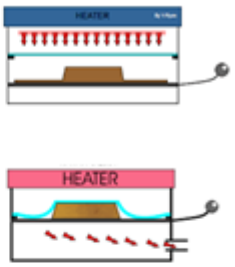
Shaping Process	Diagram
Bending	
Sheets of paper are placed onto a folding table. Then bent to the desired angle	

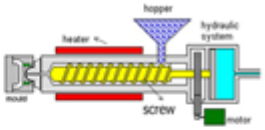
Wasting Process	Diagram
Laser cutting	
A laser is used to cut and engrave into the sheet material. This is often a more quick and accurate process than manual methods, and ideal for one-off and batch production	

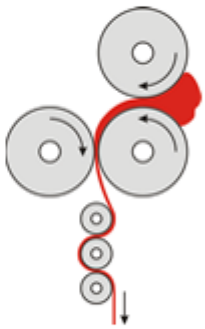
Adhesive Name	Description
PVA Glue	Water-based adhesive for attaching wood to wood. Not water-proof
Contact Adhesive	Used for bonding large areas and can be used attaching different materials together e.g. plastics to woods, etc
UV Hardening Adhesive	A clear liquid that “cures” when exposed to UV light. Can be used on metal, glass and plastics
Solvent Cement	Commonly known as dichloromethane and can join polymers to each other. It softens the polymers’ surface, making it easier to fuse together
Epoxy Resin	Comes in two parts; a resin and a hardener. One combined, the mix can join different materials together and must be left to “set”
Jigs and Fixtures	These are used to ensure parts or components are made the same when made repeatedly. A Jig holds and guides a tool, and a fixture holds work in place.

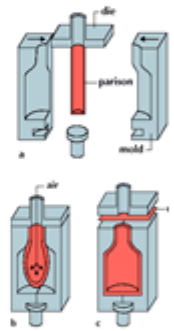
Knowledge Organiser: KS5 Design Technology

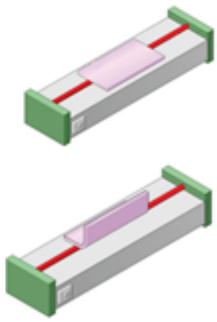
Technical Principles: Plastic Processes

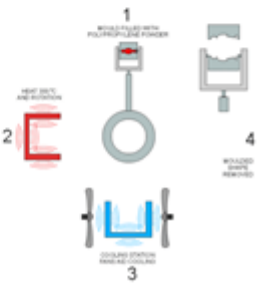
Shaping Process	Diagram
Vacuum Forming	
Heats sheets of thermoplastics around moulds. Moulds need draft angles, air holes and rounded corners to work. Ideal for batch and mass production	

Shaping Process	Diagram
Injection Moulding	
Complex 3D shapes are made quickly for mass or continuous production. Tooling and set-up costs are high	

Shaping Process	Diagram
Calendering	
Heated rollers squash and stretch polymer pellets to make thinner. Used for continuous production	

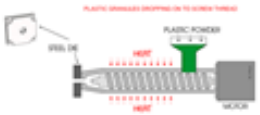
Shaping Process	Diagram
Blow Moulding	
Parison stretched to fit a mould, using hot air. High set-up costs but ideal for mass and continuous production of thin-walled components like bottles	

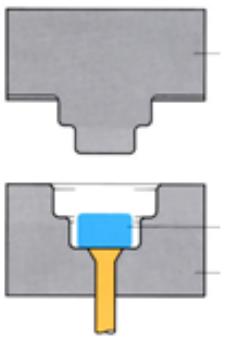
Forming Process	Diagram
Line Bending	
Heats along a line, on thermoplastic sheeting. Suitable for one-off and batch production, especially in schools	

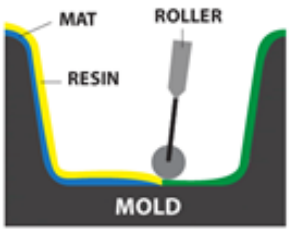
Forming Process	Diagram
Rotational Moulding	
Mould filled with thermoplastic granules or powder. Then continuously rotated through heating and cooling chambers. Ideal for batch or mass production	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Plastic Processes

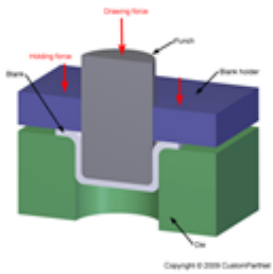
Shaping Process	Diagram
Extrusion	
Follows same process as injection moulding, but melted polymer goes through a die rather than a mould. Good for continuous production	

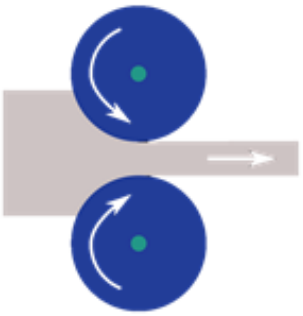
Shaping Process	Diagram
Compression Moulding	
Polymer slug is placed in the lower mould and pressed into shape. Good for large-scale batch production	

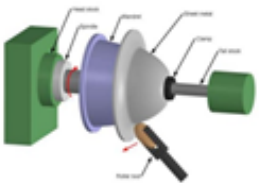
Forming Process	Diagram
Lamination (Lay-up)	
Fibre reinforced composite sheets are rolled into a mould and resin cast over the top.	

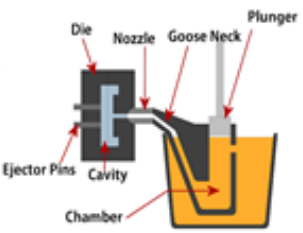
Knowledge Organiser: KS5 Design Technology

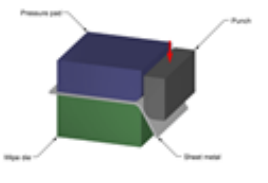
Technical Principles: Metal Processes

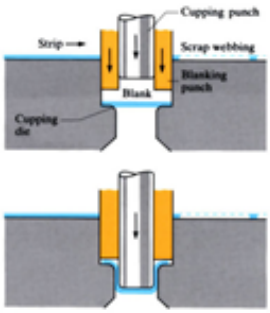
Shaping Process	Diagram
Press Forming	
Shapes sheet metals in 3D forms using a punch. Suitable for mass production	

Shaping Process	Diagram
Rolling	
Can be done hot or cold. Metal is made thinner by the rollers used.	

Shaping Process	Diagram
Spinning	
Turns sheet metal into curved 3D forms by spinning at high speed and shaped using a roller over a mandrel. Suitable for mass or batch production	

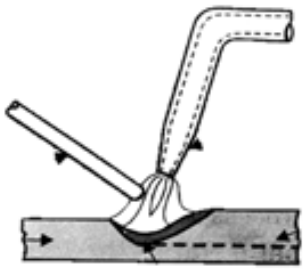
Redistribution Process	Diagram
Pressure Die Casting	
Molten metal is stored in a chamber then shot into a die. Used for batch and mass production	

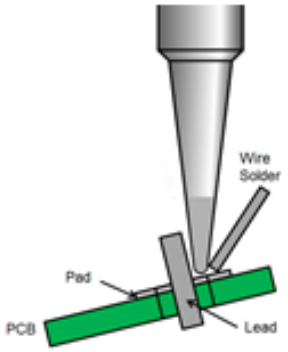
Forming Process	Diagram
Bending	
Sheet metal is bent into shape by a punch. Can be used for small-scale in schools and for mass production in industry.	

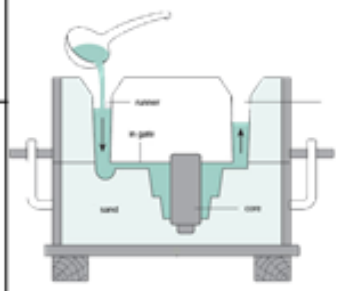
Forming Process	Diagram
Cupping and Deep Drawing	
Sheet metal blank is stretched into shape by the punch. Used in mass or continuous production	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Metal Processes

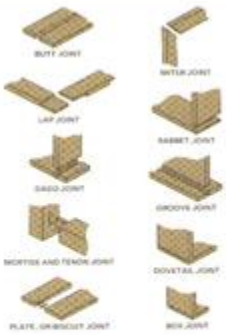
Addition Process	Diagram
Welding	
Comes in many variations; MIG, TIG, Spot and Oxy-Acetylene. Often pairing high heat with a "filler rod" to join metals together.	

Addition Process	Diagram
Soldering	
Metals solder to join components to PCBs. Can also be used in jewellery making.	

Redistribution Process	Diagram
Sand Casting	
Molten metal is poured into a cavity in the sand and cooled. Suitable for one-off production and batch production	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Wood Processes

Addition Process	Diagram
Traditional Wood Joining	
Different joints are used for purposes, and generally the larger the gluing contact area, the stronger the joint.	

Forming Process	Diagram
Milling	
Can be done using CNC or by hand but uses high speed bits to cut holes and/or channels in wood blocks	

Addition Process	Diagram
Component Jointing	
Knock-down fittings are commonly used for flat-pack furniture. Standard components can also be used e.g. wood screws, coach bolts, etc	

Forming Process	Diagram
Turning	
Turning is done on a wood lathe. The wood is spun at high speed, while either a worker with manual tools or automated tools, cut into the wood to shape it.	

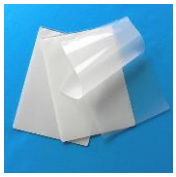
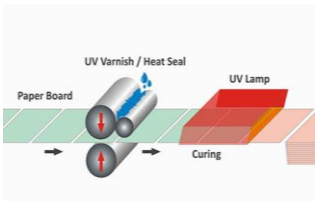
Forming Process	Diagram
Routering	
Can be CNC or hand controlled. Can be used to make channels, holes, mouldings, etc	

Forming Process	Diagram
Steam Bending	
Heat and steam makes wood strips pliable and can be shaped. Then it is clamped in place and left to dry.	

Forming Process	Diagram
Lamination	
Wood veneers or thin man-made boards are bend over a former/jig and glued together. When dried reveals a layered, shaped, sheet	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Paper Finishes

Finish	Key info	Diagram
Lamination	Can be done via encapsulation or via surface coating. Encapsulation used a desktop laminator and the paper is coated by a plastic pouch Surface Coating uses a liquid for menus and signs.	
Embossing	Creates a raised design on the surface of paper or card. Can be used on business cards, greeting cards, etc.	
Debossing	Produces an imprinted depression that sits on the surface on paper or card	
UV Varnishing	Clear non-coloured ink is used on pre-coated papers to enhance the colour and give a layer of protection. UV provides a smooth finish and is abrasion and chemical resistant. Applied using rollers and cured with UV light	
Spot Varnishing	Follows the same process as UV varnishing but is applied to specific areas rather than the whole surface	
Foil Blocking	Heat and pressure is applied to metallic paper (foil) and joins it to paper/card. This helps create depth and texture to improve aesthetics	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Paper Finishes

Key printing colours include; cyan, magenta, yellow and key black

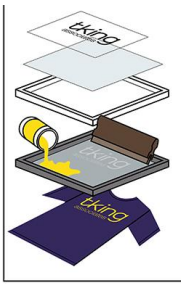
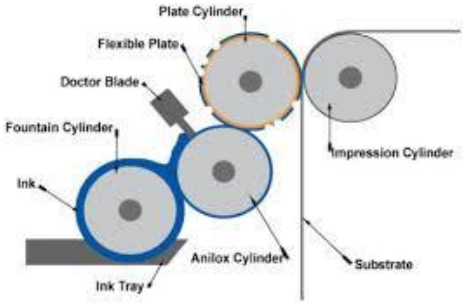
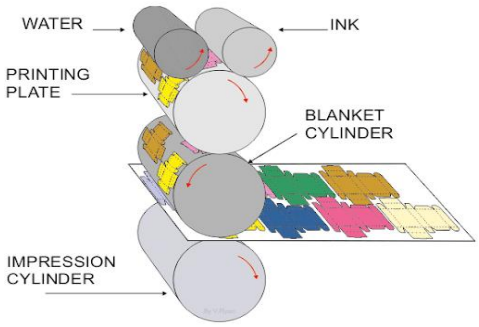
Used to provide aesthetic appeal by using colours, images and text

QA symbols in printing include printing registration marks

Printing Processes

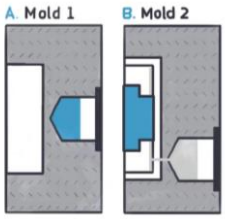
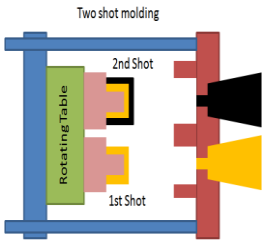
Used to create barcodes, safety warnings, etc. for consumers and retailers

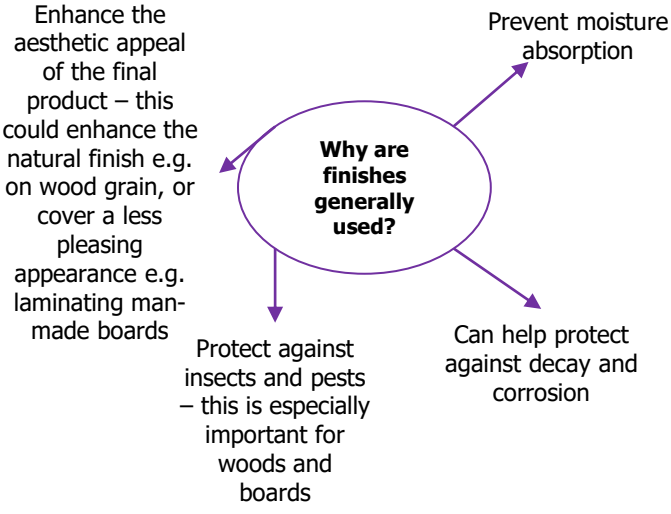
"Substrate" is a term used in printing – the material that the ink is applied to

Printing Method	Key info	Diagram
Screen Printing	Can be used in one-off and batch production. Different screens are required to print different colours, so can be slow and high-cost. Ideal for posters, t-shirts, and displays.	
Flexography	Uses the 4 main printing colours, and they are printed on top of each other to create the desired colour. The process is simple and least expensive compared to other printing methods. Used for cartons, labels, carrier bags, comics, newspaper, etc.	
Offset Lithography	Extremely versatile process that can produce 1 colour, 5 colours (CMYK + metallic) or ten features (CMYK, metallic, varnishing and duplex) Ideal for medium and long runs of products. E.g. books, magazines, etc.	

Knowledge Organiser: KS5 Design Technology

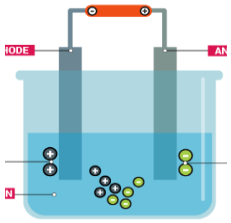
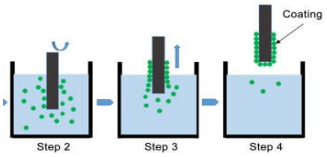
Technical Principles: Plastic Finishes

Finish	Key info	Diagram
Two Injection Moulding - Overmoulding	This is where moulds are used to effect the texture of a final product. One mould is for the product and another for the 'grip' areas. One the product is injection moulded, it is placed into a second mould where the second polymer is injection moulded onto the body.	
Twin-Shot Injection Moulding - Overmoulding	The main mould is used to create the product. Then the mould opens slightly and rotates 180 degrees. The mould closes again and the second injection applies the second polymer. This would be used for griped sections e.g. razor handles.	
Acrylic Spray Paints	Acrylic spray paint is fast-drying and becomes water resistant when dry. This is commonly used in the automotive industry, as the manufacturer can have a range of colours without having to constantly have to change the coloured pigments during manufacturing.	
Adding Pigments	Pigments can be added during manufacturing or to the stock form. This includes smart material pigments.	



Knowledge Organiser: KS5 Design Technology

Technical Principles: Metal Finishes

Finish	Key info	Diagram
Cellulose and Acrylic Paints	Once the metal is cleaned and degreased the primer is applied. Then a coloured undercoat, then the final paint colour. The colour can be applied using a brush or sprayed. Special effect and texture paints can be added	
Electroplating	The metal product and 'donor' material are placed in a container with an electrolyte solution. Direct current is applied and the product attracts the donor metal. Examples of 'donors' include; gold, zinc, copper and silver	
Polymer Dip Coating	The metal product is heated to 230 degrees and dipped into a tank of fine polymer powder. The tank has air blowing through to provide an even coating. The heat melts the polymer onto the product, then is left to cool	
Metal Dip Coating	Metal products are dipped into a tank of molten plating metal (a donor metal). There is also tin plating, and zinc plating is known as galvanising.	
Powder Coating	The metal product is (negatively) statically charged. Thermoset polymer resin (positively charged) is sprayed using an airgun. The charging results in a strong attraction and the heat melts the polymer to the metal	
Metal Varnishing	Metal is polishes and varnish applied by either spray or with a fine brush	
Sealants	Sealant is applied with a cloth or machine pad to produce a film that is then allowed to cure. Then it is buffed in with a cloth to a shine	

Knowledge Organiser: KS5 Design Technology

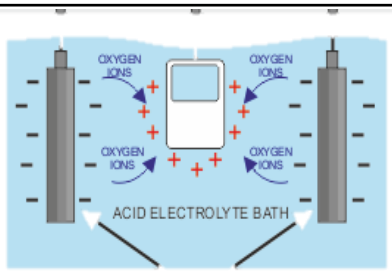
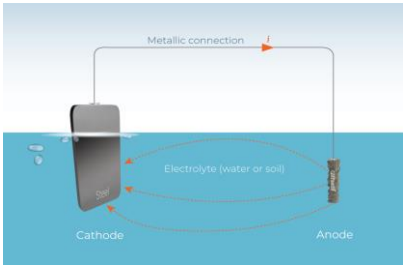
Technical Principles: Metal Finishes

Except steels, most metals have an oxide layer. This provides a slight barrier to environmental effects

Metal Finishing

Copper's oxide layer turns it form a reddish colour to a greenish colour

Steels have a porous oxide later which lets moisture through. This is what causes rust

Finish	Key info	Diagram
Preservatives	Applied with a cloth, spray or immersion. Silicon sealants can also be classed as preservatives. Often used on moulds and dues for preventing imperfections appearing on surfaces, etc.	
Anodising	An electric current passes through sulphuric acid electrolyte solution, from the part to be treated to a negative cathode. As the current flows from the positive to the negative, the aluminium oxide layer builds up on the treated part, producing an anodised finish	
Cathodic Protection	Cathodic protection helps prevent the natural voltage of metals from corroding parts, when exposed to water. There are two methods of cathodic protection – impressed current and sacrificial anodes. Impressed current protects components by flowing a current through any liquid to the component. For sacrificial anodes, the electrochemically active metal is joined to a less active metal to provide more resistance to corrosion.	

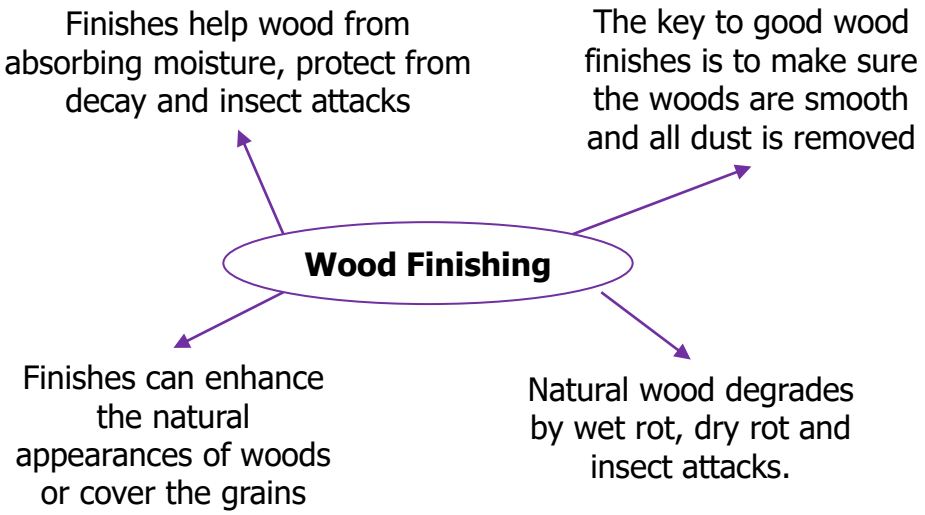
Knowledge Organiser: KS5 Design Technology

Technical Principles: Wood Finishes

Finish	Key info	Diagram
Varnish	Available in matt, satin, gloss, coloured or clear, etc. Applied using a brush and lightly sanded between layers	
Water-based Paints	Available in gloss, satin, matt and metallic. Can be applied with roller, brush or spray. Surface needs to be primed and undercoat added before the main colour	
Stains	Available in colours and types, and can be applied with a brush, roller or spray. Surfaces been to be grease-free prior to application. Stain can be used to enhance and darken grain appearance, making a wood look like a more expensive version	
Colour Wash	Can be applied with a wet sponge and available in a range of colours.	
Wax	Can come in clear and coloured waxes for indoor products. Applied with brush or cloth and once dry buffed in with a clean, dry cloth	
Yacht Varnish	Available in high gloss and satin finishes. Applied with a brush or sprayed directly onto the wood	
Danish Oil	Available in clear and colour tints. Apply with a lint-free cloth, rub the oil into the surface of the wood. Let absorb and then rub away excess oil. Lightly sand down between coats	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Wood Finishes



Finish	Key info	Diagram
Teak Oil	Available in a clear tint. Apply with a cloth and rub in the oil. Leave to absorb and then rub away any excess oil. This oil is primarily used for outdoor wood products	
Pressure Treating	Wood is placed in a pressure vessel containing a solution consisting of copper sulphate and other preserving salts. Vacuum and pressure are controlled to force the preservative deep into the wood and then steam dried.	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Scales of Production

One-off Production	
Also known as Bespoke or Prototype manufacture Generally, specialist workers create, custom-made products and can uses specialist machines and materials. High Quality but expensive and involves individual client consultation and design work.	
Advantages	**Disadvantages**
• Custom made • High Quality Materials • High Quality Craftsmanship	• Time consuming • Specialist training for workers • Expensive to buy

Batch Production	
Uses a mix of workers and machinery with jigs, moulds and templates to help make identical products. Stations of workers e.g. cutting station, painting station, etc. Can have some variation e.g. colour, finish, flavour.	
Advantages	**Disadvantages**
• Lower cost than one-off • Jigs, moulds and templates help products look identical • Can have some variety	• High storage costs • Jugs, moulds and templates have to be checked • Workers can become bored on their station

Mass/Line Production	
Workers carry out a single process in the production line, but generally manufacture is heavily automated. Production is linear with sub assembly lines working parallel to the main production line.	
Advantages	**Disadvantages**
• Large amounts made at once • All products are identical and to same standard • Using automation reduced human error	• Initial starting costs are high • If production line stops, the product can't be made • Workers become bored monitoring machines and repetitive tasks

Knowledge Organiser: KS5 Design Technology

Technical Principles: Scales of Production

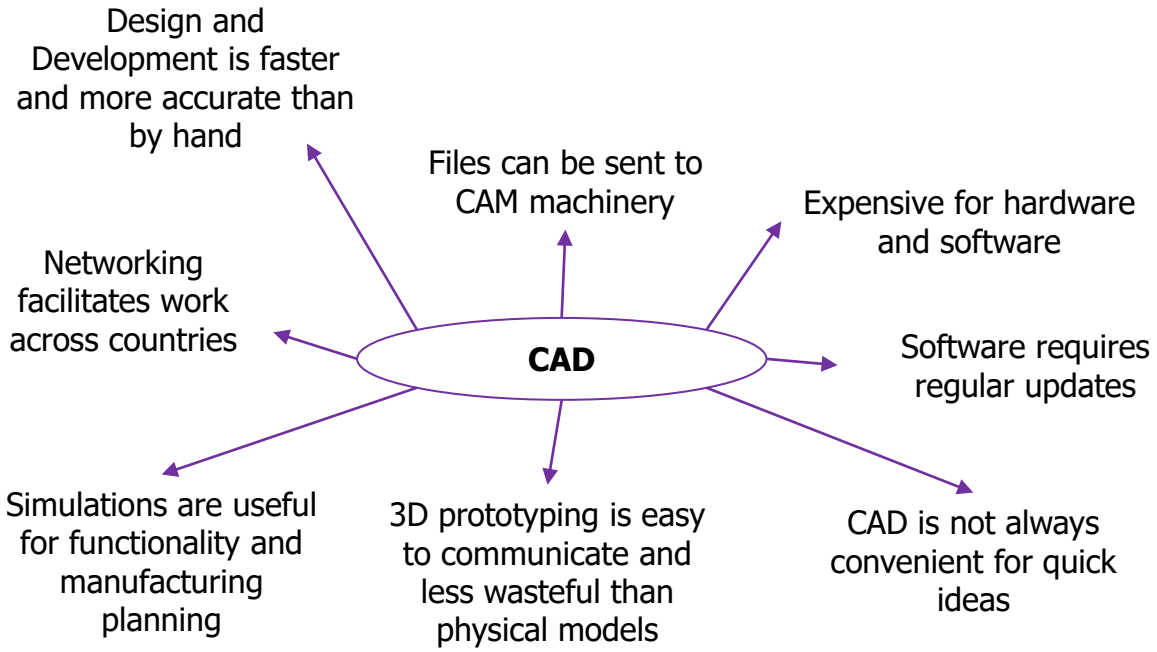
Quick Response Manufacturing (QRM) Production	
This strategy is used to reduce time taken to respond to orders. Rapid completion of design and development processes to minimise delays. However, quality and customer needs are still a high priority	
Advantages	**Disadvantages**
• High product turnover • Generally makes smaller batches, so lower storage costs • Efficient use of materials minimises waste	• If there is a large variation in demand, then can cause problems if the manufacturer can't react to meet it • Managing and planning can be difficult • Highly dependent on suppliers to react to demand changes

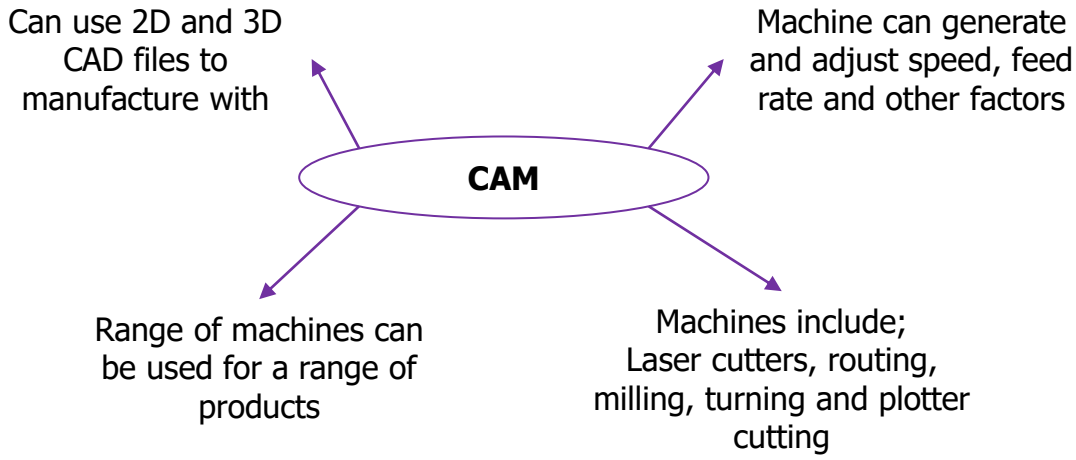
Unit Production Systems (UPS)	
Used in textiles manufacturing. Computer controlled and incorporates hanging carriers to carry garments from station to station.	
Advantages	**Disadvantages**
• Quick and efficient transfer of garments • Product output is easily tracked and recorded • Multiple styles of garment can be used in the system	• High investment and set-up costs • High maintenance cost • Pre-production planning is essential

Vertical In-House Production	
This is where the company owns its supply chain, which minimises dependency on external suppliers. Factories must then have the ability to manufacture all components required	
Advantages	**Disadvantages**
• Reduced risk of component prices changing • Less impacted by suppliers going out of business • Protects the brand and improves security of intellectual property rights • QA is easier to implement	• Specialisation reduced, potentially diluting expertise • Increase in administration • Reduction in flexibility

Knowledge Organiser: KS5 Design Technology

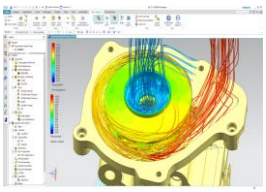
Technical Principles: ICT and CAD CAM

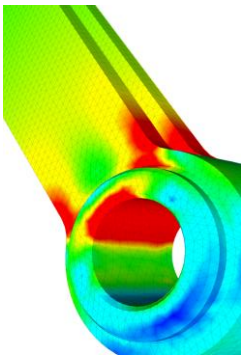


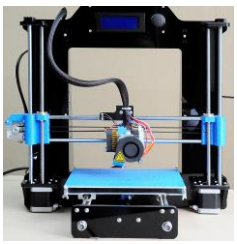


Knowledge Organiser: KS5 Design Technology

Technical Principles: ICT and CAD CAM

Virtual Modelling	Diagram
Computational Fluid Dynamics	
A CAD simulation tool for fluid or gas flow. Test results can inform aerodynamic improvements and saves money rather than physical testing	

Virtual Modelling	Diagram
Finite Element Analysis	
This analyses stress in elements of a CAD design. It can simulate forces, vibrations or shock loads. Weak points are then highlighted to the designer. It saves money and time as products can be tested and re-designed virtually	

Rapid Prototyping Processes	Diagram
Fused Deposition Modelling/ 3D Printing	
3D printers used FDM to build a model from CAD. The sliced layers are built up to make a full product or prototype, Custom products can also be created e.g. prosthetics	

Electronic Data Interchange	Diagram
Electronic Point of Sale (EPOS)	
This is a computer-based scanned barcode system to track product sales. Any low stock items are automatically ordered and recording trends of sales. Customer data can also be gathered for marketing e.g. loyalty cards	

Production, Planning and Control (PPC)
Computers are used to; plan and control production, organise component availability and co-ordinate suppliers. An efficient supply chain network (SCN) is vital to ensure the flow of materials. This is especially useful in JIT systems A Master Production Schedule (MPS) software carries out lots of functions, including; ordering low stock items, delivers components to production lines at precise times, scheduling workers, networking departments and co-ordinating suppliers and customers.

Knowledge Organiser: KS5 Design Technology

Technical Principles: Safety in Working Practices

What Employers Should Ensure

- Workplace is safe and free from risk
- First Aid is provided
- Dangerous substances, etc are stored safely and correctly
- Training and supervision is provided, where needed
- PPE is provided
- Machines are maintained and have guards in place
- Signage is present and clear
- Accident reporting systems are in place

What Employees Should Ensure

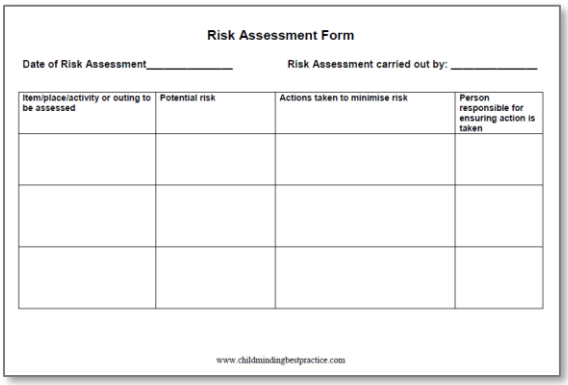
- Take care of their health and safety, as well as those around them
- Use provided PPE
- Use machines correctly and after training
- Report any accidents or near-misses

Precautions and Risk Assessments

Safety precautions are actions that are carried out before an activity that could be a danger or cause an injury. E.g. wearing goggles and having extraction on before using a belt sander.

The use of signage is also a type of precaution, allowing employees and visitors to be aware of hazards with certain areas, equipment, etc.

Risk Assessments must be carried out by law, by employers and reviewed regularly – they are working documents. These consider what could harm people and if reasonable steps are being taken to prevent that harm. Not all risks can be eliminated but the can be minimised.



Risk Assessment Form

Date of Risk Assessment_____ Risk Assessment carried out by: _____

Item/place/activity or outing to be assessed	Potential risk	Actions taken to minimise risk	Person responsible for ensuring action is taken

www.childmindingbestpractice.com

Knowledge Organiser: KS5 Design Technology

Technical Principles: Safety in Working Practices

Legislation

The Health and Safety at Work Act (1974) ensures that all employers must ensure that employees and visitors are protected in the workplace, in terms of health, safety and welfare

The Control of Substances Hazardous to Health Regulations (2002), otherwise known as COSHH is where employers need to prevent, reduce or control their workers exposure to substances that mat be hazardous or cause ill health. These substances will usually have symbols indicating their hazards

General Safety Symbols in Workshops, etc.

Stages of a 5 Step Risk Assessment

1	Identification of the hazards
2	Who could be harmed and how
3	Evaluate the risks and minimise them
4	Record and document your findings
5	Review regularly

Knowledge Organiser: KS5 Design Technology

Technical Principles: Safety in Products and Services

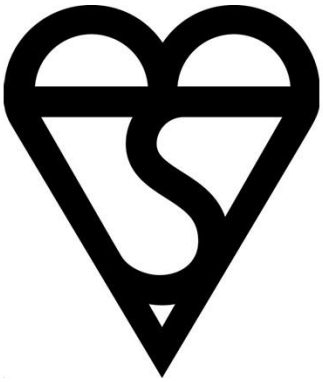
Safety in Products and Services to the Customer

- Designers must make sure their products are safe to use
- Legislation protects users, by making sure products meet standards and requirements before being released
- The legislation also allows the user the right to exchange or get a refund faulty goods

British Standards Institute (BSI)

The BSI works with government and industry to produce standards to ensure products are well produced, safe and fit for purpose. This are more rigorous and to a higher standard than the European Conformity equivalent.

The BSI Kitemark (shown on the right) is a quality assurance symbol, showing customers that the product has met this standard. This symbol is used/shown on a range of products.



Legislation

Consumer Rights Act 2015 safeguards consumers from faulty products, including digital content.

Goods must be of satisfactory quality and fit for purpose.
Customers can return and either exchange or get refunded for unsuitable products , as well as a right to compensation to any damage the product or digital content might have caused.

Customers are also entitles to clear contracts, and fair notices for any goods and services. As well as fees and services being transparent

Knowledge Organiser: KS5 Design Technology

Technical Principles: Safety in Products and Services

Safety in Toys

Toys (safety) Regulations 2011, European Toy Safety Directive and British Standard DS EN 71 are all what manufactures of children's toys must comply with.

Toy manufactures must ensure their toys; comply with safety requirements, have been assessed and tested, are accompanied with instructions, and any issues/ complaints are thoroughly investigated.

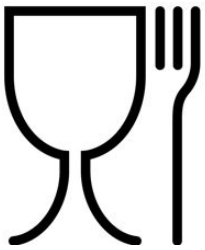
The Lion Mark shows customers that the toy has been made with quality and safety in mind.

General Safety Symbols for Customers

European Conformity Symbol

Age Restriction Symbol

Flammable



Food Safe Symbol

Flame/Fire Resistant Symbol

Knowledge Organiser: KS5 Design Technology

Technical Principles: Protecting Designs and Intellectual property

Intellectual Property

Intellectual Property is an idea that is developed into a physical creation, that did not already exist. To seek Intellectual Property Rights the idea must be unique.

Laws vary from country to country, but some rights are automatic e.g. copyright, but others have to be applied for e.g. patenting a design

Copyright and Design Rights

Copyright is legal protection of literary and artistic works such as books, images, videos, music, etc.
To use any of the work, the owner must be asked for permission. The UK Copyright, Designs and Patents act cover most works 70 years after the creators death.

Unregistered Design Rights provide legal protection from being copied for 10 years. However, this only covers the product's aesthetic qualities.

Trademarks and Logos

A Trademark protects a brand definition/ identity such as colours, logos, slogans, etc.

A protected logo needs to instantly identifiable and unique, in order to stand out. Trademarks can also cover a word or phrase that a company uses.

Once again the IPO needs an application and a fee paid, and the trademark needs to be renewed every 10 years.

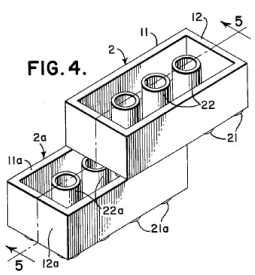
Registered Designs

A Registered Design protects the appearance of a product e.g. shape and aesthetic. This can be renewed every 5 years up to a total of 25 years protection, but a fee must be paid to the Intellectual Property Office (IPO).

Patents

The Intellectual Property Office (IPO) grants patens for novel creations. A patent only covers the functional and working parts of designs.

It can provide 20 years legal protection but are difficult to obtain.
Detailed and labelled diagrams must be submitted.



Open Design

Open designs are communal and intended to show designs are for the common good rather than financial reward.

Key examples of this include open-source software, 3D printable files, ethical designs etc

A creative commons licence is used to maintain an originator's rights, but allows development of the design and free distribution to the public.

Knowledge Organiser: KS5 Design Technology

Technical Principles: Maintenance, Repair and Disposal

Ease of Manufacture

Efficient manufacturing helps reduce cost and maximise product quality.
This can be done in a range of ways, including:

- Use of standard components
- Ensuring the manufacturing layout is optimal
- Use of modular designs

Reducing Manufacturing Processes

The fewer processes needed, the easier it is to make the product.
However, care needs to be taken to ensure that the products don't have their reparability or sustainability affected.

- Using a single redistribution process rather than multiple addition/wastage processes
- Using self-finishing materials
- Reduce joining processes by using fixings
- Buy parts from suppliers than in-house
- Using adhesives rather than mechanical fasteners

Choice of Materials

The material choice in manufacturing can affect the use, care and disposal of products.

Labelling of materials helps aid separating during recycling.

Products can be easily disassembled or separated by using these strategies:

- Using easily released snap fittings
- Using easily removed standard components
- Adhering to End of Life Vehicles Legislation for car disassembly

Maintenance of Products

Customers are often given instructions on how to care and maintain products correctly but sometimes designers don't want them to make any complex repairs due to the technology or potential hazards.

Using temporary fixings, standard components, offering repair services and upgrades of software are good ways to ensure that the customer can access and repair/maintain their product.

Knowledge Organiser: KS5 Design Technology

Technical Principles: Maintenance, Repair and Disposal

6 Rs of Sustainability	Links to Maintenance, Repair and Disposal
Reduce	• Using less materials and energy during manufacture • Refillable packs • Using less packaging • Optimising transport packaging • Transport powered by renewable resources
Reuse	• Rising popularity of milk bottle delivery and collection • Old building's materials are used in new structures • Refilling water bottles • Donating old furniture • Upcycling products
Recycle	• Differentiated bins for recycling collection • Maintaining 'pure' materials in manufacture so they're easier to recycle
Rethink	• Choosing eco-friendly alternatives • Use of renewable energy sources • Using a water butt in the garden rather than mains water • Cycling to work rather than driving
Repair	• Fixing products rather than throwing them away e.g. phone screens, car parts, buttons on shirts • Repairing products helps maintain the product's 'life' and produces less waste. • Companies can provide repair services for more specialised issues e.g. car brand garages or returning products and sending it back to the customer
Refuse	• Clear marking and symbols on packing to highlight environmental impact of a product • Customers not buying products with a large impact e.g. single-use plastics, products made from unsustainable woods, inefficient electrical products and products that can't be repaired

Knowledge Organiser: KS5 Design Technology

Technical Principles: Feasibility Studies

Feasibility Studies Definition

"An evaluation or analysis of the potential impact of a proposed project or product. A feasibility study is conducted to assist decision-makers in determining whether or not to implement a particular project or product."

Computer Modelling in Production Planning

Toyota developed the strategy of Lean manufacturing, in order to minimise wasted time and materials.

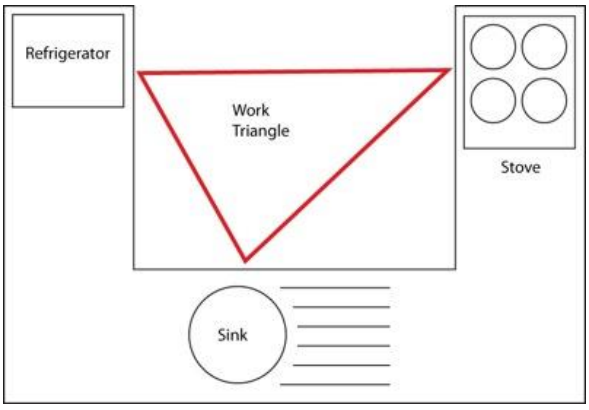
Computer modelling is a key part of this as it facilitates:

- Simulation of workstations and the assembly line
- Prediction of 'bottlenecking' and planning of 'buffer zones' to combat this
- Calculating cycle time
- Calculating of the rate of production to meet customer demand

Feasibility Modelling in Design

Computer modelling can be used to test how feasible aspects of a design are.
For example:

- Kitchen layout ergonomics – testing that the working triangle layout is efficient and accessible
- Testing the assembly and disassembly of complex designs like jet engines
- Expansions on existing buildings e.g. an extension on a house



Knowledge Organiser: KS5 Design Technology

Technical Principles: Feasibility Studies

Feasibility Studies and Costings

Spreadsheets are used to calculate:

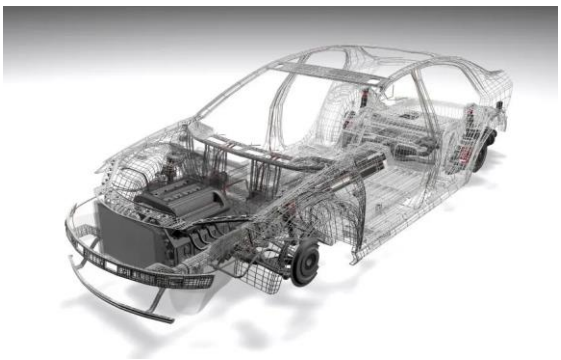
- Direct Costs – materials, labour
- Indirect costs – warehouse rent, lighting, water, etc.

Sophisticated computer modelling is used for more complex aspects of production e.g. injection modelling, so that costs can be calculated and include:

- Initial mould cost
- Size of mould – material to be used in it, cycle time, cooling, etc.
- Number of units to be made

Testing Prototypes

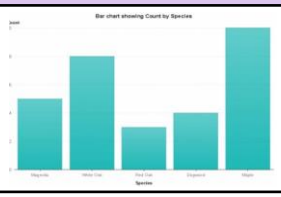
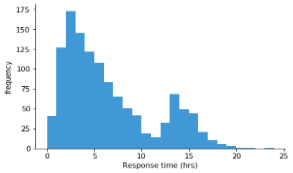
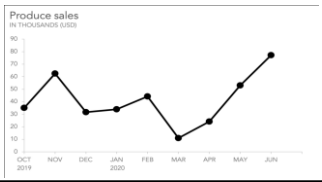
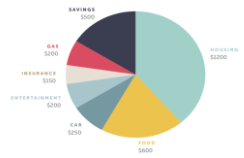
Functioning and non-functioning models allow both designers and clients to test feasibility and provide feedback prior to final decisions on production. This can be done using a range of modelling methods including; CAD, simulation and physical modelling, etc.



Knowledge Organiser: KS5 Design Technology

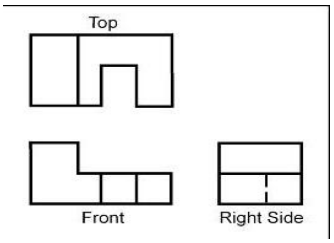
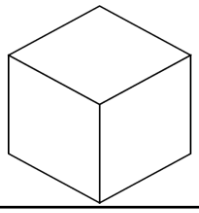
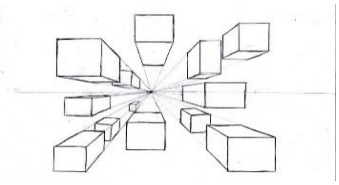
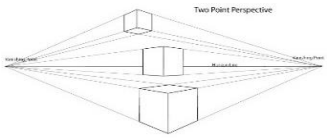
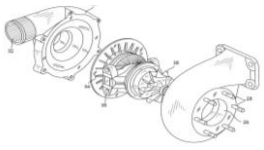
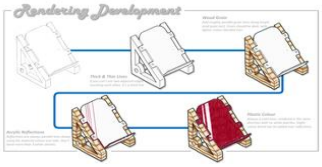
Technical Principles: Design Communication

Design and Technical Reports
A Design report is an industrial design team's project record for future reference Technical Reports are used for recording practical test results, target market research and reviewing products.

Technique	Description/ notes	Diagram
Bar Chart	• Simple way to represent data • Commonly used in a range of reports	
Pictograph	• Easy to understand • Quick to read • Not very accurate	
Histogram	• Data is shown in ranges • Useful to show frequency in data	
Line Graph	• Can show changes over time • Easy to understand • Accurate due to use of scales	
Pie Chart	• Shows data distribution • Segment size is relative to proportion of data • Easy to understand	
Data Tables	• Important to help interpret data, identify patterns and add missing data • Used in cutting lists, anthropometrics and costings	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Design Communication

Technique	Description/ notes	Diagram
Orthographic Projection/ Working Drawings	• Includes "Front", "Plan" and "End" 2D Views, and often an Isometric 3D View • Standardised method for scale, dimensions and line types • Great for manufacturing	
Isometric	• Common 3D sketching method • Can be drawn free-hand or using isometric paper and ruler • Angles are at 30 degrees • Great for seeing most of the products	
1-Point Perspective	• A 3D drawing method • Often used by interior designers and architects • Gives drawings depth • Only uses 1 vanishing point	
2-Point Perspective	• Used for 3D designs • Exaggerates the 3D effect • Objects can be drawn above of below the horizon line but must go to the 2 vanishing points	
Annotated Drawings/ Free and Sketches	• Quick and easy way of getting ideas down • Range of ideas can be seen • Annotation helps explain designs further	
Exploded View	• Helps see a final design of a product and all it's parts • Can see where all the parts fit • Great for manufacturers	
Thick and Thin Lines and Rendering	• Thick and thin lines help designs stand out • Texture and rendering help communicate designs and aesthetics	

Knowledge Organiser: KS5 Design Technology

Technical Principles: Enterprise and Marketing

Customer Identification

Knowing your target market is critical to product success. Market research helps find out background information on your market including; age, gender, income, location and interest. As well as why customers are motivated to buy certain products e.g. social and emotional needs, family needs, budget and brand preference

Labelling

Labelling can be used to promote the brand or attract customer attention.

It can also inform customers on important information:

- Nutritional information on food
- BS/ CE Standards
- Disposal and Recycling

Packaging

Designing packaging and branding is very important to communicate to customers as well as get their attention. Often a brands style of packaging is used to reflect their brand identify e.g. Apple products with their minimalist, clean design.

Corporate Identity

Corporate identify means the branding used to present the image of a company to the public. Designers use colours, logos and fonts to create a 'brand'.
Customer will often return to a brand they like or have a positive experience with.
Companies will then protect their brand identify using registered trademarks.

Knowledge Organiser: KS5 Design Technology

Technical Principles: Enterprise and Marketing

Global Marketing

Global marketing is used to promote a final product worldwide, as exposing a product to international markets can help a business grow rapidly.
However, marketing strategies may differ from country to country, depending on culture, etc. e.g. white is seen as "pure" and "clean" in western countries but represents "death" in most East Asian countries.

Advertising can come in many forms including; TV radio, social media, in-store, etc.
Social media has transformed advertising as specific markets can be reached with lower cost. Retargeted marketing uses data collection to reach specific demographics, and viral marketing is often used to have customers send their advertisement to their friends, etc.

Product Costing and Profit

Product costing can be divided into 2 categories:

- Direct Costs
- Indirect Costs

Direct costs include; labour, materials, equipment, production supplies

Indirect costs include; administration costs (stationary, hardware, etc), electricity and utilities.

Entrepreneurs and Collaborative Working

Entrepreneurs commonly work with designers to turn their proposals into reality. Occasionally these entrepreneurs have skills to invent their own products e.g. Sir James Dyson

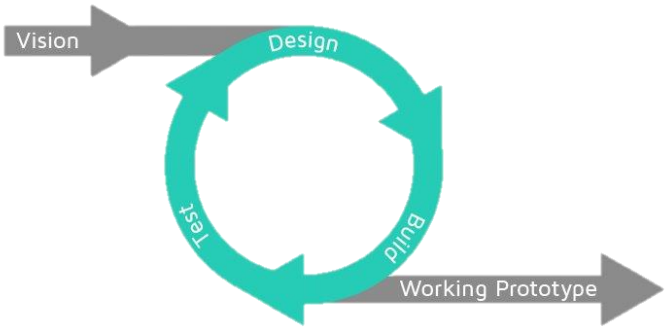
Collaborative design involves working in a design team and sharing ideas. This can be done face-to-face or via video conferencing.
Collaboration allows designers from different countries, skill sets and expertise to create the best product.

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Iterative Design

Iterative Design

Iterative design is a repetitive process, that cycles through designing, modelling and testing constantly until the designed product has been made. Designers by themselves, or in teams, have to constantly evaluate their work in order to improve.



Iterative Design

Advantages	Disadvantages
• Consistent testing helps solve problems earlier • Constant feedback • Easy evidence of progress	• Designers can loose sight of "the big picture" • Time consuming

Designing to Wants and Needs

Designers have to be aware of the needs, wants and values of consumers, and can do this through research methods.
For example:

- Physical needs of age groups (babies, teens, adults and elderly) and those with disabilities
- Emotional needs – likes, dislikes, aspirations, etc.
- Intellectual needs of age groups (babies, teens, adults, etc.) as well as those with mental disabilities
- Sociological needs and values – social pressures, culture, etc.

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: User Centred Design

User Centred Design
UCD aims to improve user experience of products. The international usability standard (ISO 13407) makes this likely, and products that comply with this standard should: • Take full account of users and their environment • Involve users in design and development • Result from a repetitive (iterative) process • Consider the whole user experience • Be developed by a multi-skilled team (engineers, designers, ergonomists, etc.)

User-Centred	
Advantages	**Disadvantages**
• User feels listened to • Makes sure the product meets their needs	• Requires extra time to get customer feedback • If focused on just one person it can limit appeal to others

Research Methods	
Primary Research	**Secondary Research**
• Questionnaires and Surveys • Interviews • Designers going through user experiences • Focus groups • Product Analysis • Anthropometric Data • Observing users using a product for ergonomic data	• Online • Books • Using existing research • Using others anthropometric data

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Design Movements

Design Movement	Images	Influences	Designers	Features
Arts and Crafts (1850-1900)	 	• Traditional craft and hand skills rather than machinery	• William Morris • Charles Voysey • Richard Norman Shaw	• Traditional wood joints in furniture • Use of natural forms • Highly decorative – with birds and florals shown on textiles and wallpapers
Art Nouveau (1880-1910)	  	• Linear patterns of Japanese prints • French Post-impressionist art • Arts and Crafts Movement	• Alphonse Mucha • Louis Comfort Tiffany • Charles Rennie Macintosh	• Floral and decorative patterns • Elegant and graceful lines • Use of traditional materials
Art Deco (1925-1939)	  	• End of WW1, growth of mass production • Range of international styles coming into the public eye	• Claric Cliff • Eileen Gray • Rene Lalique • Walkter Dorwin Teague	• Stylised geometric shapes • Bold colours often paired with black, chromes and metallic • Sunburst motiffs
Bauhaus (1919-1933)	  	• Post-WW1 idealism • Arts and crafts movement • WW1 industry methods and materials • Art Deco's geometric forms	• Walter Gropius • Marcel Breuer • Marianne Brandt • Mies Van Der Rohe	• Form follows function principle • Use of steels, chromes and leather • Modernism style-design
Streamlining (1930-1950)	 	• Post-WW2 lack of materials • Vehicle innovations breaking speed records • Rise of Bakelite	• Raymond Loewy • Norman Bel Geddes • Henry Dreyfuss • Walter Dorwin Teague	• Long horizontal lines and curving forms • Aesthetic influences from industrial and nautical design • Sleek appearance • Use of metals and plastics
Scandinavian Modern (1935-Present)	 	• Dark Scandinavian winters leading to designers maximising light and cozy features • Practical and functional designs	• Finn Juhl • Hans Wegner • Arne Jacobsen	• Clean lines • Neutral colour palette • Sleek and functional
Minimalism (1967-1978)	  	• Japanese traditional design and architecture • De Stijl art and design	• Donald Judd • Agnes Martin • Dan Flavin • Anne Truitt	• Repetition of simple geometric forms • Monochromatic/limited colour • Hard-edged • Little/minimal use of materials
Memphis (1981-1988)	  	• Rebelling against functional modernism • Art Deco • Pop Art	• Ettore Sottsass • Michele De Lucchi • Martine Bedine	• Less is Bore principles • Post-modernism design • Bright, colourful and sculptural design • Simple and Abstract forms • Use of non-traditional materials

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Work of Others

Philippe Starck	
Image	**Juicy Salif Lemon Squeezer (1990)**
	• Aluminium casting • Inspired by Philippe Starck eating squid • Sculptural aesthetics • Potentially unstable • Pip collection isn't perfect

James Dyson	
Image	**DC01 Vacuum Cleaner (1993)**
	• Introduced "bag-less" dual-cyclone cleaning system • Colour scheme aids use • Injection moulded ABS • Uses many integral fixings • Clear bin shows dust

Dieter Rams	
Image	**Braun SK4 Radio Record Player (1956)**
	• Innovative incorporation of thermoplastics and electronics • Highly functional • No superfluous features

Marianne Brandt	
Image	**Tea Infuser MT49 (1924)**
	• Typical Bauhaus design • Simple geometric form • Offset lid is functional for preventing drips • Ebony handle positioned for ease of pouring

Charles and Ray Eames	
Image	**Lounge Chair 670 (1956)**
	• Design aims for a "warm look" • Combines industrial production with hand craftsmanship • Moulded plywood shell with rosewood veneer • Leather upholstery

Margaret Calvert	
Image	**"Men at Work" Road Sign (1965)**
	• Stylised pictogram • Simple and clear communication • Standardised sign systems • Replaced old-fashioned signs that had 'all caps' text

Marc Newson	
Image	**Lockheed Lounge (1986)**
	• Aircraft style rivet construction • Styled on mercury "blob" • Statement piece rather than functional • Limited batch made • Only needed to be "more comfortable than a bus stop"

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Work of Others

Dieter Rams 10 Principles of Good Design	
Good Design:	**Which Means:**
Is innovative	Makes appropriate use of modern materials, technologies and approaches
Makes a product useful	Address functionality to ensure that they successfully solve the particular problem for the consumers' benefit
Is aesthetic	Create well-executed, beautiful produces in accordance with "form follows function" principles
Makes a product understandable	Makes products intuitive with no distracting elements that might cause confusion
In unobtrusive	Ensure that their designs are neutral and restrained, without superfluous decoration or detail
Is honest	Not deceiving to consumers e.g. using wood veneer to pretend the product is made from a solid, more expensive, timber
Has longevity	Design products that will continue to be useful over time
Is thorough down to the last detail	Consider every element of designs to ensure that they function well
Is environmentally friendly	Uses sustainable materials and processes in the development and production of products
Is as little design as possible	Include only essential elements in a design, since superfluous feature detract from the product's function

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Developments in Technology

Microelectronics	
Impact on Products	Advancements in manufacturing technology for electronic components e.g. integrated circuits resulted in increasingly powerful and miniaturised range of products • E.g. 1940s transistor used for portable radios • LCD displays • Lithium batteries used for rechargeable power and longer battery life
Impact on Design and Manufacture	Technology developments have impacted how designers and manufacturers work • E.g. use of internet searches in research • Sketching used along side graphics tablets and CAD • Manufacturing using CNC and automatic machinery

Internet of Things (IoT)
The networking of multiple microelectronic devices using Wi-Fi and the internet • E.g. Smart fridges using scanners to identify most used products and automatically ordering them • Automatic JIT manufacturing that organises its own flow of parts, etc.

Advancements in CAD/CAM
Examples include: • Standardised file formats to connect a range of software to hardware • Use of 3D printing • Use of FEA and CFD in CAD simulations • Cloud-bases packages • Virtual reality systems

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Developments in Technology

New Materials

New materials are ones that have recently been developed and offer improvements over traditional materials.

- E.g. Glulam is a layered timber and glue used in buildings and structures
- Kevlar is woven fibres used in bulletproof vests
- Graphene is nanomaterials, made from carbon particles with a honey-comb structure that is used from medical treatments to battery manufacture
- Precious metal clay is precious metal particles in pliable clay and used to make jewellery and decorative items

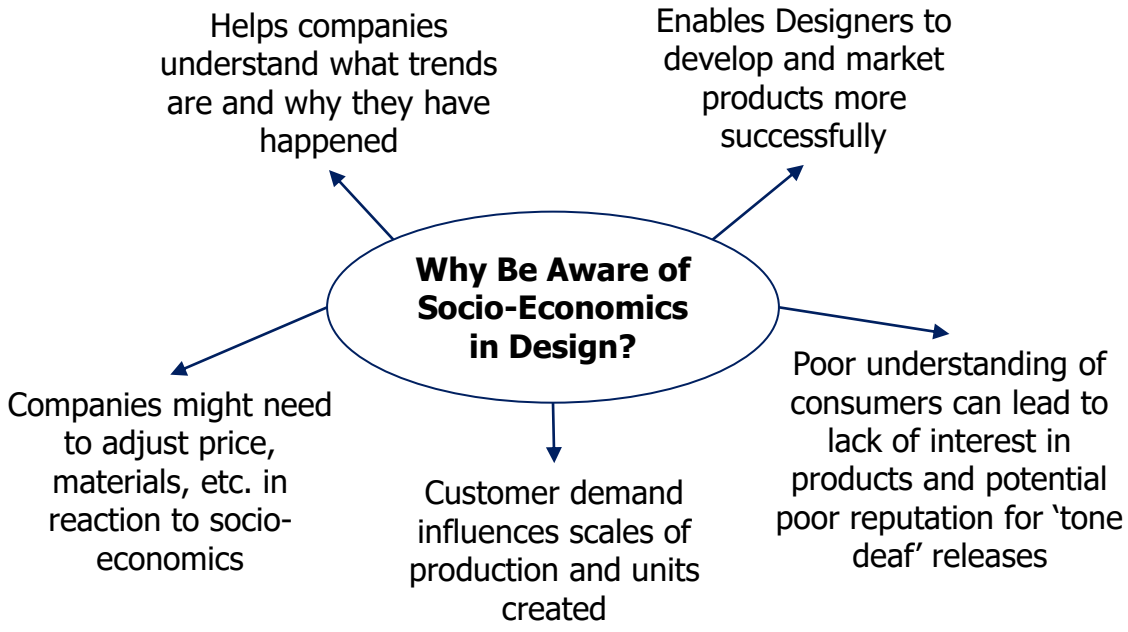
New Methods of Manufacture

Examples include:

- Electrohydraulic Forming – car parts
- 3D printing of metals – one-off prototyping
- Fibre injection moulding – lightweight parts for aerospace, medical equipment, etc.
- Laser beam welding – shipbuilding and construction
- Physical vapour deposition – food packaging, machinery and decorative products

Knowledge Organiser: KS5 Design Technology

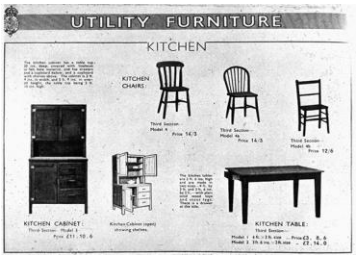
Design and Making Principles: Socio Economic Influence



Post-First World War	
Images	**Key Info**
 	• Development of materials and technologies for WW1 were used in civilian products e.g. using metal tubing rather than wood • Tubular steel didn't suffer from the problem of inconsistent strength of traditional wood construction • This adaptation to tubular steel was a huge influence on Bauhaus art school e.g. The Wassily Chair • Use of tubular steel also allowed easier mass production set-up and could be used in manufacture without traditional hand-crafting skills

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Socio Economic Influence

Second World War	
Images	**Key Info**
 CC41	• Due to resources being directed to military manufacture, domestic materials were rationed and limited • This left designers producing more practical design, with limited use of materials • The utility furniture schemes targeted solving product shortages: ○ Gordon Russell led the schemes ○ Fulfilled basic requirements ○ Prioritised people made homeless by raids and those without furniture to begin with (newly married couples) ○ Strong, simple and fit for purpose

Contemporary Times	
Images	**Key Info**
 	• After years of simple and plain furniture, customer demand focused more on decorative and fashionable design • The Council of Industrial Design (COID) was set-up in 1944 and set out to improve standards in design and design competition. • The COID gave way to the Design Council in 1972, who set out to act as an advisor to the government on design and focus on products, service and user experience • Developments of technologies and materials e.g. polymers, transistors, formed plywood, etc. changed the design world massively

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Social, Moral and Ethical Issues

Sustainable Materials and Ethical Problems

Companies are becoming aware of their corporate social responsibility (CSR) when designing and making products. E.g. Lego Group are trying to use 100% renewable energy and have a target of only using sustainable materials by 2030.

Some SME issues that have arisen for companies include; sweatshop and unethical use of labour, toxic chemicals released into developing countries water and soil, safety failures in energy production, etc.

Some good practice has also become more common, including; use of FSC materials, addressing slave labour issues, use of safety schemes, using Fairtrade products, etc.

Cultural Acceptability

Companies need to be aware of offensive products and marketing to different countries. Offense and outcry will have an effect on a businesses reputation and finances.

Examples of issues to be aware of, include; religious imagery, perception by different genders, country traditions and customs, social justice movements, legality, cultural significance of colour, etc.

Social Problems

Designers can encourage social change and positive social behaviour in their designs. E.g. child-friendly litter bins to promote good habits and 'black boxes' in cars to monitor and reward good driving habits.

Innovative design has also helped those in poverty and difficult living situations e.g. wind-up torches for families in developing countries with no access to electricity and 3D printing of prosthetics, medical equipment and bone implants for medical care.

IKEA have put forward several initiatives including; accessible furniture and accessories for Disabled customers called 'Thisables' and 'Better Shelter' flat-pack emergence housing for refugees

Inclusive and Exclusive Design

Exclusive design is where a product (or range) is specifically designed for a group of people. E.g. baby carriers.

Inclusive design is where products and services are accessible to as many people as possible without the need for specialist design.

This is in line with the Disability Discrimination Act (DDA) 1995.

Examples include accessible entrances to buildings, wide and tall doorways, automatic doors, adjustable office workstations, hearing induction loops in theatres, pedestrian crossings with raised bumps and sensory feedback, etc.

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Social, Moral and Ethical Issues

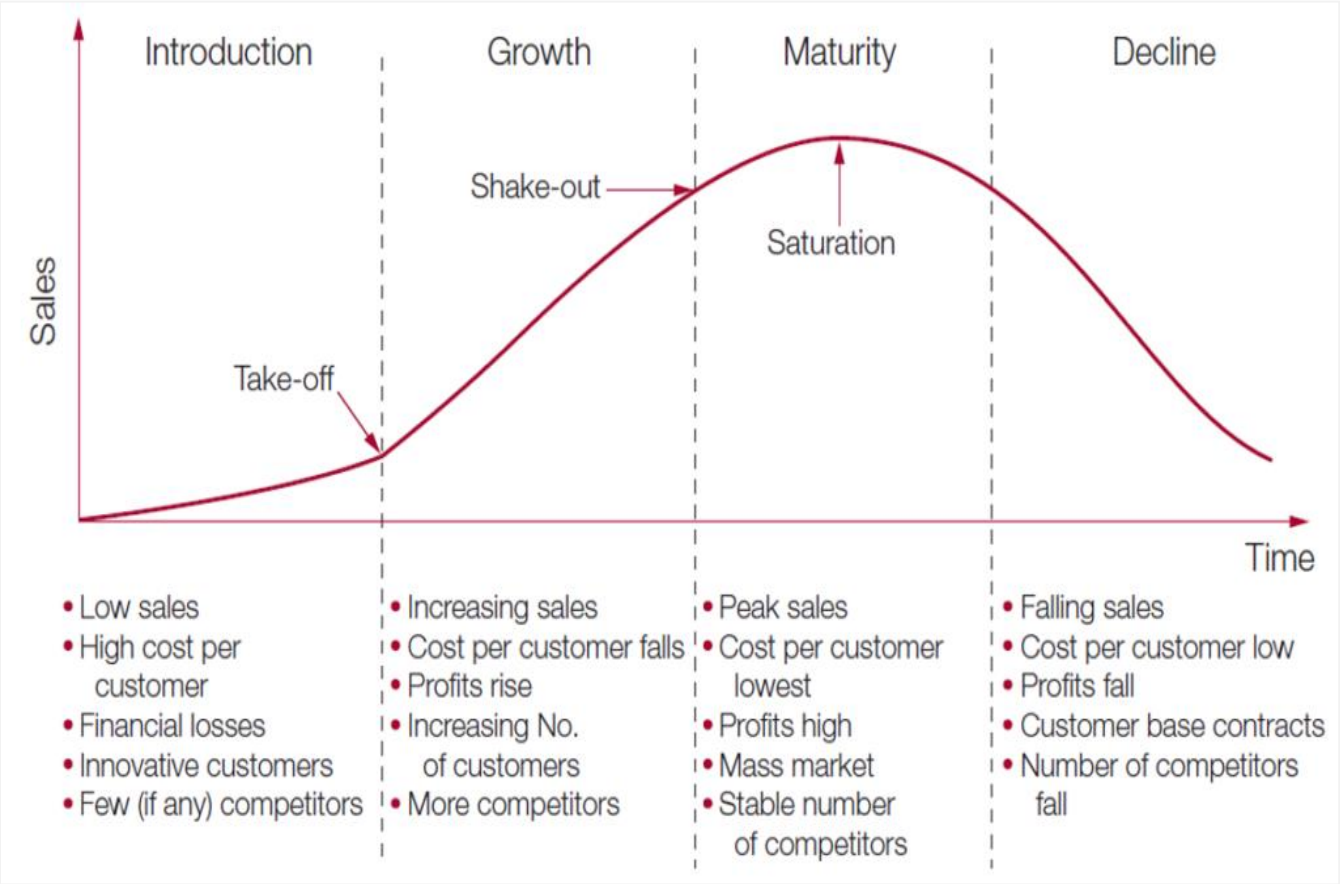
Fairtrade
The Fairtrade organisation negotiates with buyers to secure fair prices for the farmers/ producers of the goods (in developing countries) as well as their ethical treatment. Qualifying products display the mark, so customers know they are supporting Fairtrade. Examples include; cotton, chocolate, bananas, coffee, etc.

6 Rs of Sustainability	Meaning	Examples
Reduce	Minimising waste, energy and materials used in manufacture and transport of products	Less packaging on products, buying from local suppliers, having factories closer to retailers, etc.
Reuse	Using the product, or its parts, for another purpose	Plastic bottles can be used for craft projects, refilled with other liquids, made into bottle rockets for science experiments in schools, etc.
Recycle	Using parts and materials to be broken down and processed into a new product	Plastics, metals, papers and boards being processed to stock forms in recycling centres and returned to manufacturers to make new products from
Rethink	Considering alternatives to current manufacturing solutions	Customers considering travel – cycling to work or driving, or designers reconsidering material choices and choosing plastic alternatives
Repair	Fixing and maintaining a product rather than throwing it away	Replacing phone screens, repairing tears in clothing, designers ensuring its easy for the customer to repair at home, etc.
Refuse	Not buying or supporting designs that have a large environmental impact	Not buying products that use an excess of plastic or excess of packaging, etc.

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Product Life Cycle

Product Life Cycle (PLC) Chart



The Product Life Cycle Chart helps companies track and predict product sales.

This is not to be confused with the life cycle assessment of products in regards to sustainability

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Product Life Cycle

Redefining and Redeveloping Products	
Companies will often employ extension strategies to maintain their sales. Examples include:	
Demand/Customer Pull	This is where designers respond to demand from consumers for desirable product features. E.g. colour choice and battery life in smart phones
Technology Push	Research and development costs lead to the technology push of new ideas. However, these then need to be 'sold' to consumers. E.g. Google Glass failed to be sold to consumers due to cost and privacy concerns
Planned Obsolescence	This is where products are designed to fail and be replaced. This can be for company profit or lack of compatibility with software or lack of parts being manufactured.
Evolution of Products	This is generally caused by new technologies, manufacturing methods, materials, etc. Research and Development departments (R&D) explore and develop new ideas for companies.

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Analysis and Evaluation

How to Critically Analyse and Evaluate

Critical analysis is an in depth, research linked, objective study of elements of a design.

During the design process, the research and investigation provide the information to form a Design Specification. Evaluation of ideas includes comparing them to the Specification criteria.

Methodical checking of points of the Specification during idea generation increases the chances of a design being successful.

Analysis of existing products is also important. This might include;

- Identification of the target market and the product purpose
- Likely Specification criteria and how well they have been met
- Product disassembly to study manufacturing and other features

Testing and Evaluating Products in Industrial or Commercial Contexts

Before a product goes onto the market, it needs to be critically evaluated and tested.

Product safety is vital to avoid harm as well as product recall issues. Product recall is often 1000X more expensive than dealing with an issue during the design process, and mass recall can often harm a companies reputation.

Manufacturers often used testing facilities to check their products, as well as third-party, independent organisations to check for legislation compliance

Use of Third-Party Feedback in the Testing and Evaluation Process

Designers use third-party and independent evaluations of their ideas and products to get feedback on improvements and developments. This unbiased feedback often leads to a greater chance of success than using those of the design team.

Examples of third-party feedback include:

- British Standards Institute – who can certificate the product meeting standards and show this by awarding the BSI Kite mark and CE mark

There are also focus groups, that are samples of the desired target market. These are organised by independent market research organisations. These groups will interact with the product and be recorded for analysis. As well as asking for their views and opinions.

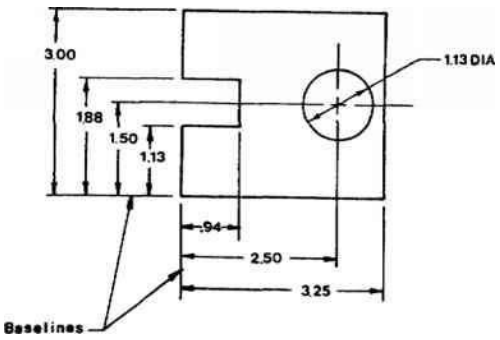
Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Accuracy in Design and Manufacture

Importance of Accuracy

Accurately fitting parts to ensure the correct function of products.
The acceptable range of accuracy is known as the tolerance.

The use of datum edges and surfaces, as well as vertical and horizontal lines as generated by laser levels, provide reference points to facilitate improved accuracy

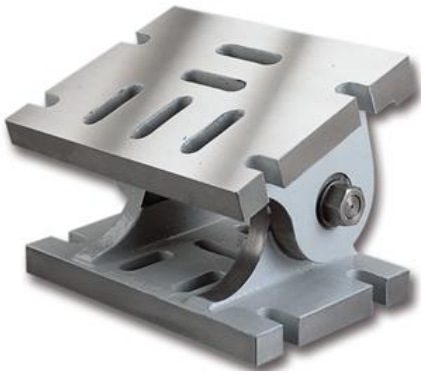


Testing Eliminating Errors

- Dials on machine controls allow precise movement on tools
- Digital test gauges are very accurate and are often computer linked
- Profile inspectors measure fine details
- CNC machines use computer codes to control their movement and ensure accuracy
- Laser micrometres, material thickness sensors and alignment systems are examples of non-contact testing devices

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Accuracy in Design and Manufacture

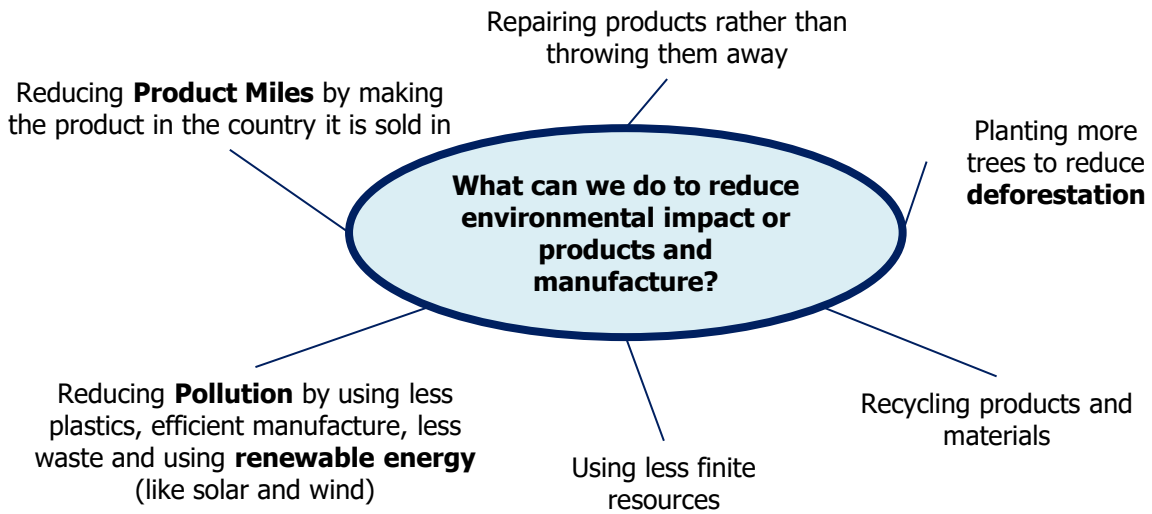
Measuring Aids	
Jigs are guides for cutting tools. They help tools, such as drills, for repetitive machine operations without needing to mark out. This helps reduce the need for skilled workers and reduces the chance from human error.	
Fixtures hold work in place for processes such as welding. They maintain the accurate alignment of parts by providing framework into which they are securely clamped during manufacture. They are often designed so that parts can only be fitted the right way round, they ensure that every manufactured assembly is of high quality.	
Templates ensure the consistent repetition of the same outline, by providing a consistent, rigid, profile of a shape. This helps create identical pieces and are incredibly common in batch production.	

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Environmental Issues

Using Sustainable Materials and Components
Designers have an ever-increasing responsibility to design products that have minimal environmental impact and must consider: • How to conserve materials • How to conserve energy during manufacture • The products are as sustainable and environmentally friendly as possible • Total carbon footprint • The total product miles

Sustainability is maintaining our planet and its resources and making a minimal negative impact	
Finite Resources *Will run out of eventually*	**Infinite Resources** *Can be re-grown and renewed. Will not run out of*
Plastics	Paper
Metals	Boards
Polymers (Textiles)	Natural Timbers
	Cotton
	Leather



Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Environmental Issues

Life Cycle Assessment

This is when a designer looks at the environmental impact a product makes over its life time and how it could be reduced. Including:

- Impact of materials
- Impact of processes
- Impact of packaging
- Product Miles (how far a product has to travel to get from factory to consumer)
- Impact while in use
- Impact when disposed of (6Rs)

Impact of Packaging

Designers and manufacturers need to consider factors that use the optimum amount of packaging to protect and preserve products and prevent waste. E.g.:

- Making packaging lightweight
- Using recycled content
- Making the packaging recyclable or reusable
- The use of refills and concentrates
- Using minimal packaging materials
- Charging for items – like supermarket carrier bags

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Conservation of Energy and Resources

Sustainability is maintaining our planet and its resources and making a minimal negative impact	
Non-Renewable Energy Sources *Will run out of eventually*	**Renewable Energy Sources** *Will not run out of*
Oil	Hydro
Gas	Wind
Coal	Solar
Nuclear	Tidal
	Geothermal
	Biomass

Advantages of Renewable Energy	**Disadvantages of Renewable Energy**
• Sustainable	• Difficult to product large quantities
• Generally require less maintenance than traditional generators	• Often relies on weather which can be unreliable and inconsistent
• Reduces operational costs	• Cannot be stored in large quantities
• Little to no waste	• Currently more expensive than traditional energy due to large capital costs associated with new technologies
• Social and economic benefits	

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Conservation of Energy and Resources

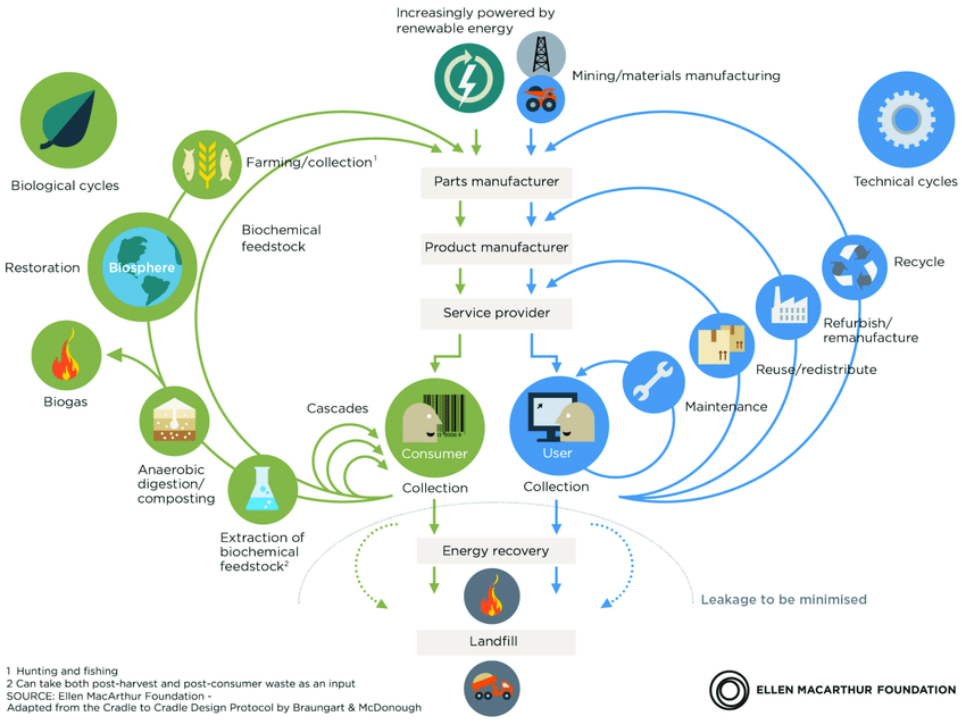
Circular Economy

The circular economy is a cradle-to-grave approach in the product life cycle. There are two 'nutrient' types:

- Biological nutrients – Organic, non-toxic, materials that can simply be composted and can safely re-enter ecosystems.
- Technical nutrients – man-made materials are designed to be used repeatedly, and at the same time high quality with minimal energy.

This economy will:

- Work against the unsustainable 'take, make dispose' culture
- Reduce use of finite resources
- Reduce waste
- Avoid pollution
- Deliver a more competitive UK economy
- Help reduce environmental impact of product manufacture and consumption



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Design and Making Principles: Quality Assurance and Quality Control

Quality Assurance	
There are policies and procedure to ensure are products are 'right first time and every time' Examples include • Materials and components are from Quality Management Standard Suppliers • Checking correct temperature in moulding • Rigid maintenance schedules • Effective QA procedures • Pre-production CAD modelling • Use of FEA and MFA • Using embossed mould identification marks to trace faults	
Total Quality Management	• TQM aims to remove waste and make products right first time by continuous improvement • Workforce's views, feedback, etc. are highly prioritised
Scrum (Agile Manufacture)	• The main focus is working in a team to reach goals in short time frames • Team goals are specified and individuals feed back progress daily • Regularly feed backing in meetings to facilitate quick response to issues
Six Sigma	• System for process improvement to reduce defects to fewer than 3.4 in every million • This procedure monitors, assess and improves each stage of design and manufacture • The 5 stages are; define the issue, measure the issues extent, analyse where the issues occur, improve, control modified procedures
Critical Path Analysis (CPA)	• CPA uses schedule efficient completion of process stages; • A sequential order of tasks is established for a project or process • Unnecessary waiting time can be identified • Parallel processing opportunities can then be exploited for maximum efficiency

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: Quality Assurance and Quality Control

<table>
<tr><th colspan="3">Quality Control</th></tr>
<tr><td colspan="3">QC is the monitoring, checking and testing of QA tolerance conformity throughout production specified by the strict guidance of client requirements</td></tr>
<tr><td>Monitoring, Checking and Testing</td><td colspan="2">Compliance can be checked by:

• Visual checks
• Chemical analysis of samples
• Colour matching
• Use of digital measuring devices
• Interval sample testing</td></tr>
<tr><td>Tolerance</td><td colspan="2">Tolerance is the acceptable level of accuracy in a product/part:

• Depends on material, parts, size and function
• Fine tolerances are particularly important when parts are interchangeable
• Components not meeting tolerance and rejected</td></tr>
<tr><td rowspan="2">Specific QC Methods</td><td>Go/no go gauges:

• Check a single measurement for tolerance range – either pass or fail
• Minimum and maximum dimensions are on it so its easy to use
• Quick to use</td><td> 
</td></tr>
<tr><td>Laser or probe scanning and measuring:

• Probe scanners check predetermined measurements (highly accurate)
• Non-contact lasers can scan thousands of readings
• Can be used to check tooling accuracy for QA</td><td>  </td></tr>
<tr><td>Digital Measuring</td><td colspan="2">• Provide a read out of the dimension measured
• Can be used in a range of situations
• Vernier callipers are generally used for external, internal and depth measurements with 0.002 mm accuracy
• The screw thread utilised in a micrometer facilities accuracy of 0.01</td></tr>
<tr><td>Non-Destructive Testing</td><td colspan="2">Non-destruct testing (NDT) is carried out on products rather than material samples. The product is not destroyed during testing.

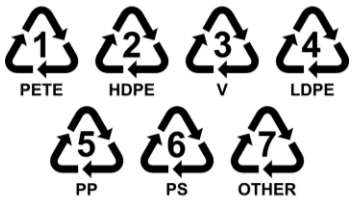
It is used to find faults in the material e.g. using ultrasounds and x-rays</td></tr>
</table>

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: National and International Standards

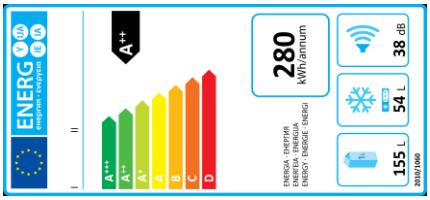
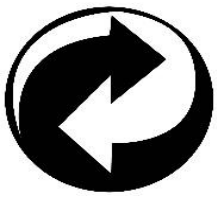
British Standards Institution
The BSI is a national organisation that devises agreed standard procedures. • The portfolio currently exceeds 30,000 standards • The BSI Kitemark shows that standards have been met • The BSI Kitemark is influential when consumers decide on purchases

International Organization for Standardization (ISO)
The ISO consists of 150 notional standards bodies, including BSI. • Implements internationally recognised standards • The CE marks means the product conforms to all relevant EU safety standards

Directive and Labelling Initiatives		
Image	**Name**	**Key Information**
	Mobius Loop Recycling Symbol	• Internationally recognised • Shows product can be recycled • Helps separate materials
	Restriction of Hazardous Substances (RoHS) Directive	• European directive • Restricts use of hazardous materials in electrical products • Aims to protect human and environmental health
	Waste from Electrical and Electronic Equipment (WEEE) Directive	• European directive • Covers end of life of electrical equipment

Knowledge Organiser: KS5 Design Technology

Design and Making Principles: National and International Standards

Directive and Labelling Initiatives		
Image	**Name**	**Key Information**
	EC Energy Label	• Compulsory European scheme • Shows consumers energy consumption of household appliances • Scale from A+++ to D
	NAPM Recycled Mark	• National Association of Paper Merchant's scheme • Encourage the use of recycled paper
	European Ecolabel	• Voluntary certification • Shows product has had a life cycle assessment
	Forest Stewardship Council Logo	• Applies to timber products sourced from sustainable forests • People and wildlife have been protected • Local, trained and fairly paid workers have been used
	EU Energy Star	• Collaborative scheme between EU and USA • Standardises IT equipment energy labelling
	Green Dot	• Used in Europe • Shows the manufacturer has made a financial contribution to recycling packaging in Europe

Structuring your answers in Design Technology

P.E.E Chains

In Technology we use PEE chains to expand our answers so we are communicating our thoughts and ideas clearly. This makes sure that we say what we think and then back up, or justify, our thoughts with explanations and evidence from research which support them.

POINT	Say WHAT you think.	*I think the product should be…*
EXPLAIN	Say WHY you think it.	*This is because…*
EVIDENCE	Say what RESEARCH you've done to back this up.	*I know this from my research into…*

ACCESS FM

ACCESS FM is an analysis and annotation tool which makes sure we consider all the important design criteria and the impact they have on products we are investigating, designing or evaluating,

A	Appearance	Where did the designer get their inspiration? Could the product look better? Do you think it looks attractive or ugly, Why? What does the product look like? *THINK* shape, form, materials, size, beauty, ugliness.
C	Cost	Is it affordable to your customer? Will it make a profit? Is it value for money? How much does it cost to make?
C	Customer	What impact would it have on a customers life? Why would a customer buy it? What makes it suitable for them? Who would buy it? Who would use it?
E	Environment	What is the products impact on the environment? *THINK* batteries, rethink, refuse, reduce, reuse, recycle, lifecycle. How would the product be disposed of? Is the product needed or wanted? How long will it last?
S	Safety	Is the product high quality? Does it meet safety standards? How has the designer considered safety? Could the product hurt anyone? Are there any sharp edges?
S	Size	Is it an appropriate size? Would it work better if it was bigger or smaller? Does it come in different sizes? How big is it?
F	Function	Does the product work? Could the product work better? How does the product work? Why is the product needed? What does the product do? Is it easy to use?
M	Materials/ Manufacture	What impact could the designer's choice of material have on the environment? Would a different material make it better? What material has it been made from? What process would be used to make it?

Structure Strips in Design Technology

State			2 marks
Example Question State two reasons why corrugated cardboard is used as packaging for cooked pizzas.			
1	Reason 1 (1 mark)	It is a rigid material that won't flex and bend as easily as other types of cardboard which offers protection to the pizza.	
2	Reason 2 (1 mark)	The thermal properties of the material as cavities in the cardboard keep the pizza warm.	

Give			2 marks
Example Question In 2010 the use of renewable energy in the UK accounted for 6.5% of total energy usage. By 2015 this figure had increased to 25%. Give two reasons for the increase in the use of renewable energy sources.			
1	Reason 1 (1 mark)	The Government set specific targets to reduce CO2 emissions.	
2	Reason 2 (1 mark)	People now have an increased awareness of environmental issues and are more conscientious about them.	

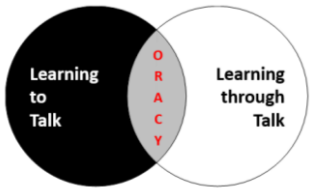
Describe			4 marks
Example Question Describe two ways that materials and/or products are strengthened or reinforced. Give examples in your answer.			
1	Description 1 (1 mark)	Layering materials can make materials stronger as you can lay them with their grain in different directions. This ensures the weak lines of the grain are strengthened.	
2	Example (1 mark)	Plywood is created in layers to strengthen the material.	
3	Description 2 (1 mark)	Laminating is adding a plastic coating to a material to make it more rigid, tougher and weather resistant.	
4	Example (1 mark)	Plastic coating is added to card and paper to make the materials more wear resistant and rigid, for example a restaurant menu.	

Explain (written)			4 marks
Example Question Explain what is meant by the term 'anthropometrics' and why it is important for designers to consider.			
1	Define key word (1)	Anthropometrics is the study of human measurements.	
2	Give 3 reasons why (3)	Designers need to consider anthropometric data in order to: • ensure that wearable items fit • ensure that products are comfortable • ensure that products are easy to use	
Explain (notes and sketches)			**6 marks**
Example Question Name one industrial process used in the manufacture of a polymer toy musical instrument. In the box below, use notes and/or sketches to explain this process in detail.			
1	Identify (1)	A suitable process would be Injection Moulding	
2	Describe (2)	A polymer is placed in the hopper and enters the chamber of the injection moulding machine. The chamber is heated until the plastic melts. The plastic is then forced in to a mould where it cools to create the shape of the object.	
3	Sketches to help with description (2)	Sketch of injection moulding machine and movement of plastic.	
4	Explain why (1)	Injection moulding is suitable because it is quick and cheap for mass produced parts and it does not require finishing.	
Evaluate			**4 marks**
Example Question Evaluate the Apple watch in terms of its suitability for the user.			
1	Positives / Advantages (1-2)	• Waterproof which allows for use when outdoors and does not absorb sweat. • Clear display screen which is easy to read even when moving.	
2	Negatives / Disadvantages (1-2)	• Flat screen susceptible to reflection • Screen can scratch easily	
3	Summary (1)	Overall the watch is well suited to the user as it has a range of specific features which are suited to the environment in which it will be used and the negative design features are minimal.	

Justify			8 Marks
Example Question Justify the design decisions which have been made to make the Apple watch more aesthetically appealing and gender neutral for the user.			Q:
1	Identify / underline each key word	• Aesthetically appealing • Gender neutral	
2	Define each key word (2)	• An aesthetically appealing product is one which looks attractive to its specific target market. • A gender neutral product is not aimed specifically at one gender, but it may have options to target each gender.	
3	Promote Positives / Advantages (2)	• Black in colour which is neutral and sophisticated which will appeal to an adult target market. • A plain colour that will not date/go out of fashion and appropriate for a wide range of settings • Brightly coloured icons on the screen that are attractive and easy to recognise • Geometric, simple styling that can be worn by men or women.	
4	Discount Negatives / Disadvantages (2)	• Black is a boring colour that will not excite, but you can purchase alternative straps to make it more personalised. • Square shape face may not appeal to all users or may appeal masculine, however, this has featured on previous products and they have sold well.	
5	Summary (2)	Previous sales show that the latest Apple watch is appropriate for the target market as it sells in high volumes. As it can be personalised through different straps, the customer can tailor the watch to their personal style which makes it more aesthetically appealing to them and the original watch being gender neutral allows this to be done effectively.	

Evaluate			10 marks
Example Question Designers sometimes choose materials according to their impact on society and the environment. Examples include the use of fair trade cotton, recycled components and biodegradable packaging. Evaluate how the use of such materials might be seen as the ethical choice.			
1	Identify / underline each key word	• Biodegradable Packaging • Fair trade Cotton • Recycled components • Ethical choice	
2	Define each key word (3 marks)	• Biodegradable Packaging is made from materials which decompose much more quickly so that less waste is left in landfill • Fair trade Cotton is produced by cotton farmers who are paid a living wage which allows them to survive and earn enough money to feed their families • Recycled Components are made from waste products where the material has been melted down and reformed. • An ethical choice is one which avoids harm to people, animals and the environment.	
3	Positives / Advantages (3 marks)	**Biodegradable packaging:** • Require less energy to process into a useable material. • Are easier to recycle/use less energy to recycle. • Are non-toxic when they break down. **Fair trade Cotton:** • Ensures workers / farmers get a fair price for their labour / products. • It gives small scale farmers access to global markets. • Buying this product shows your support for these communities. **Recycled components:** • Often contain valuable materials such as gold, copper, aluminium. • Saves landfill space.	
4	Negatives / Disadvantages (3 marks)	**Biodegradable packaging:** • Are relatively new materials and not currently widely used. • May be more expensive. **Fair trade Cotton:** • Paying a higher wage results in products having a higher overall cost/price. **Recycled components:** • Are non-renewable and are becoming more difficult and costly to find.	
5	Summary (1 mark)	Overall, the main disadvantage of choosing these materials seems to be cost. However, I think that they are ethically right as they reduce the impact on the environment and are more socially acceptable as well and I think this is more important than the fact that products will be more expensive.	

Oracy in Design Technology



Oracy means being able to express yourself clearly using spoken language. We build oracy tasks into Technology lessons to help you develop the technical language and understanding that you need to be able to communicate your ideas and opinions effectively to others. These are some of the activities which we use in lessons, but you can try them out at home too!

RANT

You need to discuss and explain all the negatives you can think of on the topic you have been given.

Success Criteria	Sentence Starters
• Consider all the potential negatives • State your opinion clearly • Take turns with your partner / group • Explain your reasons • Give examples • Don't lose your temper!	• The problems are… • I disagree with you because… • The effects of that are… • That's true but have you considered… • I hear what you are saying but…

RAVE

You need to discuss and explain all the positives you can think of on the topic you have been given.

Success Criteria	Sentence Starters
• Consider all the potential positives • State your opinion clearly • Take turns with your partner / group • Explain your reasons • Give examples • Be enthusiastic!	• The benefits of this are… • I feel this is positive because… • The effects of that are… • That's true but have you considered… • I hear what you are saying but…

Talk Detective

You need to observe conversations and identify examples of good oracy.

Success Criteria	• Look for what people are doing well • Record specific phrases and names • Give praise in your feedback • Use positive body language when you feedback

Things to look for:

✓ **Invited someone else to contribute** ✓ **Challenged someone's opinion** ✓ **Summarised their thinking or the group opinion** ✓ **Clarified someone's idea**	✓ **Gave a good example** ✓ **Used appropriate body language** ✓ **Used technical language / key words**

Revision Strategies in Design Technology

Technique	Difficulty	Description	Used
Revision Cards	Hard Challenge	Write out 'flash cards' which have questions on the front and answers on the back which can be used for testing yourself/each other.	
Memory Map	Challenge	Mind map all the key points and key words related to the topics. Use images as appropriate.	
mnemonics	Hard Challenge	Use the first letter of key words to spell out a word or phrase to remember lists or large chunks of information e.g. Richard of York gave battle in vain (colours of the rainbow: red, orange, yellow, green, blue, indigo, violet) or ACCESS FM.	
Self Test	Challenge	Use flash cards or the practice questions in the book to test your knowledge of topics.	
	Hard Challenge	Designing your own question and mark scheme for the topic	
	Extreme Challenge	Create a model answer for the question you designed.	
Smartass Lists	Extreme Challenge	Write down impressive/unusual key words or expressions which you could use to answer a question on that topic	
Example Q&A	Hard Challenge	Make up an example exam question on the topic and write a mark scheme for it using the revision guide. Then test a peer with the question, mark their work and work in pairs to develop the mark scheme.	
Songs/Poems	Hard Challenge	Write a poem or a rhyme (you could even include a tune) which will help you to remember the key words or points for a topic.	
Pictograms	Challenge	Draw images surrounded by key words which will remind you of the key information or help to summarise the topics. This may be a single image (e.g. materials/tools) or a story board (e.g. processes)	
Bullets/Lists	Challenge	Number or bullet point the key information on a topic. Try and list them in order of importance.	
Audio Tape	Challenge	Create an audio account of the key information which you can then play back to yourself to help you remember the key points.	
	Hard Challenge	In pairs write and record an interview which includes the key information about a topic and requires the interviewee to explain and justify the information being covered.	
Physical Map	Challenge	Put key points about a topic around the room. Move to that point and either read out loud or write down the fact/point/information. This means that the information then becomes associated with this specific place and thinking about the place should trigger the recall of information.	
Round Robin	Challenge	In teams of 3-4, take it in turns to relay the information about a topic until you run out of key points. Then check that you covered all the information by using the revision guide/notes as a checklist.	
Quiz Quiz Trade	Hard Challenge	Create quiz, quiz, trade cards and use them in small groups to cover the information for a topic. Each card should feature a question and a sub-question or hint on one side, with the answer on the reverse.	
Talk Pair Share/speed dating	Hard Challenge	Talk in pairs and cover the main points of a topic (make a note of what you remember together in your revision books) Then pair up with someone else and add to you notes, repeat this until you think you have all the information – then check against the revision guide.	
Talking Tables	Challenge	Similar to Talk, Pair, Share - working in teams of 3-4 cover the main points of a topic (make a note of what you remember together in your revision books) and then move teams and add to you notes, repeat this until you think you have all the information – then check against the revision guide.	
Consensus	Hard Challenge	Useful for key words. Independently define a key word, then in teams of 3-4 bring definitions together and synthesise the information to create the best definition possible. Can also be used to develop responses to exam questions.	

Personalised Learning Checklist: KS5 Design Technology

Create a **revision aid** for each of the statements below, to prove you can do each one.
- If you can definitely do the full task, tick green.
- If you can do some of the task, tick amber.
- If you can do less than half of the task, tick red.

If you have not ticked green, spend some extra time revising that area!
What's a revision aid? This could be revision notes, a mind map, a list, flashcards. Whatever works for you! Look at the revision strategies page for more ideas.

A Level DT REVISION PLC

Topic	Revision Task	R	A	G
Materials and their applications	Create a quiz covering the information in the topic.			
Testing materials	Mind map all the key points and key words related to the topics. Use images as appropriate.			
Performance characteristics of materials: papers/boards, composites, polymers, woods, smart materials, metals	Write out 'flash cards' which have questions on the front and answers on the back which can be used for testing yourself/each other.			
How technology and cultural changes can impact on the work of designers	Use flash cards or the practice questions in the book to test your knowledge of the topic.			
Selecting appropriate tools, equipment and processes.	Number or bullet point the key information on a topic.			
Accuracy in design and manufacture.	Make up an example exam question on the topic and write a mark scheme for it using the revision guide.			
Design for manufacture.	Independently define key words and produce a glossary.			
Enhancement of materials.	Use flash cards or the practice questions in the book to test your knowledge of topics.			
Forming, redistribution and addition processes – wood, metal, polymers	Create a quiz covering the information in the topic.			
Joining methods, adhesives and fixings along with the use of jigs and fixtures.	Draw images surrounded by key words which will remind you of the key information.			
The use of finishes – paper/board, polymers.	Mind map all the key points and key words related to the topics.			

Personalised Learning Checklist: KS5 Design Technology

A Level DT REVISION PLC

Topic	Revision Task	R	A	G
Modern and industrial commercial practice	Write out 'flash cards' which have questions on the front and answers on the back which can be used for testing yourself/each other.			
Digital design & manufacture.	Independently define key words and produce a glossary.			
The requirements for product design and development.	Make up an example exam question on the topic and write a mark scheme for it using the revision guide.			
Health and safety.	Create a quiz covering the information in the topic.			
Design for manufacturing, maintenance, repair and disposal.	Number or bullet point the key information on a topic.			
Enterprise /marketing in the development of products.	Use flash cards or the practice questions in the book to test your knowledge of topics.			
Design communication.	Draw images surrounded by key words which will remind you of the key information.			
Technology and cultural changes	Independently define key words and produce a glossary.			
Design theory.	Number or bullet point the key information on a topic.			
Responsible design.	Make up an example exam question on the topic and write a mark scheme for it using the revision guide.			
National and international standards in product design.	Create a quiz covering the information in the topic.			
Protecting designs and intellectual property.	Use flash cards or the practice questions in the book to test your knowledge of topics.			
Feasibility studies.	Draw images surrounded by key words which will remind you of the key information.			
Modern manufacturing systems.	Independently define key words and produce a glossary.			