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GCSE DESIGN & TECHNOLOGY

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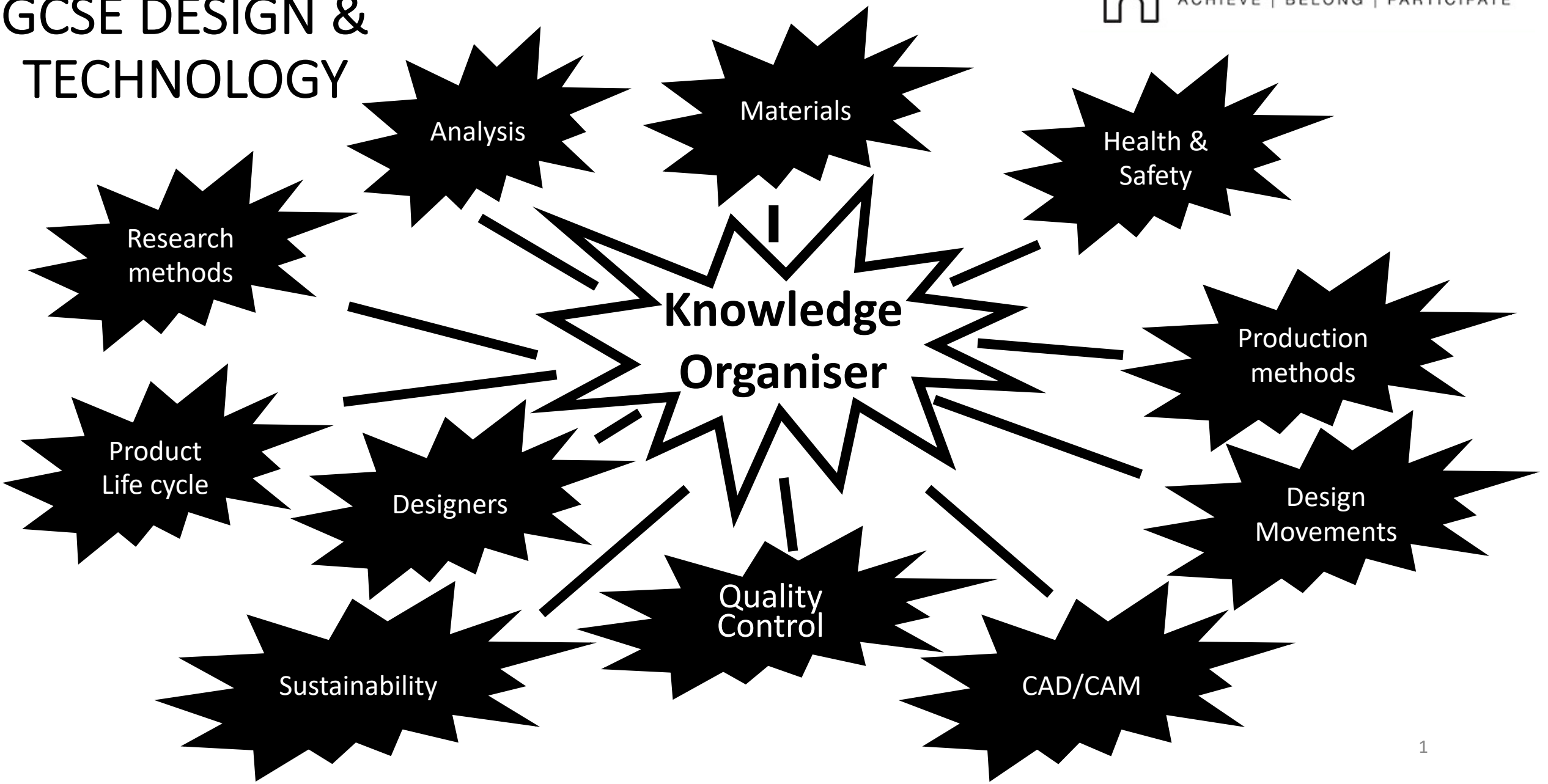

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Revision checklist. Ensure you have covered all the topics below to give yourself the best chance of performing well in the examination.

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Topic	Page number	Tick when completed		Page number	Tick when completed
Timber	3		Manufacturing processes (Polymers)	18	
Manufacturing processes (Timber)	4		Selection of materials	19	
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Materials & Their Properties

Timber

Natural timber: *General name for wood materials. Properties can change according to direction of grain. At the end of its life, wood can be burnt as fuel or broken down into fibres. Wood is biodegradable.*

Hardwood: *Come from trees that shed their leaves each autumn.*
OAK: Very strong and hard, easy to work with, open grained light brown colour. Use in furniture.
BIRCH: *Hard but easy to work with. Close fine grain, very light brown colour. Furniture and turned items*
ASH: *Tough and flexible. Open grained, light and creamy brown colour. Tool handles, ladders, pool cues*
MAHOGANY*: Fairly strong/durable. Some interlocking grain, reddish colour High quality furniture*
BALSA: *Soft. Off white colour. Used in modelling*

Softwood: *Come from coniferous trees. They keep their leaves all year round. They grow faster than hardwoods. They have a more open grain and also typically cost less. Softwood trees can come from managed forests. As they are cut down new ones are planted. They are a renewable resource.*
PINE: *Strong and durable, easy to work with. Straight grained, yellowish colour. Used in construction and furniture*
LARCH: *Tough, water resistant and durable. Straight or spiralled grain. Yellow/brownish colour. Used in boats, exterior cladding*
SPRUCE: *Strong and hard. Lo resistance to decay. Yellowish colour. Used in construction*

Standard form & Sizes

Trunks are cut into planks in a saw mill. Planks are limited by size of tree. Planks are available in range of sizes, lengths, widths and thicknesses. They can be rough cut/sawn or PSE planed square edge. PSE sizes are smaller than rough cut as they have been made smooth. Wood can be seasoned. (Dried to remove moisture) This makes the wood less likely to bend/warp. Wood can also come in variety of sections that have been shaped called mouldings.

Manufactured Timbers

These are made by gluing layers of wood fibres/veneers together.
They often use waste materials from the cutting of timber.
Top layers are often a high quality wood to give a good look or added protection. Manufactured boards come in very large sheets. Common sheet sizes are (8ft by 4ft).
Sheets are available in standard thicknesses (3 , 6, 9, 12, 15 etc…)

MDF (Medium - density fibreboard): *Made from fine wood particles combined with glue. Smooth and easily machined. Used in furniture*

PLYWOOD: *Layers of Veneer cut or shaved from timber and glued at 90 degrees to each other. Interior and exterior grades available. Used in furniture and boat building*

CHIPBOARD**:** *Made from chips of timber mixed with glue and pressed together. Often covered with a laminate or polymer such as Melamine Formaldehyde. Used for cupboards and kitchen worktops.*

Key Words
You must know the meanings of the key words below:
grain
hardwood
softwood
veneer
Key Point
Hardwood/Softwood refer to the type of tree that the wood comes from and not the properties
Manufacture boards offer consistent properties as they come in sheet form.
You must be able to:
Explain the difference between hard and soft wood
Describe the characteristics and common uses of a variety of timbers.
Explain hw timber is converted to usable material

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Wasting, addition & deforming/reforming processes

Tools Equipment & processes

Manufacturing Processes 2: Timber based materials

Wasting Processes typically carried out by hand:

Sawing tools:
Tenon saws used for straight cuts

Coping saws, fret saws and jig saws used for cutting curves



Band saws used for cutting straight lines

Circular saws for cutting straight cuts in large pieces of timber

Chisels
There are four chisels
Bevel edge for corners less than 90 degrees
Firmer chisel for general waste removal
Mortise chisel for joints and deep holes
A gouge for carving




Planning
This uses a wedge shaped blade to shave off thin layers of wood.
Jack plane is used to reduce timber size

Smoothing plan used to smooth surface

Block plane used on end grain

A rasp can remove large amounts of wood when sculpting or carving shapes

Smoothing
Can be done by sanding using abrasive glass paper wrapped around a block. This can also be done using belt, disc or bobbin sanders.



Wasting processes typically carried out using machines:
Thin layers of manufactured board can be cut using the laser cutter.

Wood can be turned into round shapes using a lathe. E.g bowls and table legs

Drills make holes by clamping material tightly and boring in a clockwise direction. This can be done with portable power drills or a fixed pillar drill

A planer thicknesser cuts timber to size with a rotary blade .

Computer numerically controlled (CNC) routers make grooves and decorative edges.

Addition processes:
Timber can be permanently bonded(stuck) using (PVA) glue

Laminating can be used to create curved wooden shape. Adhesives are applied to thin layers of wood clamped into a mould or former. One the adhesive is dry the timber becomes rigid in the shape of the mould.

Deforming
Strips of timber can be bent by heating them in steam to make them pliable (soft/flexible). Once pliable they can shaped around a former until cool.

Reforming(Laminating)
Sheets glued together and shaped and clamped around former until dry.

Key Words
You must know the meanings of the key words below:
Turning
CNC
former
Key points
There is a wide variety of different wasting tools designed to carry out specific tasks
You must be able to:
Identify different processes and equipment used o manufacture products from timber based materials
Select an appropriate tool to carry out a process needed on timber and justify reasons for your choice

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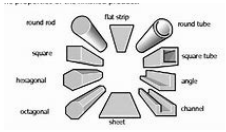
Materials & Their Properties

Standard Components

Stock Forms: *These are standard shapes/sizes in which material are available. To minimise effort designers try to use stock form or closet size that is required for their product that requires smallest amount of processing/changes.*



Reasons for using standard components:
They can be used in many different products.
Materials can be purchased in bulk reducing cost.
Processes can be automated speeding up the process.
Efficient use of labour
Consistency in quality of manufacture produced
Parts can be made in range of standard size.

Used with paper & board:
Clips 
Fasteners 
Rivets 
Sticky tape 
Bindings 

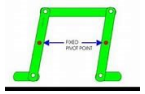
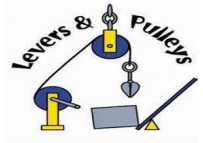
Used with timber:
Hinges 
Screws 
Handles, draw runners
Knock down fittings 
Brackets 
Nails 

Used with Polymers:
Caps 
Fasteners 
Nuts and bolts 

Used with Textiles:
Zips 
Sequins
Buttons 
Beads 
Poppers and studs 
Velcro 

Used with Metals:
Nuts, bolts, washers 
Hinges 
Rivets 

Electrical components:
Resistors 
Capacitors 
Diodes 
Switches 
LEDs 
Transistors 
Motors 
Micro controllers 

Mechanical components:
Levers
Pulleys
Linkages 
Gears 


Cams 
Belts 

Key Words
You must know the meanings of the key words below:
Standard component

Key points
Standard components are parts that are used in many different products
It is much cheaper to buy a standard component
You must be able to:
Explain why standard components are used
List standard components used with a variety of materials

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Tools Equipment & processes Pages 92 & 93

Scales of Manufacture

Scales of manufacture: *This is about making identical products. As the quantity increases the processes used may be the same but tolls and equipment may be different*

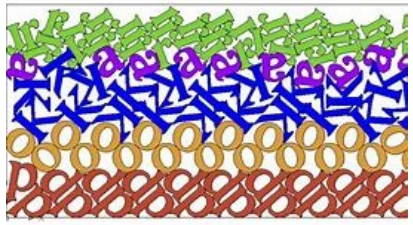
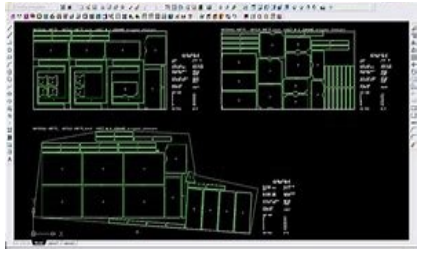



Type :	Characteristics:	Example:
One off/ bespoke production	*One product made for a specific customer. Usually takes a long time to make and high level of skill. High cost! £££££££££*	*A wedding dress, Wedding cake* 
Batch production:	*A group of identical products. Processes could be automated. Jigs might be used. Equipment set up costs are high.*	*Chairs, clothing from high street store* 
Mass production:	*Large quantities of identical products. Use of production line. Automated processes and dedicated jigs. Cost per product lower than batch manufacturing*	*Cars, Nuts & Bolts* 
Continuous production:	*Extremely large quantities 24/7. Typically used for chemicals or materials. Equipment and processes are fully automated with dedicated jigs and fixtures. Set up costs are very high. Cost per product low compared to other methods*	*Petrol, Steel* 

Influences of Quantity on Selection of Equipment:

ECONOMIES OF SCALE:
As quantities increase there are opportunities for getting bigger discounts, buying materials in larger quantities and reducing labour cots by using automated machines.
E.G If one person cuts one shape from card with scissors. A laser cutter/die cutter might be used instead to speed up manufacturing. Equipment costs more initially but is faster and labour is reduced so less money needed to pay workers. This has effect of reducing overall cost for products/companies

Material management:
Material used in manufacturing was be done so efficiently.
Most materials come in wide variety of shapes/sizes & different stock forms.
Designers use stock from to reduce machining/waste.
Designers tessellate shapes nested together using computers to reduce waste.

Key Words
You must know the meanings of the key words below:
One off/bespoke production
Batch production
Mass production
Continuous production
Economies of scale
Stock form
Key points
If a large quantity I manufactured total sot can be reduced by using automated equipment and less labour.
The quantity of products manufactured has a significant effect on equipment selection & manufacturing methods
You must be able to:
Describe different scales of production and give examples.
Explain why equipment changes with scales of production

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Approaches to Designing.

Designers

Name	Key facts
Harry Beck	*Designed the London underground map influenced by the layouts used in electronics. This has been copied with transport systems across the world*
Marcel Breuer	*Studied at the Bauhaus. Invented steel furniture inspired by bike handles. A famous example is the Wassily Chair*
William Morris	*A textile designer who was key player in Arts & Crafts. The movement was founded by the principles of traditional craftsmanship*
Charles Rennie Makintosh	*Scottish architect who influenced the Art Nouveau movement. He was inspired by Japanese architecture.*
Ettore Sottsass	*Founder of the Memphis design group in 1981. Designs incorporated symmetric shapes and colourful decoration*
Gerrit Rietveld	*Dutch architect and designer. He simplified designs to vertical and horizontal lines and used black , white and primary colours*

Design movements

Bauhaus
Key Features
Uniting art with craft and mass-production.
Form follows function.
Honest materials.
Minimalism.

Designers
Walter Gropius, Marcel Breuer

Art Nouveau
Key Features
The distinguishing ornamental characteristic of Art Nouveau is its undulating, asymmetrical line, often taking the form of flower stalks and buds, insects and other natural objects
Designers
William Morris, Louis Comfort Tiffany

Memphis
Key Features
A flat style that is often accented with bright, saturated colour choices.
Geometric shapes are the primary art element and few actual photos are used

Designers
Ettore Sottsass, Philippe Stark

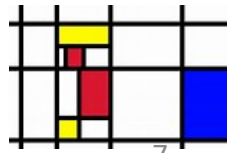
De Stijl
Key Features
De Stijl art mainly consists of the three primary colours (red, blue, and yellow), the three primary values (black and white) and horizontal and vertical lines.

Designers
Gerrit Rietveld, Max Bill, Mondrian

Key Words
You must know the meanings of the key words below:
Bauhaus
Arts and Crafts
Art Nouveau
De Stijl
Memphis

Key points
Understanding the work of past and present designers help new designers to inform their own work.

You must be able to:
Analyse the work of at least 2 different designers
Use the work of past and present designers to help develop your own designs



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Approaches to Designing.

Companies

Name of Company

Alessi

Apple

Braun

Dyson

Key facts about the company

Italian design company that produces household utensils Many products are post modern in style. An example is the Juicy Salif designed by Philippe Starck.

Company founded by Steve jobs, Steve Wozniak and Ronald Wayne in 1976. Famous for selling Macintosh personal computers. Later designed Imac G3, the ipod a portable music player and very popular Iphone. The first phone combined elements of the G3 and Ipod with a touch screen mobile phone.

German company founded by Max Braun in 1921. Well known for its popular shaving and grooming products and functional approach to design

British design engineering company formed by James Dyson in 1991 as a way of bringing his bagless vacuum cleaner ideas to market. By 2001 47% of all vacuum cleaners sold in UK were the Dyson brand.
Dyson vacuums are known for not loosing suction as they don't have bags and use cyclone dust separation.
Dyson now makes many different products including heaters, fans and hairdryers.

Name of Company

The GAP

Primark

Under Armour

Zara

Key facts about the company

The GAP is an American clothing company that trades globally.
It serves a broad target audience although initially it targeted a younger audience.
A lot of sales happen over the web with over 18 visitors in a year.

An international trading company with its main base in Ireland.
Low cost fashion
Lots of its clothes are made in places such as China, India and Bangladesh. It does not own the factories that it produces clothing in.

American sportswear company founded in 1996 by Kevin Plank, a former American footballer
They developed moisture wicking clothing that uses micro fibres to keep athletes cool/dry
They sell wide range of accessories/clothing

A Spanish company founded by Amancio Ortega and Rosalia Mera.
Known for selling products that respond to current trends. (JUST IN TIME approach to manufacturing)
Worked with Greenpeace in 2011 to eliminate toxins from its clothing

Key Words
You must know the meanings of the key words below:
Aesthetics
Fast fashion
Moisture wicking fabric
Key points
Understanding the work of design companies helps designers to develop their own ideas
You must be able to:
Analyse and evaluate the work of at least two different design companies.
Explain what was special abut the first iphone
Explain what James Dyson invented and what made I unique.
Explain what Under Armour sports wear is designed to do.
Explain what Zara began working on with Greenpeace in 2011.

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Social issues in the Design & Manufacture of Products

Approaches to Designing.

Ecological, environmental & Social issues

Effects of the use of raw materials

Deforestation. Trees removed and land converted to other uses. Loss of animal habitats & impact on climate change

Mining can cause erosion and contamination of soil. Sinkholes can be traced back to mining.

Oil is needed for plastics. Oil spills can have devastating effect on environment, killing wildlife.

Some raw materials used in bio fuels are farmed. Over farming and use of pesticides can contaminate land and kill wildlife

Carbon released from manufacturing can cause global warming

Designers must consider the distance their product travels from source to manufacture, distribution and final disposal.

Social footprint

Designers should consider how they design and manufacture their product to ensure it is made in a socially considerate way

Atmosphere pollution

This occurs when pollutant are released into the atmosphere. Air pollution has been linked to severe respiratory illnesses such as cancer and asthma

Oceanic pollution

This happens when chemicals and industrial waste is released into the oceans. This has a negative impact on marine life

Fairtrade

This helps people in developing countries get a fair deal for their product/produce.

Workers get paid a minimum rate even if global prices fall.

Receive a fairtrade premium that can be invested in education and health care.

People buy fairtrade because of its values

The Fairtrade Certification Mark show that it meets fair trade standards

FAIRTRADE

Key Words

You must know the meanings of the key words below:

Deforestation
Recycle
Atmosphere pollution
Oceanic pollution
Fair trade

Key points

Fair trade help people in developing countries get a fiar deal for the products that they produce

You must be able to:

Explain how the 6 R's can be used by designers to evaluate the impact of their products on the environment

Explain the benefits of fair trade for the producers and consumers of products

Explain what the potential impacts of oceanic pollution are.

The 6 R's

Reduce

How can the amount of materials and components used be reduced? Is the product really necessary?

Rethink

How can the design of the product be changed so its less harmful to the environment? Can a better way be found?

Refuse

Should the product be manufactured if it is not sustainably designed?

Is packaging necessary? Can it be removed?

Recycle

Is the product made using recycled materials? Could the materials be recycled once the no longer of use.

Reuse

Could the product be used in a different way once it no longer functions? Could it be taken apart and used to repair other products?

Repair

Is the product easy to repair?

Are replacement components readily available in case of failure?

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Designing products.

Research & Investigation

Market research
Information is collected to find out if there is a need of a product on the market
Interviews via face to face/internet discuss client needs

Focus groups
Group of people to assembled to test a product and give feedback. They are often consumers f the potential product

Product analysis
Designers learn from success/failures of previous/current products. They look at how they are assembled, function, wider impact on society and environment

Gathering data

ACCESSFM

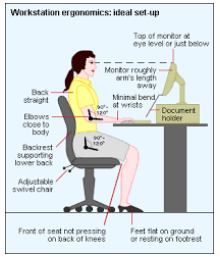
Primary data
Raw data taken first hand or from original research. This can be done through questionnaires, surveys, focus groups and then data is analysed

Secondary data
Data that is freely available that has been collected from other parties and sources. This could include using catalogues, datasheets and information about materials

Ergonomics

Definition:
In 3 words this is **human object interaction.** It is about understanding how people interact with products. It will consider things such as shape of hands, colour, sounds and weight of a product.

EXAMPLE
For instance a designer will consider the shape of a persons hand when they design a handle for a garden tool.



Anthropometrics

Definition:
The study of the human body and how it moves. It uses anthropometric data from the 5th percentile(smallest) to 95th percentile (largest). By doing this it ensures 90% of the population are catered for.
Anthropometric data is measurements taken from the population of millions of people of different sizes and is placed in charts to help design products

Uses:
For example when designing a bike helmet designers will use the head circumference of people to make sure it is correct size.

Key Words
You must know the meanings of the key words below:
Market research
Primary data
Secondary data,
Ergononomics,
Anthropometric data

Key points
Designers use anthropometric data to ensure dimensions are correct

You must be able to:
Explain what is a focus group
Explain the difference between primary and secondary data
Explain what ergonomics is.
Explain what ergonomics is.
Explain the difference between the 5th, 50t and 95th percentile. 5th is smallest/shortest, 50th is average and 95th is the tallest, biggest and heaviest.
Explain how ergonomics/anthropometrics helps in the design of products

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Storing energy

Energy generation & Storage Pages

Non renewable energy sources

Definition: *Sources that will eventually run out. Fossil fuels & nuclear power.*

Fossil fuels: *Remains of dead organisms. E.g. coal, oil, natural gas.*
They can be burnt to create steam/power to turn turbines and create electricity.
Burning fossil fuels releases carbon dioxide. Global warming
They will run out but are easy to find and generate large amounts of electricity.

Nuclear power: *Steam needed to drive turbines is created in a nuclear reactor.*
Nuclear fission uses uranium to create heat.
This is non renewable!
Nuclear power means less need for fossil fuels They can be very dangerous (radioactive waste can cause health problems.)Waste can stay hazardous for thousands of years.

Renewable Energy Sources

Definition: **Sources that will not run out. (Sustainable)They can replenish themselves. E.g solar, wind, hydro electric, tidal and biomas**

Solar: *Solar panels(Photovoltaic cells convert sun energy into electricity. Sunlight will not run out for billions of years. No waste products/ gasses are emitted. Installation costs are high. Don't work at night*

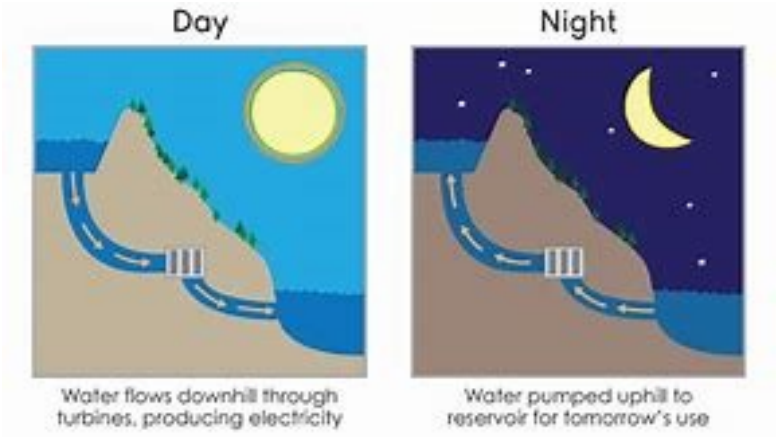
Wind: ***T****urbines catch wind and turn this into energy. Energy depends n wind so need to be carefully positioned. No waste o gasses. Can be noisy and could make landscape look ugly*

Hydro electrical: *To harness energy water is held in a dam before being released thus turning turbines to create energy. Clean and sustainable. Dams can destroy habitats and cause flooding. It harnesses energy from the sea.*

Biomass: *Fuel created from crops, scrap wood and animal waste. Readily available Biomass crops use up carbon dioxide. Can be very expensive way of producing energy*

Purpose:
Batteries convert energy into electricity. Rechargeable batteries are popular as can be used lots of times reducing costs and waste for landfill.

Kinetic pumped storage systems
Store energy in water for. Usually this is pumped from lower reservoir to a higher reservoir. During times of high demand this can be released to turn turbines & create extra energy



Key Words
You must know the meanings of the key words below:
Non renewable energy
Source
Fossil fuel
Nuclear power
Renewable energy
Solar energy
Wind energy
Hydro electrical energy
Biomass
battery

Key Points
Renewable energy can be replenished quickly and will not run out.
Energy can be stored using batteries and kinetic pumped storage systems

You must be able to:
Describe how energy can be generated and be stored.
Explain the advantages/disadvantages of using renewable energy sources to power products and systems.

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User-Centred Design

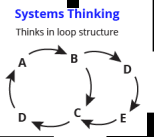
Approaches to Designing

Design Strategies

Iterative design
Cyclic approach
Each idea is tested/ evaluated leading to new ideas
Dyson vacuum cleaner DC01. 1000s of prototypes

User - Centred Design
Needs/Wants considered at each design stage

Systems Thinking
Top down approach.
Often used with electronic, mechanical systems.
Considers inputs, outputs and processes involved



Advantages
User involved feels listened to. Has ownership of final product.
More likely final product will meet users needs

☺

Disadvantages
Need time to meet and discuss ideas with user
Product may not suit wide audience limiting end use and profit

☹

Key Words
You must know the meanings of the key words below:
Iterative design
User-centred design
Systems thinking
Design fixation

Key points
User centred design considers the needs and wants of the end user at each stage of the design process

You must be able to:
Describe the main features of iterative design, user centred design and a systems approach to design.
Explain the advantages and disadvantages of each system

Iterative Design

Advantages
Problems are considered/discovered earlier & dealt with quickly
Focuses on most critical aspects
Feedback constantly gathered and used
Evidence can be provided early in process for stake holders to support decision making

Disadvantages
Lose sight of end goal as can be over reflective
Prototypes are time consuming and expensive

Systems thinking

Advantages
Does not require highly specialist knowledge
Easy to communicate system to non specialists, clients & stakeholders
System designed in blocks. Easy to fault find

Disadvantages
Can lead to unnecessary components being used
Can lead to larger systems and extra cost if planned incorrectly

£££££££
£££££££

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Materials & Their Properties

Metals

Making Metal: *Metal ore is extracted from the ground by mining/quarrying. The metal is refined from ore by using heat and a lot of energy. This can happen through electrolysis or using chemicals to remove unwanted elements. After refining metals are melted and cast into products and shaped into stock forms. They can be treated to soften metal by annealing which softens the metal and improves its malleability. Metals can be recycled by melting.*

Ferrous Metals: *Contain iron. They are commonly used with other metals. They have a melting point of 1600 C or higher. Most ferrous metals are prone to rust and corrosion and can be picked up by a magnet.*

Cast Iron: *Hard & compressive strength. Engine mounts, pipes, cookware*

Low carbon steel: *Tough, easy to machine. Nuts and bolts, car body panels*

High carbon steel: *Strong & hard. Springs, high tension wires*

Non – Ferrous Metals: *Do not contain iron. They have good resistance to corrosion and do not tarnish. They are not magnetic.*

Aluminium: *Light weight, strong. Drinks cans, cooking pans*

Copper: Conducts heat/electricity. Wiring & water pipes

Tin: *Soft & malleable, corrosion resistant. Tin cans, solder*

Zinc: *Hard & brittle. Low melting point. Coating for Steel*

Common Alloys

An alloy is a mixture of 2 or more metals. They can be ferrous or non ferrous. They have better properties than a pure metal.

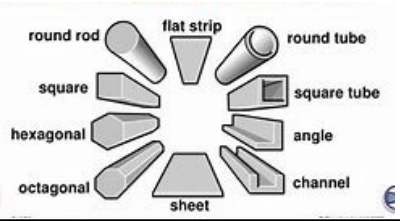
Brass: *Copper and Zinc. Low friction, corrosion resistant, malleable. Used in locks & musical instruments*

Stainless Steel: *Iron & Chromium with small amount of Carbon. Tough , strong, corrosion resistant, difficult to machine. Used in kitchen equipment & medical instruments.*

High Speed Steel: *Iron with small amounts of carbon, tungsten, Molybdenum, Vanadium and Chromium. Very hard even at high temperatures. Used for saw blades, drill bits, files & wood turning tools.*

Stock Forms

Metals come in standard shapes including, sheet, rod, square bar and tube.
They come in standard sizes , lengths, thicknesses.
Metal Ingots can be melted into standard shapes.



Key Words

You must know the meanings of the key words below:

Ferrous metal
Non – ferrous metal
Alloy

Key Point

Alloys are designed to have better properties for an application than just using a pure metal.

You must be able to:

The difference between ferrous and non ferrous metals.
Describe the characteristic properties and common uses of a variety of metals.
Explain how metal ore is converted into usable material

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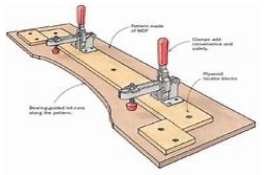
Tools Equipment & processes

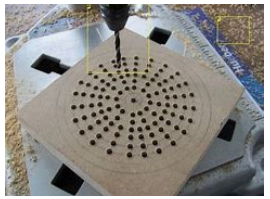
Measurement and Production Aids

Measurement and Reference Points:
Measurements can be taken from a datum surface, or reference point, product, or angle.
Sometimes 2 datum surfaces are used at right angles to complete a measuring task.
Sometimes a datum surface can be created on a material. E.g. A file can be used to create smooth surface on metal.

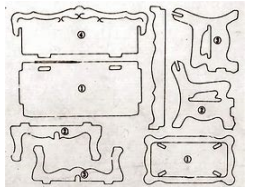
Production Aids:
To achieve precision, aids are used. The main aids used in Design & Technology are jigs, templates and patterns. These are known as production aids.
Production aids are often used in batch production
The use of CAM (Computer aided design) and CNC (Computer numerical control) means the use of jigs, templates and patterns are less widely used.



Jigs:
Jigs are tools used for repeatability and accuracy in manufacture.
They ensure things are made exactly the same without the need for marking out.
They can be used for things like drilling holes or holding wood in position to be cut. PCB jigs can be used to fault find in electronics



Templates:
Templates can be drawn or cut around repeatedly.
They are useful when creating identical shapes
They can be made from inexpensive material. (cardboard, newsprint, MDF)



Patterns:
There are two types used in technology.
Textiles patterns
Usually paper or card. Used to trace garment parts onto fabric before cutting out. Being a specialist pattern maker is a highly skilled job.

Casting patterns
Used when casting metal or plastic resin. Used to prepare cavity where molten material will be poured. It is a replica of the product that will be cast. It can be made from wood & plastic.

Key Words
You must know the meanings of the key words below:
Datum surface
Jig
Template
Pattern

Key points
Textiles or fabric patterns are used to trace parts of a garment onto fabric.

Production aids are used to ensure accuracy and precision in manufacturing

You must be able to:
Explain the importance and meaning of reference points used in measuring.
Explain the reasons why production jigs are used.
Describe how jigs, templates and patterns are used in manufacture

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Tools Equipment & processes

Ensuring Accuracy

Difference between accuracy and Precision

Accuracy is the degree of closeness to a true value, measurement or standard.

Precision is how repeatable the measurement is.

It is possible to be accurate but not precise and vice versa

Why is accuracy important?

Accuracy is very important when manufacturing products/prototypes
A working drawing/specification will provide dimensions (sizes). If you don't stick to the working drawing/specification things may not function. This could cause the product to be remade. Meaning extra cost, time and labour.

Tools that improve accuracy

Jigs, templates and patterns are used in batch production to ensure accuracy. The use of CAD (Computer aided design) and CAM (Computer aided manufacture) also helps be more precise.

Tolerance:

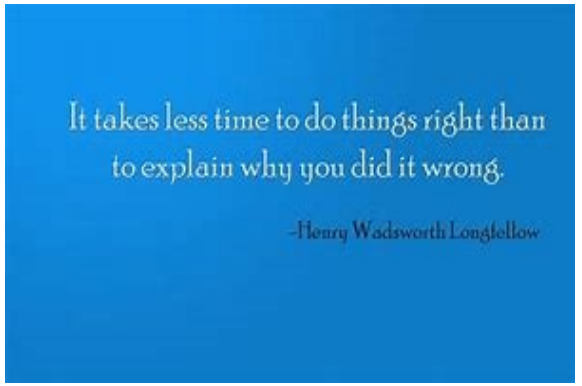
Tolerance is permissible limits of variation of a part /product. This would normally be found on a cutting list/product specification
Not considering tolerances can lead to poor fits, wasted material and additional cost if having to remake a product.
Another example is electrical components. Using an incorrect component could result in the product not functioning correctly or stopping operating after a period of time.

Quality Control:

Quality control *is product orientated. It is about checking a product meets quality standards set by a specification*

Quality assurance *is about putting systems in place to ensure quality in the manufacture of a product. E.g. Training staff to use equipment or servicing machines and equipment.*

She says she's from Quality Control. We've failed the furniture inspection.



Key Words
You must know the meanings of the key words below:
Accuracy
Precision
Tolerance
Quality Control
Quality assurance

Key points
Taking tolerances into account reduces the likelihood of improper fits or manufactured parts

It is possible to be accurate but imprecise

You must be able to:
Explain the reasons why accuracy is important when manufacturing products and prototypes

Explain the meaning of quality control/quality assurance.

Explain the importance of tolerances when manufacturing products

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Materials & Their Properties

Polymers

Making Polymers: *Polymers are made from chains of monomers in a process called Polymerisation. Most polymers are synthetic made from oil. The oil is refined and separated into different chemicals by fractional distillation. Chemicals are broken down by a process called cracking. Fossil fuels are a finite resource. Extracting them can have impact on environment. Some polymers break down under sunlight. (UV light).*
To resist this chemicals are added that will not degrade

Thermosetting Polymers: *Thermosetting polymers cannot soften when heated but may char. They have permanent chemical bonds. They come as resins (liquid) or powder. They are cured (set) with other chemicals to create the polymer. They cannot be reused and end up in landfill at the end of their life.*

Types of Thermosetting Polymers, Characteristics & typica uses:

EPOXY RESIN: Made by mixing chemical with hardener. Hard and resists well to chemicals Used as an adhesive e.g. Aradite

POLYESTER RESIN: Made by mixing resin with hardener. Can be reinforced with glass fibre (GRP). Stiff hard and brittle. Used on car bodies and boats

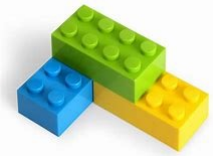
UREA FORMALDEHYDE: Hard, strong & good insulator. Used on plug sockets and switches

MELAMINE FORMALDEHYDE: Hard, resists some chemicals. Used for kitchen worktops and cupboards

PHENOL FORMALDEHYDE: Hard, high strength to weight ratio. Excellent flame resistance. Used for snooker balls, countertops, coatings & adhesives

Characteristics & uses

Thermoforming Polymers: *Thermoplastics. Soften when heated and shaped when hot. Can be reshaped if heated again. Available in sheets 1.5, 2 mm etc.. They also come as films, foam or rods in different lengths/thicknesses.*
They are available as pellets for injection moulding and powders for dip coating. They can be sorted and recycled



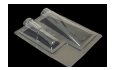
Types of Thermoforming Polymers, Characteristics & typical uses:

PET(Polyethylene erephthalate) Transparent used for blow moulding & vacuum forming. Softens at 80C. Used for drinks bottles & food packaging

HDPE (High density polyethene) Strong & stiff softens at 130C, Used for bowls, pipes & buckets.

PVC (Polyvinylchloride) Stiff, hard wearing softens at 100 -125C. Used in pipe, packaging.

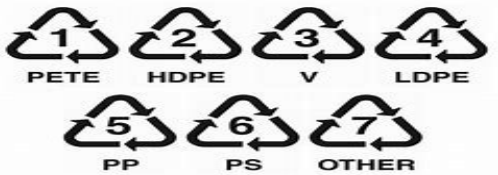
HIPS (High impact polystyrene) Light, strong, used for vacuum forming. Used for blister packaging



PP (Polypropylene) Tough & flexible. Used for carpets and ropes

PMMA(Polymethylmethacrylate) Commonly known as Acyrilc/Perspex. Hard wearing. Used for baths, windows & signs

Recycling symbols:



Key Words
You must know the meanings of the key words below:
Polymer
Synthetic
Fractional distillation
Cracking
Finite resource
Thermosetting
Thermoforming

Key Points
Thermoforming polymer can be reshaped/recycled.
Thermosetting cannot

Most synthetic polymersare made from non renewable fossil fuels

You must be able to:
Explain how polymers are converted into materials
Explain the difference between thermosetting and thermo forming polymers
Describe the properties of polymers
Describe forms of different polymers.
Describe what happens at the end of their lifes.

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Reinforcing materials

Materials & Their Properties Pages 80 & 81

Working with materials

Meting the properties needed by a Product:
Properties of individual materials can sometimes be modified/changed to improve them.

Sometimes a material will meet lots of requirements for a product but not all of them.

Sometimes a product has to be modified to satisfy the applications of the material available

Examples of how material properties can be modified:
Additives added to paper/board to prevent moisture transfer. E.g food packaging

Timber can be dried to reduce warping. (bending)

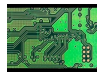
Annealing can soften metal making it less hard allowing the grains in micro structure to grow.

Aluminium can be anodized making it harder.

Stabilizers can be added to polymers to stop them becoming brittle. Useful in windows!

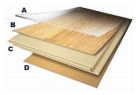
Flame retardants can be added to textiles to reduce the risk of fire hazards.

Photosensitive board can be used for making PCB boards. This way using chemicals and light unwanted Copper can be removed



Reinforcing the design to enhance performance:
Products can be reinforced/stiffened or even made more flexible
Reinforcement allows part of a product to be stiffened or have greater strength. This can lower the weight and price of a product.

Methods of reinforcement:
Bending/folding and lamination can all increase stiffness and thickness of material. This can be used with most sheet materials, paper, card, fabrics and metal



Webbing are ribs of material used to increase stiffness of a product. E.g A battery casing

Interfacing is used in textiles to increase strength of a product. In shirts, collars are made stiff/rigid using interfacing placed onto the wrong side of the shirt.

Key Words
You must know the meanings of the key words below:
Reinforcement
Webbing
Interfacing
Key points
The properties of some materials can often be enhanced to make them suitable for specific applications
The method used to enhance the properties of a product depends upon the type of product, what it is made from and what properties are needed.
You must be able to:
Explain why reinforcement is used in products
Describe how the properties of a material can be enhanced
Describe a range of examples of how products can be modified to improve performance.

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Tools Equipment & processes Pages

Manufacturing Processes: Polymers

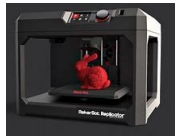
Wasting Processes:
Thin sheets of Polymers can be sawn using coping saws , fret saws and band saws.

Holes can be drilled using power drills or pillar(pedestal) drills

Addition processes:
Solvent cement is an adhesive. It can bond (join polymers). It dissolves the surface to mix/join them so they solidify together.

Thermoplastics can be welded . The faces can be heated using an electrical welding gun or hot plate. On melting of the surfaces they are pushed together forming a joint as they cool.

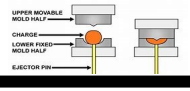
3d printing involves printing out a CAD(computer aided design model). A complex Shape can be made in a single operation. Instead of using numerous machines. The 3d printer deposits material one layer at a time until the item is finished.



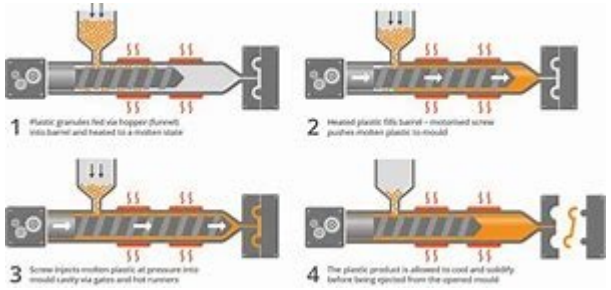
Deforming and Reforming:
Bends can be made in thermo plastics using a line bender. This heats just the area where the plastic is needed to be bent. The plastic once hot can be bent against a former or jig until it cools and goes rigid.

3D products can be made using a vacuum former where the plastic is heated around a mould and then the air around the mould is sucked out of the former.

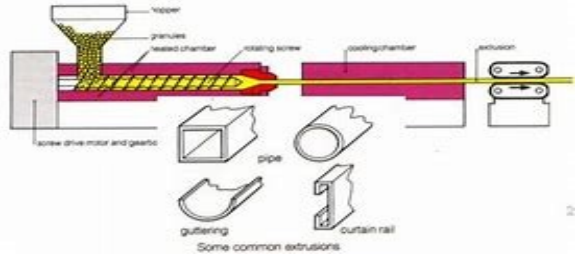
Yoke/Press moulding heats plastic sheet until it is flexible. It is then pressed between a mould and yoke. Once cool it retains the shape of the mould.



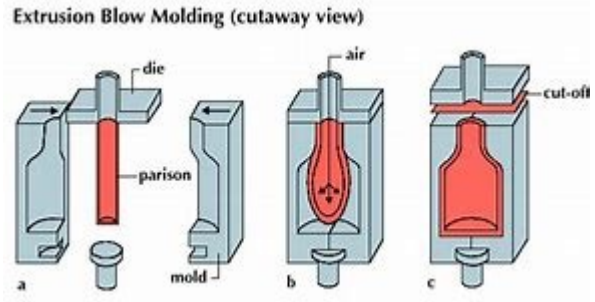
Injection moulding:
Plastic powder/granules are fed into a hopper. Heaters melt the plastic as a screw moves it towards a mould. This is forced into the mould and pressure maintained until cooled.



Extrusion:
Similar to injection moulding without using a mould. The plastic is forced through a die in a continuous stream to create long tubes/sections.



Blow moulding:
Similar to extrusion. An air supply and split mould are used to make hollow products such as bottles.



Key Words
You must know the meanings of the key words below:
Line bending
Moulding
Vacuum forming
Injection moulding
Extrusion
Blow moulding

Key points
Most industrial polymer moulding processes use reusable metal moulds and are designed to make large quantities

You must be able to:
Identify the processes and equipment used to manufacture products from polymers
Select an appropriate tool to carry out a process needed on a polymer and justify your choice

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Materials & Their Properties

Selection of Materials

Functionality and choice of material:

Material has functionality, mechanical & physical properties needed for what it has been designed for.

Designers consider products and how they can be manufactured from the material.

Designers also have to consider customer needs.

Factors affecting material selection:

Aesthetics (looks) colour, texture and finish

Environment. Can the product be recycled or reused.

Availability of materials. Location and stock form.

Costs. Can materials be bought in bulk. Discounted prices.

Social Factors. For example not using a material for its environmental impact or for political reasons.

Ethical considerations: Eg fair trade products , not using parts made in sweat shops. Using wood from managed forests. (FSC) Forestry Stewardship Council. Trees are replanted for everyone cut down.

Cultural factors, such as fashion or religious beliefs.

Properties required in commercial products:

Type of material	*Product*	*Properties*
Paper and boards	*Flyers and leaflets*	*Can be printed onto.*
	Food packaging	*Absorbency, ability to be printed on, aesthetics & cost*

Type of material, Commercial product and important properties

Timber based materials	Children's toys	Aesthetics/looks that appeal to children Resistance to corrosion . Toughness in case dropped. Hardness to resist scratches
	Flat pack furniture	Toughness to resist damage. Hardness to resist scratches.
Metals and alloys	Cooking utensils	Thermal conductivity so heat will go through. Resistance to corrosion. Malleability for ease of making. Hardness to avoid scratches. Density, lightweight so easy to lift.
	Hand tools	Strength, toughness, to resist impact. Malleability, ability to be shaped into tool.
Polymers	Seating	Compressive strength to support weight of person. Resistance to corrosion. Lightweight so can be lifted easily
	Electrical fittings	Electrical conductivity, Insulation to protect user. Toughness so doesn't break. (Safety)
Textiles	Sportswear	Aesthetics that appeal to user. Hardwearing so lasts long time. Non flammable
	Furnishings	Aesthetics to appeal to user. Hardwearing to last. Non Flammable
Electronic and mechanical systems	Motor vehicles	Toughness so doesn't rea on impact Lightweight to reduce fuel use Resistance to corrosion Hard so lasts a long time
	Domestic appliances (fridges etc..)	Resistance to corrosion Strong to support weight and resist damage Electrical conductivity. Should be insulated to prevent electric shocks.

Key Words

You must know the meanings of the key words below:

Functionality
Aesthetics
Sustainable

Key points

Selecting material is not just about material properties

You must be able to:

Describe a wide range of factors that can influence choice of material for a product.

Explain the important properties required by commercial products.

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Typical Relative Properties of Materials

Materials & their properties Pages 62 & 63

Paper & Board

Sources and Disposal

Paper and card are made from cellulose fibres from wood and grasses.
Chemicals are added to produce a surface finish or texture
Wood pulp can be sourced from managed trees (This is where new trees are planted to replace those that are cut down).
This helps reduce environmental impact (damage)
Most card and paper can be recycled by being processed and mixed with wood pulp.
Recycled paper cannot be used for food packaging.
Paper will biodegrade
Foil lined board is a composite and cannot be recycled


Wood is cut/debarked


wood is pulped


chemicals added


mesh


roll paper

Standard Sizes and Forms

Paper is available in sheets or rolls
Sheets of paper come in standard sizes
A6 is smallest size, A0 is the largest size
Paper is weighed in gsm. The higher the number, the thiscker the paper is.
Paper is normally 80 gsm.
Card is normally 200 gsm or more.

Types of Paper and Board

Type	Properties	Uses
Layout & tracing paper	Translucent. 50-90gsm	Working drawings & tracing
Bleed proof paper	Smooth, resistant to ink to stop seeping, sharp images 70-150gsm	Printed leaflets & with felt tips
Cartridge paper	Cream, lightly textured 100-150 gsm	Drawing & painting
Grid paper	Squares & grids 60-100gsm	Sketches & model making
Corrugate cardboard	2 or more layers. Good strength to weight ratio 250 gsm	Boxes & packaging
Duplex board	White , tough & lightly textured. Can prevent moisture transfer	Food packaging
Foil lined board	Aluminium stuck to cardboard	Drink cartons, ready meals
Foam core board	Polystyrene centre, paper either side	Archtectural models
Solid white board	High quality board	Book covers
Inkjet card	Strong card, often coated	Greeting & business cards

Key Words
You must know the meanings of the key words below:
GSM
Ply
Biodegradable

Key points
Paper and card can be recycled, however composites added to paper mean this type of paper cannot normally be recycled E.G Foiled line board cannot be recycled

You must be able to:
Explain that paper and card have different thicknesses for different functions

You must be able to:
Explain what card is good for printing on.
Explain what gsm stands for?
Why recycled paper cant be used for duplex board

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Materials & Their Properties

Textiles

Fibres and Fabrics: *Fabric is made from fibres. These are hair like and range in size. From short staple fibres to continuous and long filaments.*
Individual fibres are weak. They are spun together to from **yarn.**
Fibres can be treated to make them flame proof. (fire retardant)

Fabric Construction: *Knitted fabrics are interlocking loops arranged across a warp & weft.*
Woven Fabrics are interlaced yarns. It is strongest along the straight grain but lacks elasticity
Woven fabric has a selvedge that will not fray. Fabric will fray once cut.
Non woven fabric (felt) are entangled fibres.
Non woven fabric are made using chemicals to mat them together with heat (bonding)or by stitching. (interlocking)



Natural Fibres: *Come from animals or plants*
Animal fibres include wool, silk, alpaca, angora, camel, hair, cashmere & mohair
Plant fibres include cotton, linen, jute & hemp
Natural fibres are bio degradable



Synthetic Fibres: ***Are made from chemicals. (typically oil) Oil is a fossil fuel. Oil is processed to extract chemicals needed for the fibres. Typically synthetic fibres do not bio degrade.***

Characteristics & Properties

Natural fibre, characteristics & properties:
COTTON: From seeds of cotton plant. Strong, cool, durable, absorbent & creases easily. Used in Denim, calico, t shirts, underwear.

WOOL: From sheep. Warm , soft, absorbent and crease resistant. Used in felt, jumpers, suits, carpets.

SILK: From cocoon of silk moth. Smooth, lustrous and strong. Used in chiffon, velvet, shirts and ties

Synthetic fibre, characteristics & properties:
Polyamide (Nylon) From chemical monomers. Strong, durable, warm, crease resistant. Used in tights, sportswear, carpets

Polyester Produced from coal and oil. Strong and durable, elastic, crease resistant. Used in sportswear

Elastane (Lycra) Produced from polyurethane chemicals. High stretch, used to improve look of garments. Combine with other materials to improve look and comfort of garments. Used in sportswear, underwear, socks, suits/blazers

Blended Fibres: *Use a mix of fibres to combine different properties*
E.g. Polycotton has good absorbency and is quick drying

Availability and use of Textiles
Most are sold by the roll in different widths and weights. Ply refers to numbers of layers of fabric, Care should be considered not to waste material when laying out patterns. Textiles can often be reused/recycled.


Key Words
You must know the meanings of the key words below:
Yarn
Knitted
Woven
Selvedge
Natural fibres
Synthetic fibres

Key points
Fabrics are constructed from fibres by knitting, weaving or non woven blended methods such as felting

You must be able to:
Explain how fabric is constructed from fibres
Explain the difference between natural, synthetic and blended fibres
Describe the properties of common used textiles

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Sustainability, Cultures & Society

New and Emerging Technologies: Pages 126 & 127

Impact on Production

Impact on Sustainability and the Environment

Sourcing raw materials impacts on future of planet

Finite resources will eventually run out. Trees should be replanted to ensure a continuous supply to prevent deforestation

Non finite resources are easy to replenish and should be used to improve sustainability of products

Designers should reduce waste created through designing, making and using products. This can be achieved by making products through biodegradable products or making products easy to disassemble or reuse

New and emerging technologies can have an impact on the environment. See below:

- Continuous improvements are incremental improvements to a product or process
- Efficient working can reduce waste in terms of time and resources
- New technology can help reduce pollution. E.g electric cars are beginning to replace petrol/diesel polluting engines

Impact on Culture

Changes in fashion/trends can influence new and emerging technologies.:

- Product Designers are often influenced by what is in fashion. E.g clothing
- Designers need to keep on top of trends to keep producing popular products
- New technologies can create trends. Apples phone apps completely changed how people used their mobile phones.

- People with different faiths/beliefs should be respected when designing products

Inclusive Design

Inclusive design Is about designing products and systems that can be used by everyone, Ideally this should be without special adaptions

Exclusive Design

Exclusive design is when products are designed for a particular group or limited audience. E,g car seats designed for babies and very young children

Impact On Society

Products can have negative and positive effects on wider society. These are sometimes unexpected or unintended.

- E.g Smart phones have completely changed how people communicate in last decade
- Although easier to communicate in different locations, Some feel it is negative as people don't talk directly with each other as much.

Products should be developed so they do not have a negative impact on others.

- Disabled people have specific needs. E.g cash machines are positioned lower on walls so they can be accessed by people in wheel chairs

- The elderly have needs . E.g A mobile phone may be designed with large buttons and text
- Designers must be careful not to offend. An example where this went wrong is with the plastic £5 note introduced in 2016. It was found to contain animal fat, which was a problem for some Hindus and Sikhs, may who are vegetarian

Key Words

You must know the meanings of the key words below:

Continuous improvement
Trend
Inclusive design

Key points

New technologies can be used to reduce pollution such as electric car engines

Trends can be started through the emergence and subsequent use of new technologies

You must be able to:

Explain the difference between finite and non finite resources
How designers can reduce waste when designing/manufacturing new products
Why designers need to consider people with different religious backgrounds

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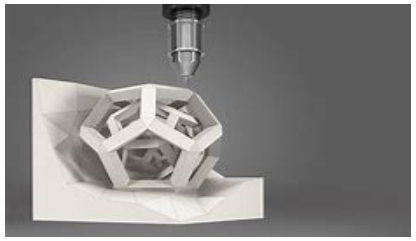
DT MIND MAPS

New and Emerging Technologies:

Impact on Industry

Impact on industry

New and emerging technologies can take several forms
AUTOMATION is use of computer systems and control technology. This could be use of robots (very efficient) in product manufacture.
BUILDINGS & WORKPLACES can be made better. E.g. Self cleaning windows, saves time, maintenance costs and make things look nice.
USE OF CAM (Computer aided design), CNC (Computer numerical control) & RAPID PROTOTYPING
Fewer hand tools used in manufacture. Greater consistency and accuracy.



Impact on Enterprise

Business innovation helps to drive enterprise. This can take different forms.

CROWD FUNDING allows people to raise awareness and money for a project/idea. There will typically be an end funding goal.
People donate money in return for rewards
The internet has made crowd funding easy. (JUST GIVING pages etc..) Websites can be set up with online payments for users. These websites typically take a share of money raised for hosting the page.
It is useful for independent people to gain money to access more funding.

JustGiving

Virtual Marketing & Retail:
This is web based marketing. It includes website banner advertising, email marketing and social media to promote products.

Cooperatives
Is a business that is jointly run by its members. Members share benefits/profits that are made.
A cooperative benefits from buying power of entire cooperative. Its very democratic
A small number of people can set up a cooperative making them easy to set up.

Fair Trade
Helps workers get fair deal/price for products they make. A living wage.

FAIRTRADE

Planned Obsolescence
Is a strategy used where products are designed to be no longer useful after a set period of time. Change can be driven by lack of compatibility of parts, fashion, improved technology or manufacturing processes. Often new products with new technology replace the old product.

Impact On Employment:

Increased automation could result in fewer jobs
More jobs for people trained in CAD/CAM less opportunities for skilled hand machine workers.
Need to retrain staff in new and emerging technologies.
Workers need to be flexible and able to update their skills in response to change.
Many important jobs didn't exist 5 -10 years ago. For example a mobile apps designer.
Workers in modern workplace need to be literate in computer based tools

Key Words
You must know the meanings of the key words below:
Automation
Crowd funding
Co – operative

Key points
Co-operatives are run by and for the benefit of their members

Automation in manufacture can help increase efficiency in production

You must be able to:
Explain the impact of new and emerging technologies on industry and enterprise.
Discuss the potential effects of the use of new and emerging technologies on employment

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Electronic System components

Approaches to Designing.

Electronic Systems

Input devices
Features
Use a real world signal such as light, sound and movement and change it to an electronic signal or current/voltage. E.g switches & sensors.

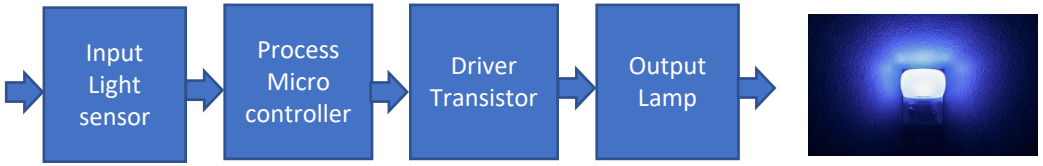
Processes
Features
Acts like the brain of a system. Can alter signal and create functions such as counting/timing. Programmable components include micro controllers

Output devices
Features
Take an electronic signal & turn it into a real signal. E.g sound, light

Drivers
Features
Increase the signal in the output. Devices can draw correct current to work better

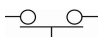
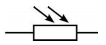
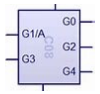
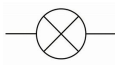
Systems Block diagrams

- *Electronic systems can be represented as block diagrams*
- *Block diagrams give atop down view of how system will work*
- *The arrows show signals moving in and out of a block*
- *The blocks represent components and alter signals*
- *In the example below a light sensor would detect the light level of a child's room.*

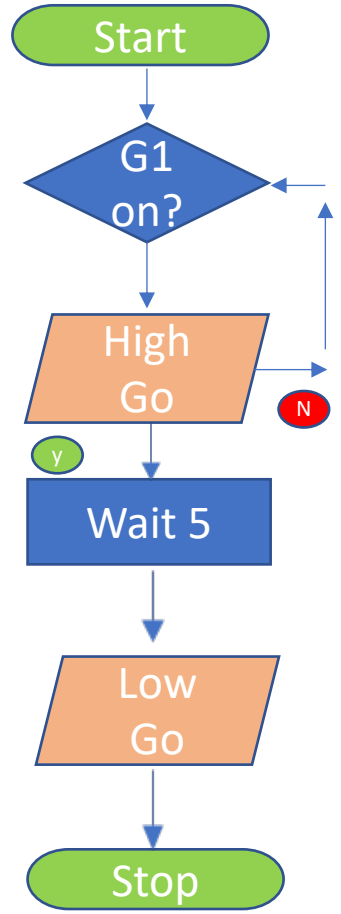


- *The micro controller can be programmed to turn lamp on for a timed period when it goes dark. They can be programmed using raw code*

Components & what they do?

Component name	Circuit symbol	What it does
Push to make switch (Input)		Allows current to flow through it when pressed
Light dependent resistor (Input)		Has a resistance that changes depending on light level
Thermistor (Input)		Resistor changes depending on temperature
Micro-controller (Process)		Small computer integrated that can be programmed to provide function such as counting/timing
Buzzer (Output)		Produces buzzer sound
Speaker (Output)		Turns signals into sound
Lamp (Output)		Produces a light

Flowchart



A flowchart for a micro controller. The lamp can be turned on for 5 seconds

Key Words
You must know the meanings of the key words below:
Electronic systems
Input device
Process
Output device
Microcontroller
Key points
Electronic systems consist of input, process and output stages, with drivers added as appropriate.
Micro controllers can be programmed to add functionality to products such as timing and counting
You must be able to:
Describe the four stages that make up an electronic system.
Understand, select and use appropriate input, process and output devices in products.
Explain how light dependent resistors work?
Explain the main methods of programming microcontrollers.

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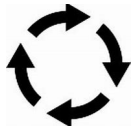
First, Second & Third Order Lever

Mechanical systems.
Pages 48 & 49

Mechanical Systems 1

Types of Motion



Rotating: *Motion in the movement of a circle.*

Linear: *Motion going in a straight mine in one direction*

Reciprocating: *Motion moving backwards and forwards*

Oscillating: *Motion swinging backwards and forwards like a pendulum*

Principles of levers

Levers are a simple machine. They change effort or force needed to move something
They consist of a rigid bar that moves a round a fulcrum.
A load is applied at one position on the lever
Effort is applied at another position. Enough effort results in the lever moving
Changing the distance between fulcrum and load increases/decreases amount of effort needed to move a load.
There are 3 types of lever

First Order Lever
(First class lever)
The fulcrum is between the load and the effort

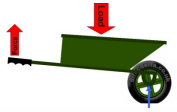
The effort is further away from the fulcrum. This means the effort needed to move lever is less than load.

The amount of mechanical advantage is proportional to the distance of the effort from fulcrum to the distance of load from the fulcrum

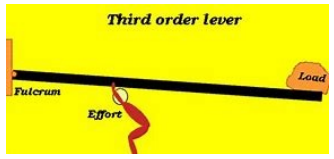
***Mechanical advantage** is the ratio of the output force to the input force applied to a mechanical device. E.g. In a steering system, the driver applies a relatively small force to the steering wheel and this results in much larger steering force at wheels*

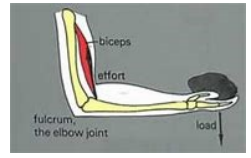
Seesaws, scissors are first order levers

Second Order Lever
The load is applied between the effort and the fulcrum.
There is mechanical advantage because the load is nearer the fulcrum than the effort.
Nutcrackers and wheel barrows are examples of second order levers.



Third Order Lever
The effort is applied between the load and the fulcrum.
Effort needed is greater than the load because effort is nearer the fulcrum.
Lifting a dumbbell is an example of a third order Lever. The load is the weight. The fulcrum is the elbow and the effort is the bicep muscle.





Key Words
You must know the meanings of the key words below:
Rotary
Linear
Reciprocating
Oscillating
Lever
Effort
Fulcrum

Key Point
There are four types of motion: rotating, linear, reciprocating and oscillating.

You must be able to:
Explain how first/second order levers can give clear mechanical advantage making it easier to move a load.
Explain the difference between different types of motion.
Describe the common features of all levers.
Identify which lever does not give mechanical advantage to the effort used.

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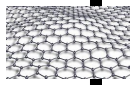
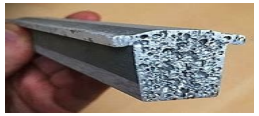
Materials & Their Properties

New Materials

Modern materials: New processes have led to the development of titanium alloys with improved properties. (Metal foams and Graphene)
One way of altering a material to perform a new function is coating the material in nano material. Materials coated in metals can improve surface quality to improve hardness and prevent corrosion. Changing physical state of material. E.g. LCDs Liquid crystal display



Metal Foams: *Metal foams are made from metal with gas pores They look like metal sponges.*
They have properties of metal but are much lighter. (75-95% lighter)
They are used for crash resistant vehicles.



Graphene: *Graphene is a form of Carbon. Atoms are arranged hexagonally. It is 200 times stronger than Steel. It is flexible, transparent and conducts heat and electricity well. Used in smart phone windows and touch panels.*

Nanomaterials: *Made of tiny particles less than 100 nanometres in size. Nano coatings can repel dirt, water with self cleaning properties*

Smart materials: *Change property in response to external stimulus. This is reversible if the stimulus changes. A smart material seems to think.*
Stimulus that might cause changes to a smart material could be: light, heat, cold, moisture, stress or even PH levels.
Shape memory allows respond to heat. They can used in spectacle frames and heated if bent to return to original shape.
Thermochromic pigments change colour in response to temperature. These pigments can be used for thermometers and food packaging.
Photochromic pigment change colour in response to light changes. E.g in transition lenses

Composites: *Combine 2 or more materials to get a better property. E.g. Carbon fibre has six times strength of concrete.*
The materials in a composite are not mixed at chemical level.
Common composites include: Glass reinforced polyester. (GRP) used in body building and boat hulls.
Carbon reinforced polyester (CRP) used to make tent poles, bikes and sports equipment.
Composites cannot be recycled and are disposed of in landfill.

Technical Textiles: *Manufactured for properties rather then looks. Their fibres are spun and then woven into fabric. Examples include Kevlar in body armour and fire resistant clothing worn by firefighters. Conductive fibres allow circuits to be incorporated into fabrics. They can control things such as light and temperature. Micro fibres incorporate tiny capsules that reduce body odour and can be used in medical textiles.*

Key Words
You must know the meanings of the key words below:
Metal foam
Graphene
Nanomaterials
Composite
Technical textiles

Key points
Composite combine 2 or more properties.
Smart materials change in response to external stimulus

You must be able to:
Describe characteristics of new materials
Explain what is a smart material and a composite material
List technical textiles, smart and composite materials.
You must be able to give examples of typical uses.

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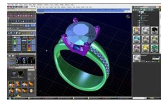
New and Emerging Technologies:

Impact on Production

Advantages of CAD
It is extremely accurate.
Easy to modify or revise existing designs
Storage space reduced.
Rotate models on computer screen
Simulation software can be used to see how something will function. Spot problems
Designs can be exported to CAM equipment for manufacture



Disadvantages of CAD
Can be expensive to buy, so high start up costs.
Need appropriate hardware to run software.
Need very good specification which adds to cost.
Time & money spent training staff.
Staff need to regularly update their skills

Advantages of CAM
Complex shapes produced much more easily then by hand
Every product is accurate, exactly the same.
Very high levels of precision/accuracy
Machines can run 24/7
Increase speed of manufacture when producing large numbers of products.

Disadvantages of CAM
Set up costs can be very high
Operators need training to use equipment, this add costs and time
One – off products can be slower to produce than manufacturing by hand in some instances

CAD:

(Computer aided design) Software used to create 2D drawings & 3D models on a computer screen

CAM:

(Computer aided manufacture) Software used to control machines to make products. (laser cutters, vinyl cutters & 3d plotters)

Push & Pull

Technology Push
When new products are produced because of new materials/processes being used/available. ***Research and development are key to this process***

Market Pull
Products are developed as result of market forces (needs/wants). Market research is used to gage opinion and needs of target market

Improving manufacturing efficiency
Lean manufacturing *aims to make products in most effective and efficient way possible. It where possible eliminates waste during manufacturing.*
This includes:
Moving products unnecessarily around a factory.
Making too many products
Time workers spend looking for tools
Doing just what the customer wants. (no extras!)
(JIT) JUST IN TIME *production deliver materials only when needed. Less money is tied up in materials. Could be delivery problems if suppliers don't deliver on time thus slowing manufacture. Could stop manufacturing leaving equipment unused and customers waiting.*
(FMS) FLEXIBLE MANUFACTURING SYSTEMS *react to unpredicted change. They change systems or the order of making components to help make the end product. They might even redesign the product.*
Increased automation is improving manufacturing efficiency but can mean fewer jobs for people.

Key Words
You must know the meanings of the key words below:
Computer aided design (CAD)
Computer aided manufacture
Lean manufacturing
Just in time
Technology push
Market pull

Key points
Different production systems/techniques improve efficiency

CAD/CAM improves accuracy of design/manufacture but often require high setup costs

You must be able to:
Explain the impact of CAD/CAM on production
Explain how production techniques and systems improve manufacturing efficiency

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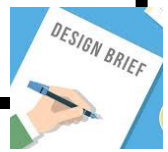
Designing products.

Design Brief

Design brief
A short description of a problem and how it will be solved.
It is typically written in a few short paragraphs



Client needs/wants
You must consider the needs, wants, interests of the end users of the product

Situation
The situation normally identifies a need that requires a solution.
E.G Developing numeracy skills can equip young children well for school.

ACCESSFM

Aesthetics – How will the product look. E.g. Colour, texture, shape.
Client- Who is the product for? Gender and age of user.
Cost- How much will it cost to manufacture your product? How much will it cost consumer?
Environment- What impact will the product have on the environment? How can it be designed and be made to be more sustainable?
Safety- How will product be designed to be safe to use?
Size- What will the dimensions be in millimetres of the finished product? This should include Height, Length and Depth.
Function- What will the product do and how will it work?
Materials- What materials/components will be used to make the product

Design Specification

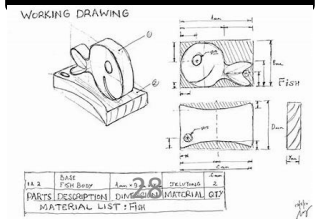
Definition/purpose:
A design specification is a list of measurable criteria that the product must meet. Each point must be concise and be justified.
It provides detail on the specific requirements of the product.
A good specification will include; aesthetics, function, ergonomics, components and materials, sustainable issues and social issues.

Design Specification	Justify my choice
1. I want my design to be simple so that it can be made very well and work well, but very good to look at as this will make my father happy to see a good and creative picture everyday	Since the card is to make someone happy it should have a good and creative design but it also shouldn't be too complicated as this will mean that it will be difficult to make sure the circuit works well
2. My design must have an electrical circuit that works well.	The electrical circuit cannot have any gaps or parts that don't work as then the led lights will not work
3. My design must have a good battery holder	This is important so that the battery does not fall out and then the lights in the card will not work.
4. My design should be colourful and attractive	This is so that the person recieving this card will be pleased and think that i tis a good design.
5. My design should be cost effective and not too expensive to make	It would be a good idea to keep the costs down wherever possible and avoid unnecessary spending so that the card is good value for money.
6. It should be made using the following materials: graffite pencil or copper tape, card, paint or colour pencils, a battery and led lights.	These are the materials I have chosen for my design because it is the simplest and most cost effective way to make a card with an electrical circuit (because grafite is conductive)
7. It should look neat professional and well presented.	This is important because the card should appear like it has been carefully made and not messy or badly made.
8. My card should have a switch so that the Light turns on when I tis pressed	I think that this is important because it will make the card more fun and interactive

Manufacturing Specification

Definition/purpose:
A manufacturing Specification should contain information needed to make the design.
It should include the following information:
The scale of production to be used:. Is the product to be batch or mass produced or made as a one off item?
A drawing of the final design. This should include assembly and construction details.
Details of components and materials needed & any standard components. This could be a cutting list
Details of how quality will be ensured, such as quality control and quality assurance. This can be a flow diagram or visual making diary

Key Words
You must know the meanings of the key words below:
Design brief
Design specification
End user
Manufacturing specification
Key points
ACCESSFM is a tool used to help designers write a specification
You must be able to:
Explain what is a design brief
Explain what is a design specification?
Explain what should be included in a manufacturing specification
Write a design brief and design specification for a product
Modify a design brief as a result of user feedback
Produce a manufacturing specification for a product



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Designing products:

Communication of ideas

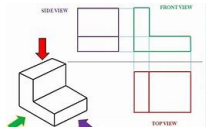
Sketching
Freehand sketching is fast
Do not have to be to scale/accurate & include exact dimensions

3d sketching
This could be isomeric, perspective drawing. Perspective drawing uses vanishing points to help create a realistic view

Exploded drawings
Show how parts/objects fit together.
They should show relative size to each other
Useful for showing how to assemble parts. E.g. furniture

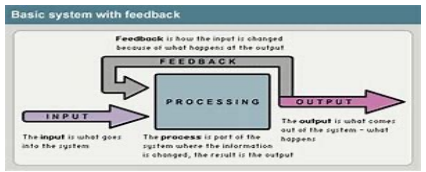
Working drawings

Purpose:
Also known as orthographic drawing communicate drawings in sizes. They ae drawn in British standard BS58888:2006
3rd angle shows 3 views. Top, front,side
The drawing should be completed in scale. Half size is written as 2:1



System & Schematic drawings

Purpose:
They show how a system would work. They include input, process and output blocks. They show how components are linked together. A systems drawing may include a feedback loop



Mathematical modelling

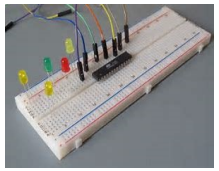
Purpose
Simulate real life situations using formula.
Can be used to demonstrate a system.
Used in aircraft testing, bridge building, wind tunnels

Computer based tools

Purpose
Using CAD (Computer aided design) orthographic drawings can be produced.
Virtual models can test how things fit together
They can involve complicated Maths formula.

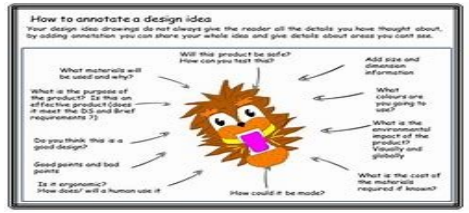
Physical Modelling

Purpose
Making a physical model/prototype from things such as card gives an idea of shape and size.
Models can test fit and size. Toile is used in textiles and breadboarding is used to construct electronic circuits.

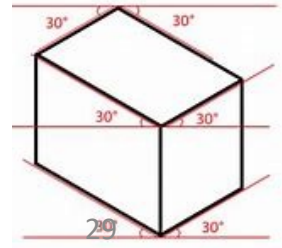


Other ways of communicating

Purpose
Use of films, audio, interviews to get primary (first hand research)
Use of annotation to add meanings to sketches and drawings. They can explain the reason for design choices and modifications.



Key Words
You must know the meanings of the key words below:
Scale , perspective, isometric drawing, exploded drawing, annotation.
Key Point
Exploded drawings show how the parts of a product fit together.
Good annotation is essential to discuss/explain features of designs and how they link to the design specification
You must be able to:
Produce sketches using perspective and isometric drawing.
You must be able to annotate a drawing effectively to discuss features of your design
State 3 ways of drawing in 3d.
Know the angle used for isometric projection.
Describe the purpose of an exploded drawing



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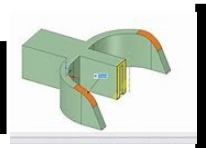
Designing products.

Computer based tools



Effects of tools
Designers can have virtual meetings across the other side of the world. Almost anyone anywhere with access to computers can do this and discuss designs with clients.

Clients & stakeholders
Reduces cost as do not have to travel to communicate globally.
Quick response time with emails.
Virtual meetings can happen using networks.
Can involve lots of stakeholders in process

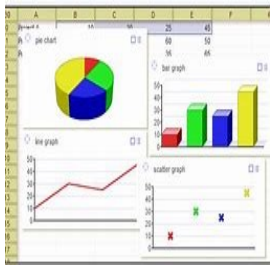
Presentation of ideas
Key part of using computer tools is getting face to face feedback.

Use of CAD/CAM

CAD (Computer aided design)
CAM (Computer aided manufacture
Can be used to model
Good for demonstrating to clients
Allows products to be viewed from different angles
Files can be sent directly to computer aided manufacturers
Can be shared via emails, memory sticks

Spreadsheet software

Good for calculations, costings, quantities
Used for cutting lists.
Graphs can used to demonstrate growth etc to clients



Prototypes

Definition/purpose:
Full sized versions of an intended product/system
They help check function and look of a product.
They can reduce waste of materials, time and money by spotting problems before manufacture

Evaluating prototypes
The designer will use prototypes to get feedback from a client, to test a need for a market, to check functionality, to check looks (aesthetics), to check ergonomics (how it reacts with a user), to make refinements prior to manufacture

CAFÉ QUE

Definition/purpose:
A tool for evaluating a prototype or system
Cost: Cost of materials. Will the product be good value for money?
Aesthetics: *How does the product appeal to the 5 senses and its target mrket?*
Function: *Does it work? Does it do its intended job?*
Ergonomics: Has usability and human factors been considered?
Quality: *How ill quality be ensured during manufacture?*
User: *Who is the intended user? Does the prototype meet their needs? If not how can it be changed?*
Environment: *How sustainable is the product? Can it be made out of recycled materials? Can components be easily changed? Does it use biodegradable materials?*

Key Words
You must know the meanings of the key words below:
Virtual meeting software
Presentation software
Spreadsheet software
Prototype
Evaluation

Key Point
Spreadsheet software can be used to share data (e.g. anthropometrics, measurements, quantities relating to a product
Virtual meetings allow designers to meet with clients almost anywhere in the world
Making prototypes ensures problems are found and dealt with early on

You must be able to:
Explain the benefits of computer based tools when communicating ideas.
Describe how to share and communicate using computers
Explain why designers produce prototypes

Student name

DT Knowledge Organiser

The Castle School
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Materials & Their Properties

Finishing Materials

Purpose of finishing:
The main reasons are for making something look nice and improve function.
Finish can make something last longer and for example make something waterproof. A painted front door will not warp or bend as the paint protects it from the elements.

Metal based materials:
Dip coating involves putting powder onto metal, dipping it in fluid and then heating it to create a smooth finish.

Galvanising Metal is dipped in a bath of molten zinc to prevent it rusting.

Polymers:
The main finishing technique is polishing to remove fine scratches
Polishing includes using abrasive liquids and surfaces to remove scratches until very smooth.

Waxes can be used to fill gaps in the polymer.
Vinyl decals can be added for decoration
Plastics can also be printed directly onto.

Textile based materials:
Block and screen printing can be used to apply decoration to fabric.
Fabric can be dyed by hand or machine.
Stain resistant finishes can be applied.

Timber based materials:
Timber can be painted with brushes or sprayed. Oil, water based and solvent paints can be used. Paints can protect and decorate wood. Paint is available in a extremely wide range of colours.

Timber can be treated with Polyurethane varnish.. This is tough, heat proof and waterproof. Varnish can come in different colours. It is normally applied in three layers and then smoothed using glass paper.

Tanalising is pressure treating wood to preserve it. Wood is placed in a closed container and vacuum created. Pressure is then applied which pushes preservative into the wood.

Papers and boards:
Screen printing, block printing, lithography, flexography, letter press are used to put text /designs onto paper

Embossing presses a shape into the material. This gives a tactile 3d effect.

Ultraviolet varnishing applies a glossy coating which is then dried using UV light

Electronic and mechanical systems:
Printed Circuit boards (PCBS) *can be lacquered. This provides a waterproof layer for the tracks.*

Gears *can be lubricated to reduce friction and reduce heat and noise*

Key Words
You must know the meanings of the key words below:
Polishing
Varnishing
Embossing
PCB lacquering

Key points
Finishing a material can improve its looks (aesthetics), durability and resistant to damage.

Screen /block printing are methods used for textiles & paper /board

You must be able to:
Explain the purpose of finishing materials
Describe how surface finishes are applied to a range of materials