Fibres and Fabrics Knowledge Organiser

Natural Fibre Products

Traditional fibres from plants and animals.

Wool: Fibres from sheep's wool are spun into yarn and can be woven and knitted. The fibres can also be spun into finer yarn which is turned into cloth. Absorbent, soft or coarse handle, not durable.

Used in yarn form in knitwear, scarves, gloves, bags, dresses and suits.

Cotton: Thread is spun from fibres from the cotton plant. Used widely due to its good durability and soft handle. Can be machine washed, but requires ironing as creases easily. Highly-absorbent.

Used in canvas, muslin, calico and denim, clothing, home furnishings

Silk: Natural fibre from silkworms, woven into fine fabric, which has a high sheen or lustre. Cool to wear.

Used in high-class clothing and home furnishings in Satin form.

Linen Made from fibres of the flax plant, linen is a traditional fabric. Does not cause allergies and is cool to wear. Highly absorbent.

Used in home furnishings, summer clothing.

Leather: Made from animal skins, leather is not strictly a fabric. Comfortable in both hot and cold conditions. Untreated, leather is absorbent but can be treated with a range of finishes to improve its effectiveness and durability. Tough and elastic.

Used in clothing, car upholstery, home furnishings.

Manmade Fibre Products (synthetic)

Modern fibres manufactured using polymers.

Nylon: Strong and durable manmade polymer fibre. Has a wide range of applications, as a clothing fabric and in other uses where durability is important. Warm to wear, non-absorbent and good drape. Can be made with soft or coarse handle.

Used in wide range of clothing in pure and blended form. Waterproof coats, tents.

Polyester: Very durable polymer fibre, non-absorbent and cool to wear. Often blended with cotton to produce low cost, breathable fabrics and used widely in place of pure cotton.

Used in clothing and home furnishings, industrial polyester used for ropes, seat-belts.

Organza: A lightweight, sheer fabric traditionally made from silk, although more often now made from polyester. Its decorative properties make it popular for embellishments on clothing.

Used in home furnishings, hat decorations, wedding dresses.

Lycra (brand name for spandex/elastane): A 20th century 'wonder material', Lycra is commonly found in sportswear due to its breathable and elastic qualities. Excellent shape retention. When blended with natural fibres, clothing with the feel of natural fire, and the elasticity of Lycra can be achieved.

Used in tight-fitting sports wear, stockings and leggings, blended in denim, woollen clothing.

Property	Definition	Found in
absorbent	A fabric's ability to hold moisture.	wool, cotton, limen, non-woven fabrics such as felt
blended	A fabric or yarn made from a mix of natural and manmade fibres, purposefully created to use the features of both.	
breathable	A fabric that uses specific fibres and weave that allows air to pass through the clothing, thereby preventing heat and moisture build-up.	sportswear blended fabrics, line, cotton, wool
drape	The way a fabric looks when it is hanging down. Clothing designers must consider the drape of a fabric when choosing the material for a garment.	all fabrics
durable	Hard-wearing, stain resistant. Man-made fibres are mainly more durable, and are therefore blended with natural fibres to create more durable products.	nylon, polyester, denim, lycra
handle	What a fabric feels like to the touch, for instance: smooth, rough, stiff.	all fabrics
sheen	A smooth and slightly reflective surface finish to a fabric.	silk and synthetic satins, polyester products, some leathers
sheer	Fabrics that are flimsy and semi-transparent.	organza, voile, muslin lingerie products
shape retention	A fabric's ability to keep its shape and not become deformed through use.	lycra and lycra blends, leather, polyester, nylon
water-repellent	Non-absorbent. A fabric's natural ability, or manufactured finish, allowing water to not penetrate through the weave.	polyester, nylon, leather

Smart Fabrics

Advancements in modern technology have implications for fabrics and design. **Wearable technology** and **performance enhancing textiles** are important strands of sports and fashion design in the modern age.

This acupuncture therapy shirt allows the wearer to receive specific therapy at the same time as getting on with their job.

This light emitting fabric is an example of how designers can use fibre-optics to create high-impact visual clothing and accessories.

Wasting

Fabrics are a compliant material and are relatively easy to cut and shape. They are, however, an unforgiving material, and an incorrect cut will be often difficult to undo or disguise.

Cutting: Fabric is normally cut with textile shears. The blades are 150mm long and the lower handle is always bigger. This allows for a steadier, longer cut. Rotary cutters are used for cutting non-woven fabrics such as felt.

Shearing: Although shearing and cutting are the same force and movement, pinking shears give a zig-zag edge to their cut. This prevents woven fabric from fraying

Wasting Fabrics with CAD/CAM

Sections of fabric can be wasted effectively using a laser cutter. A pattern can be created using CAD software such as 2D Design and used to control the laser cutter. Identical patterns can be created very quickly using this method with a high level of accuracy.

Seam Allowance

Fabrics require a seam allowance; the material where the stitch joins two pieces of fabric together. This means fabric must be cut larger than the size needed by approximately 10mm on all sides where a join is required.

Addition

Addition by hand-stitching

All projects will require some degree of hand-stitching. This may be to add a button, join one piece of fabric over the top of another, such as in applique, or embroidering by hand. There are a range of stitches which can be done using a needle and thread:

- **Running stitch:** Quickly joints two fabrics along a line
- **Overstitch:** Loops over the edge of the fabric preventing fraying.
- **Blanket-stitch:** Ornamental stitch effective on decorative work.
- **Back stitch:** Stronger that a running stitch and good for seams.

Zips, buttons, hook and eye, press-studs and Velcro can all be added to fabrics and used to add and fasten pieces together.

Addition by machine-sewing

The correct method for joining fabrics is dependent on the type of fabric being used, and the loads and stresses that will act upon the join. An overlock machine is good for professional looking products as it binds the seam inside the join. Sewing machines are required to add fasteners such as zips.

Addition by computer sewing machine

Many jobs can be completed by a programmable CAM sewing machine.

Some schools have embroidery machines. A design is created on a computer, before being uploaded to the embroidery machine. Decoration, detail and personalised names can be added to a panel of a product this way.

Deforming and Reforming

Deforming by tailoring

Once the pattern and fabric pieces have been cut, the main tool for shaping an item of clothing is a tailor's dummy. Re-forming, adjustment and fitting can be done whilst seeing the overall shape of the product. Because fabrics are compliant materials, they deform as part of their nature. Imagine wearing a pair of skinny jeans which didn't deform as you moved!

Deforming by pleating and gathering

Shape can be created and accentuated through the use of gathering. Pleating can create a strong visual effect and allow for movement in a garment.

Pleat: Repeated folds in a textiles product, usually stitched at the top.

Gather: To shorted a piece of fabric by drawing it together, like the top of some curtains.

Deforming by heat and liquids

Heat treatment: Some specially laminated fabrics can be formed into shape using heat. This is useful where the designer needs parts of a design to hold a shape without support, such as collars.

Blocking: Traditionally, moulded hats, for both men and women have been created by deforming felt on wooden blocks. A felt hood or cone is placed on the block and a liquid stiffener is applied. A steam iron is then used to shape the felt around the block before shaping the brim and cutting off waste material.

GCSE D&T Knowledge Organiser

Mechanical Systems

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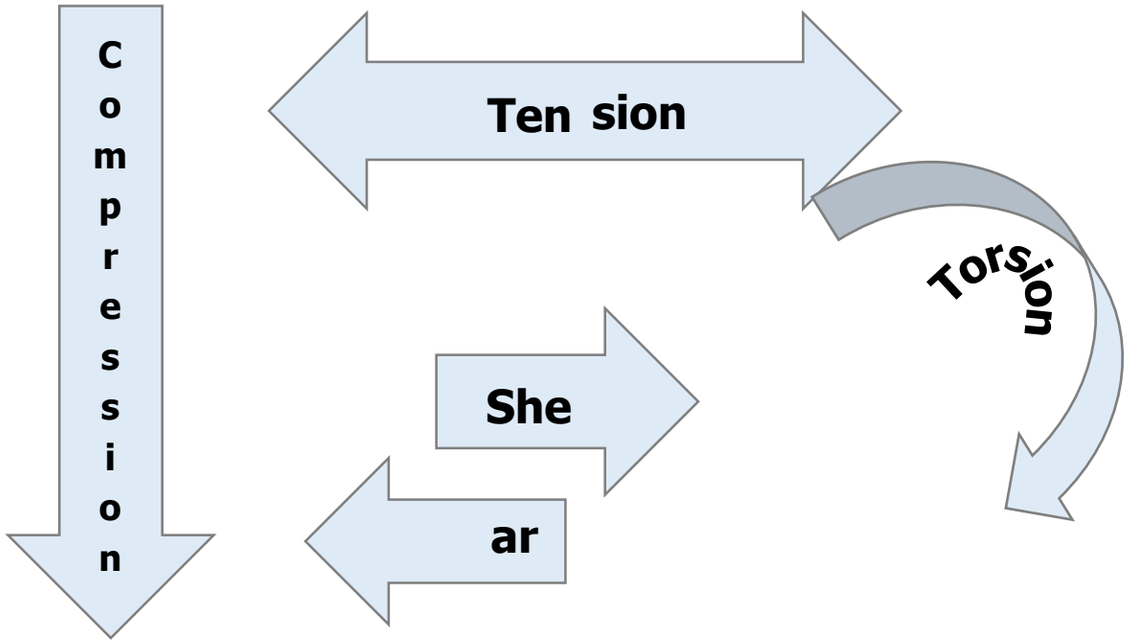
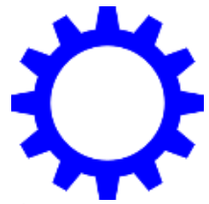
Forces

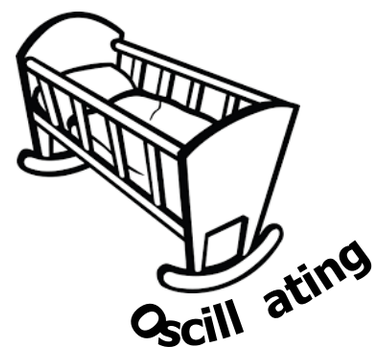


Motion

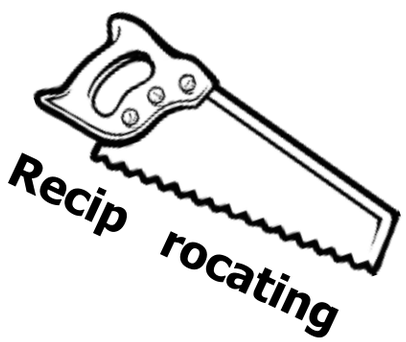
Linear



Rotation

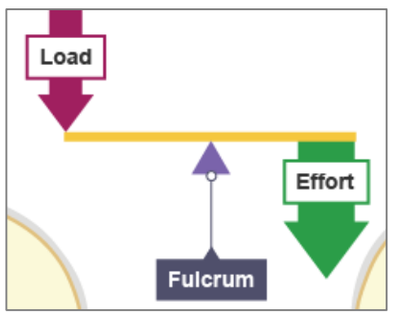


Oscill ating

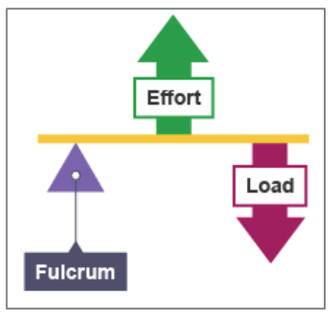


Recip rocating

Levers

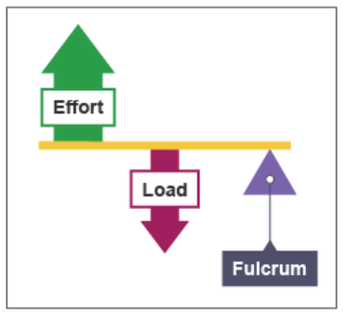


1st Class Lever:
Fulcrum in the centre
E.g. Scissors



3rd Class Lever:
Force in the centre
E.g. Lifting a dumbbell

2nd Class Lever:
Load in the centre
E.g. wheelbarrow



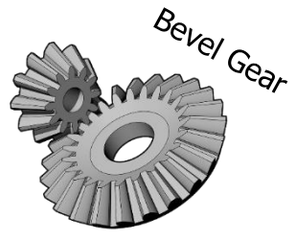
Gears and Pulleys

A Pulley is a grooved wheel, that has a belt running through it

This uses rotary motion and is often used to help with heavy loads, and transfer force from a motor to a tool in machines like drills, etc

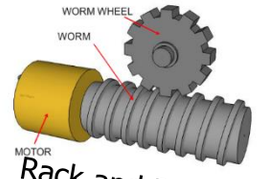
Gears have teeth that mesh together with each other (like teeth on a zip)

They mainly focus on rotary motion on tools and machinery e.g. car steering and pillar drills



Bevel Gear

Spur Gear



Rack and Pinion

Worm and Wheel

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Modern and Smart Materials

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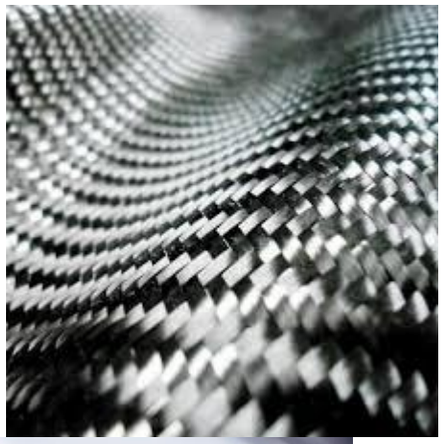
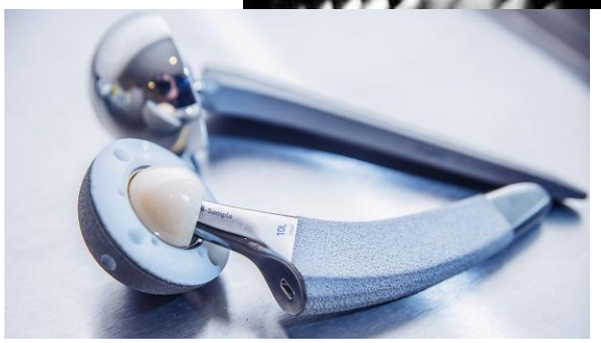
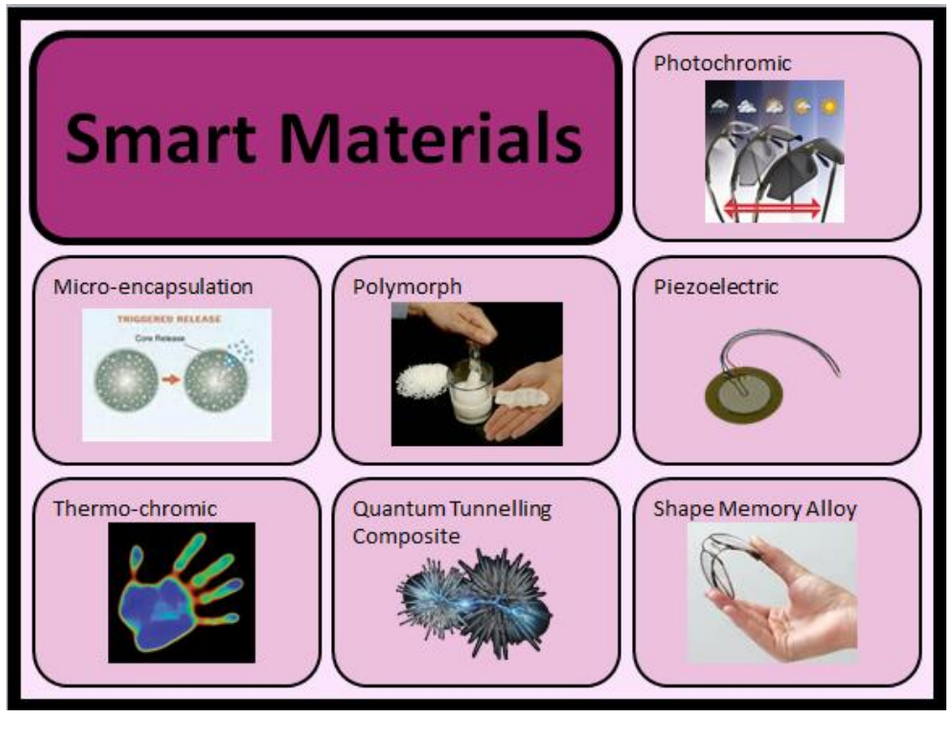




Modern Materials are materials that have been developed recently		
Material	**Key info**	**Examples**
Corn-starch Polymers	These are plant-based polymers that are a replacement for plastics that are **biodegradable** but cannot be recycled.	Plastic bottles, tubs, food containers, etc
Flexible MDF	Made in the same way as normal MDF but with grooves cut into the surface so it is flexible. **Flexiply** is the same but for Plywood. These can easily be shaped into curves	Modern furniture, interior walls and room dividers
Titanium	High strength to weight ratio. Doesn't corrode or rust. Suitable for medical use as its hypo-allergneic	Prosthetics, medical applications, sports cars, etc
Kevlar	A woven polymer with a high strength to weight ratio.	Bullet-proof vests, tyres, helmets, etc



Smart Materials are materials that change and react to the stimuli		
Material	**Key info**	**Examples**
Thermochromic Pigments	Change colour in reaction to heat	Kettles, baby bottles, etc
Photochromic Pigments	Change colour in reaction to light	Colour changing glasses, windows, etc
Shape Memory Alloy	Returns to its original shape, in reaction to heat	Braces and glasses
Polymorph	Granules that once exposed to hot water, become a modelling material (like a dough or clay)	Modelling and repairs

Design Engineering (Electronics) Knowledge Organiser

Input Components

These devices form the crucial control needed for a product to operate. Most input components need to be bought but some can be manufactured especially for a project. For instance, a pressure sensor.

Light dependent resistors (LDRs) are a type of variable resistor whose resistance increases with light.

Push to make switches are simple input devices which allow electrical current to flow when pushed.

Time delay switches lengthen the time a product operates for.

Motion sensors use infrared to detect changes in the environment to activate the system.

Tilt switches use mercury to connect two electrodes when moved.

Thermistors are a type of variable resistor whose resistance changes when it becomes hot or cold.

Process Components

These devices are used in combinations to turn the signal from the input component into the signal to the output component. Careful designing and a good knowledge of the way circuits are designed is crucial.

Resistors limit current flow in an electronic circuit and have to be placed before some components to prevent damage.

Capacitors store charge in circuits and release charge when the circuit is off.

Transistors are semi-conductor electronic switches which allow current to flow through their third leg to a separate part of the circuit.

Diodes allow current to flow in one direction only, acting as a safety valve. They are a semi-conductor.

Integrated circuits (ICs) are manufactured for many different uses and functions. A tiny circuit is encased in silicone (a semi-conductor material). Although they look complex, they follow the same logic as simple circuits. Because of their reduced size, smaller products can be achieved as more technology can be made to fit into smaller spaces. The 555 timer is an example of a pre-programmed 8 pin IC. It can be used to produce time delays.

Microcontrollers are tiny integrated circuits used widely in automatically controlled devices such as engine management in cars. These can be combined with **drivers** to control devices such as motors. **Raspberry Pi** and **BBC micro:bit** computers are examples used in schools.

Process Components

The output is the end function of the product. In most cases, the output can be classed as light, sound, motion or a combination of two or more functions.

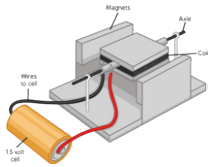
Light emitting diode (LED) come in different colours and levels of brightness. They have replaced the filament bulb in many everyday uses.

Light bulbs are not as widely used because of LEDs in an everyday context but mini-light bulbs do not require soldering, so can still be useful.

Buzzers use electric current to create their own sound. Used in alarm systems.

Speakers allow a sound signal from a circuit to be amplified.

Motors are magnetic devices and are behind nearly all moving parts in electronic systems.



Properties and Definitions in Electronics

Key Term	Definition
conductor	A material which allows heat or electricity to pass through it easily.
input	What has to happen to actuate the function of a circuit.
insulator	A material that does not conduct electricity and can therefore be used as a coating to components, circuit boards and wires.
heat sink	A conductive device, such as a crocodile clip, that allows heat to discharge from delicate components when soldering.
mono-filament	Single strand core found in some wire.
short-circuit	In a circuit, often as the result of a solder bridge, electricity will flow in the shortest path back to the battery.
resistance	How effective a conductor a material or component is.
semi-conductor	A component that allows current flow only under certain conditions, such as a transistor.

How to Read a Resistor

The fourth band tells you the tolerance % of the resistor. Gold is 5%. Silver is 10%. **Always on the right!**

The first band is a numerical value. Brown = 1

The second band is a numerical value.

Green = 5

The third band is the multiplier- how many zeros the value has. Red = 2 (00)

1 5 00 Ω ± 5%

0 1 2 3 4 5 6 7 8 9

Wasting in Electronics Design

Etching is a chemical process for PCB (printed circuit board) production that requires photo-sensitive copper board for best results. A design is produced and then 'photographed' onto the copper board before the board is placed in an acid bath. Only the circuit remains on the board. Effective for one-off high-quality PCBs.

Wasting using CAM in electronics.

Milling a PCBs is a quick and clean method of manufacture, ideal for batch production or one-offs. A CAD file is designed before being used to control a CAM milling machine to waste unwanted copper from a copper clad board.

Key Words

Printed Circuit Board (PCB) A hard-thermoset plastic board and copper circuit. Holes are drilled for components to be mounted on the reverse side.

Batch production manufacturing processes are planned so that a limited number of the same product can be manufactured.

Computer-Aided Design (CAD) Computer applications are used to support the design development of a product or component, such as PCB design.

Computer-Aided Manufacturing (CAM) A design file is used to control the machinery that creates a part or whole of the product.

Addition in Electronics Design

Electronic project 'bread-boards' are a practical method of creating functioning prototype circuits and developing them. Components push-fit into the board and are connected via a metal rail inside the casing. Extra boards can be joined using mono-filament wire for modular circuits.

Soldering is a permanent addition method for electronic components. Solder is a soft alloy usually made from copper and tin. An added substance, called flux, allows the solder to flow over the components to give a good join.

Soldering irons can be gas or electric. In schools, they are electric. Care must be taken to make sure the lead does not trail across the soldering area or off the desk.

A few components can be joined directly together, such as these LEDs in series. A heat-sink, such as a crocodile clip must be used.

Circuit boards can be created by adding adhesive copper strips to card or MDF. Components can then be surface mounted onto the copper with solder.

Veroboard (or stripboard) addition is suitable for one-off prototype circuits. Components are added on the blank side and soldered on the side which has copper 'rails'. The rails can be joined either by wire loops, components or a blob of solder. They can be 'broken' by removing part of the copper with a drill.

PCB component addition:

Once the holes for the component legs are drilled, the component is mounted on the blank side of the board and the legs are soldered in place on the printed circuit side.

Surface mount components:

Many commercial circuit boards have their components mounted directly onto the circuit side of the board. This method saves space as there are no holes to drill. Found in mobile phone technology.

Addition using CAM in electronics:

A CAD file can be quickly converted into a PCB using a cutter/plotter. Special adhesive-backed copper foil is loaded into the machine which then runs the program in exactly the same way as if it was on card or paper. It has to be very carefully transferred to card or a blank PCB. Holes can then be pierced or drilled for components to be mounted and soldered.

GCSE D&T Knowledge Organiser

Briefs, Specifications, ideas and development

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Design Briefs

A Design Brief is the statement of how you will solve the Design Problem
It will often include:

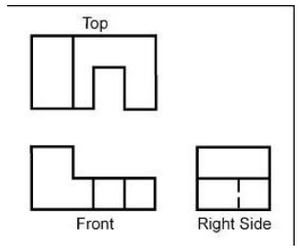
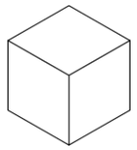
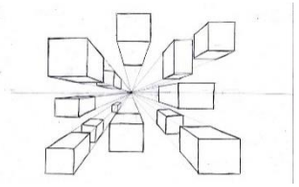
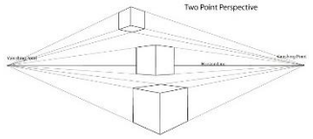
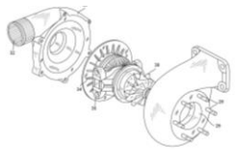
- Constraints/ limitations
- What the product is
- Materials/processes
- Any key information you know

Design Specifications

A Design Specification is a list of requirements your product has to meet in order to be successful

It is also useful for evaluation. If your product hasn't met the Spec then it gives you a starting point for improvements.

Aesthetics	What the product looks like? Style? Colour Scheme? Design Movement?
Customer	Who would buy it? (Age, gender, socio-economic, personality) How does the design appeal to them?
Cost	How much will it cost? (min-max) Why?
Environment	Where will it be used? Why? How will you make it suitable?
Safety	How is it safe? How will it be checked? Why must it be safe?
Size	What is the maximum or minimum size? Why?
Function	What does the product do? What features make it do that function well? How is it unique from similar products?
Materials	What is it made from? Why?
Manufacture	How might it be made? Why? What scale of production? Why?

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	

Modelling and Development

Modelling and development are key to testing and improving products
This can be done physically using materials like; card, foam, clay, man-made boards or virtually in **CAD**
Modelling helps the designer get feedback from the customer, check aesthetics, function, sizes and even materials and production methods and change them if needed

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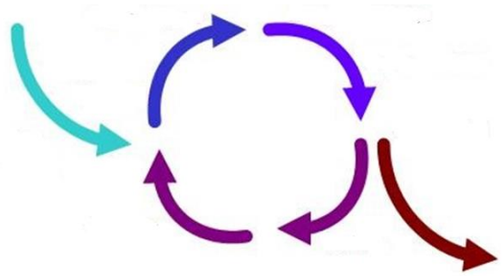
Design Strategies

Design Strategies are used to solve **Design Fixation**, and help develop creative design ideas.



Iterative Design

- A Proposal is made
- It is then planned and developed to meet the brief
- It is analysed and refined
- It is then tested and modelled
- Then evaluated against the brief – many versions fail but that then informs development to make the idea better
- The cycle then repeats and if the product is successful it is then made and sold on the market

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

User-Centred Design

- This is when designs are based on fulfilling the needs and wants of the Users/ Clients at every stage of the design process
- Questioning and testing is ongoing and is often found through interviews, questionnaires, surveys, 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

Systems Approach

- Usually used for electronic products
- Often uses diagrams to show systems in a visual way
- Planning the layout for the correct sequences e.g. inputs, outputs, timings, etc
- Electronics and mechanical systems need an ordered and logical approach

Systems Approach	
Advantages	**Disadvantages**
• Does not need specialist knowledge • Easy to communicate stages • Easy to find errors	• Sometimes over-simplifies stages • Can lead to unnecessary stages

Collaborative Approach

- Working with others to share data and solving problems and coming up with design proposals can help with creativity
- Numerous companies work in teams, and has been shown to improve the range and quality of ideas produced

Collaborative Approach	
Advantages	**Disadvantages**
• Gets multiple opinions and a range of views • Working in groups can produce more ideas	• Can be difficult to design ideas with opposing views • Can be difficult to find time to communicate with multiple people