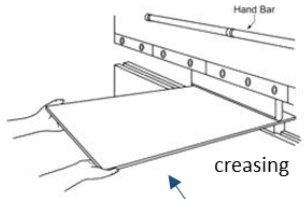
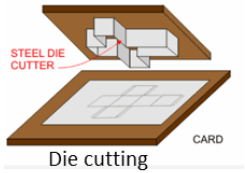
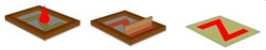
Paper and Board knowledge organiser



creasing



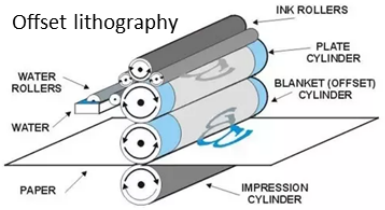
Die cutting


Screen printing

Wastage process – cutting

Deforming process – folding

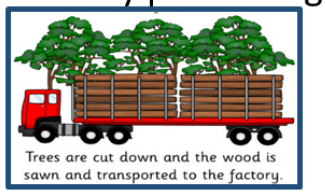
Addition process – bonding with adhesives

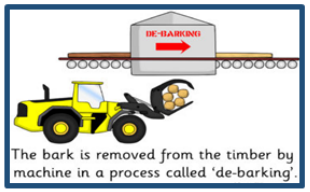


Stock Forms	
Stock Forms for paper range from A0 to A8. They can also be available in rolls after being **primary processed.** Paper thickness is in **grams per square metre (gsm)**	

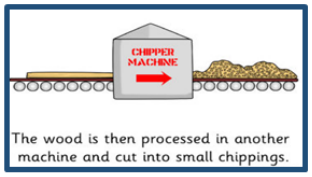
Adhesive Name	Description
PVA Glue	Water-based adhesive for attaching wood to wood. Not water-proof
Contact Adhesive	Used for bonding large areas and can be used attaching different materials together e.g. plastics to woods, ect
UV Hardening Adhesive	A clear liquid that "cures" when exposed to UV light.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

Primary processing

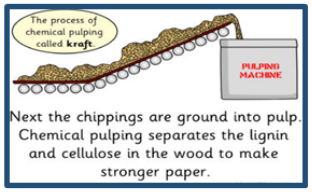

Trees are cut down and the wood is sawn and transported to the factory.



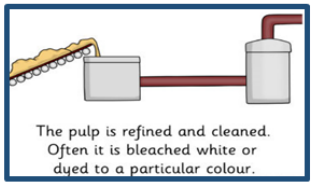
The bark is removed from the timber by machine in a process called 'de-barking'.



The wood is then processed in another machine and cut into small chippings.



Next the chippings are ground into pulp. Chemical pulping separates the lignin and cellulose in the wood to make stronger paper.


The pulp is refined and cleaned. Often it is bleached white or dyed to a particular colour.

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

Year 10 materials knowledge organiser

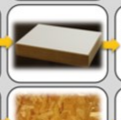
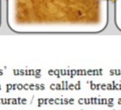
Timber knowledge organiser

Hardwoods	Softwoods
Ash	Larch
Balsa	Pine
Beech	Spruce
Mahogany	
Oak	

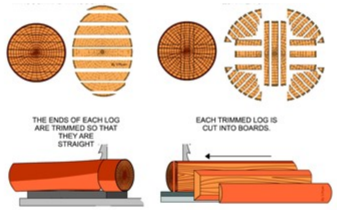
Hardwood trees take a long time to grow, around 60 years (sometimes up to 100). Hardwoods include ash, balsa, beech, mahogany and oak. Softwood trees take around half the time, 25 to 30 years and include larch, pine and spruce. As trees are **felled**, it is important to plant new ones so that the timber source is **sustainable**.

Stock forms

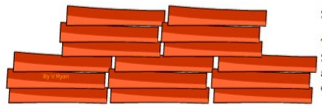
Common Manufactured Boards

Name	Picture	Properties	Used for
PLYWOOD		• Very strong board due to layers glued at 90 degrees to each other • Smooth surface	• Interior panels • Can be veneered on top • Loft boards
MDF MEDIUM DENSITY FIBREBOARD		• Easier to shape • Many thicknesses • Smooth surface • Can be fire and water resistant	• Interior DIY • Can be veneered on top • Furniture
CHIPBOARD		• Made from wood chips glued in a resin • Usually covered with a laminate • Can warp if wet	• Kitchen worktops • Flat pack furniture • General DIY

At the sawmill, the logs are cut into 'boards' using equipment such as circular saws and bandsaws. This is called 'conversion'. The first stage of conversion is a process called 'breaking down', which means rough sawing. The second stage is called 'resawing' and refers to more accurate / precise cutting and finishing, such as planing and further machining. Two types of rough sawing for the breaking down process, are shown below.

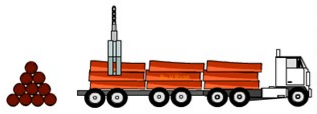


Mature trees are selected by a forestry worker. Only older trees are chosen, allowing the younger trees to grow to maturity. Felled trees are replaced with saplings. Consequently, the forest is sustainable (it should not run out of trees).
If small numbers of trees are harvested each day, a skilled forestry worker will use a chainsaw. When high numbers of trees are to be harvested, a team of forestry workers will work together felling trees. Alternative, in large forests, such as in Norway, specially designed 'tractors' with cutters and grabbers, will be used to fell hundreds of trees in one day.



STAGE TWO:

The tree trunks (logs) are stored / stacked in a clearing. Sometimes logs are stored in the forest until they are needed at the sawmill. This also allows some of the 'free' water content to evaporate, reducing the weight of the tree / log.



STAGE THREE:

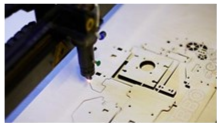
The logs are transported to the sawmill, using vehicles equipped with lifting gear.

In the Tropics, large numbers of logs are transported by floating them in rivers and allowing them to be carried down stream by the current, to sawmills.

Permanent fixings

Materials are joined permanently by using **adhesives**, a substance that bonds surfaces together. Adhesives can range in bonding strength and types depending on the materials that need joining. Examples include:

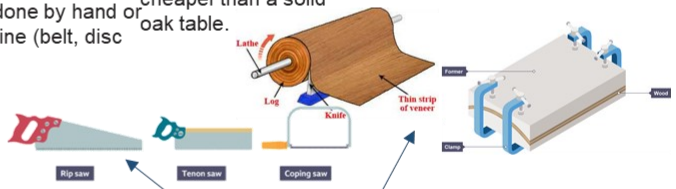
- **Polyvinyl acetate (PVA)** - Used as a general purpose woodworking glue, and some PVA adhesives are water resistant. This is most commonly used to join wood but can also be used with papers and boards.
- **Epoxy resin (ER)** - Used for joining woods to other materials such as metals and plastics. It is waterproof but is a two-part glue that must be mixed up immediately before use.
- **Contact adhesive** - Used for joining a range of materials, such as fixing plastic laminates to a wooden base, and provides a strong bond. It needs to be applied to both materials and allowed to dry before joining.



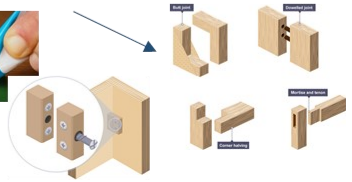
As well as marking, cutting and drilling, there are other skills to develop to shape timber:

- **chiselling** - used to remove timber, usually up to a cut or between two cuts, eg in the production of wooden joints such as dovetails
- **planing** - used to smooth the edge of a piece of timber by running a sharp blade in the direction of the grain, or can be used at an angle to produce a chamfered edge
- **sanding** - used to achieve a profiled shape or smooth surface finish by removing fine particles, normally the final stage in shaping the timber and done by hand or with a machine (belt, disc or orbital)

Veneer is the term used to describe a thin sheet of timber, usually made from an expensive hardwood. Veneer is cut in the same way that a pencil sharpener works - the timber is rotated as a blade cuts a thin sheet of veneer from the trunk. Veneer is often used to cover a cheaper material such as plywood, MDF or even a softwood. Quite often an 'oak' table will actually be an MDF table with an oak veneer. The table could still be considered expensive to buy, but would be considerably cheaper than a solid oak table.



Wastage process – sawing, laser cutting
Deforming process – veneering
Addition process – joints, adhesives, nails/screws



Wood joints

Wood joints are a traditional method of joining timber. There are a range of different joints that can be used for different situations that provide a variety of levels of strength and structure. Joints are often glued to make them secure and permanent. Wood joints are classified into two construction categories:

- frame
- box

Frame joints

- **dowelled** - uses a wooden or plastic peg, called a **dowel**, which fits into aligned holes to reinforce the joint
- **corner halving** - a strong joint due to the surface area available for gluing, and the shoulder gives extra mechanical strength
- **mortise and tenon** - a very strong join cut with a tenon saw and mortise chisel – however, in production, a mortise machine may be used instead
- **bridle** - similar to a mortise and tenon – however, the cuts are made to the full width of the timber
- **mitre** - cut at a 45-degree angle and glued together, used for picture frames

Box joints

- **butt** - a simple join where the edges of the timber are glued together, so it is easy to make but weak
- **housing** - a simple slot into one piece, usually cut by a router, often used in shelving.
- **lap** - a stronger joint due to the surface area that can be glued, and a shoulder is cut from the edge one piece
- **dovetail** - very strong and looks good but complex and difficult to cut (jigs can be used to aid this process), often used in high-quality furniture
- **comb** - easier to make than a dovetail, offers good contact for gluing and the pieces of the wood interlock providing strength, often used in wooden boxes

Year 10 materials knowledge organiser

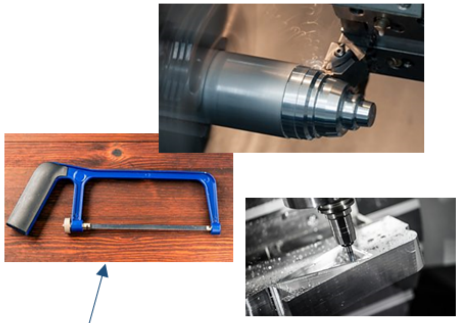
Metal knowledge organiser

Ferrous metals

Name	Properties	Identifying features	Uses	Forms
Cast Iron (CI Alloy)	Excellent strength, tough, cannot be bent or forged. A hard outer skin	Usually painted to avoid rust, very dark grey to black with a matt texture	Fences, garden benches, pots, weights, drain covers.	Ingots, bar and pipe
Mild Steel (CI Alloy)	Ductile and malleable yet tough. Easy to weld.	Silvery grey with poor corrosion resistance.	Car bodies, nuts, bolts, nails, screws, wire fencing.	Ingots, wire, bar, pipe, sheet
High Carbon Steel (CI Alloy)	Malleable, can be hardened and tempered, easily forged.	Silvery grey. Can appear dull or shiny.	Files, chisels, saws, taps, dies, lathe tools etc.	Ingots, wire, bar, pipe, sheet.

Ferrous Vs Non Ferrous Metals

	FERROUS METALS	NON FERROUS METALS
DEFINITION	Ferrous Metals: • Contain iron • Are more durable • Have a high amount of carbon	Non Ferrous Metals: • Don't contain iron • Are lighter & more malleable • Used where strength is needed
EXAMPLE	Steel, Carbon Steel, Stainless Steel. Cast iron are some examples of ferrous metals.	Aluminum, Copper, Zinc, Lead, Tin are some examples of 'non-ferrous metals.
USES	Ferrous metals can be used in pipes, machinery, construction, and engineering.	Non-ferrous metals are lighter & they are ideal for specific industries such as aircraft building.
MAGNETIC PROPERTIES	✓	✗
RESISTANCE TO RUST & CORROSION	LOW	HIGH
WEIGHT	HIGH	LOW
COST	LOW	HIGH



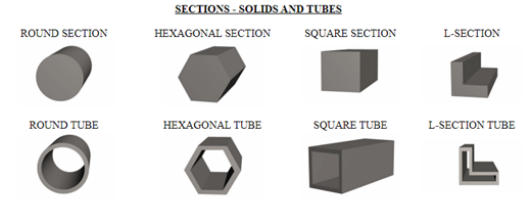
Wastage process – sawing, cnc lathe and milling
Deforming process – bending, casing, forging
Addition process – welding, brazing, soldering, riveting, bolts/screws and adhesives

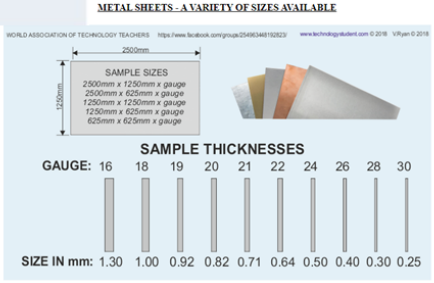
Non - Ferrous metals

Name	Properties	Identifying features	Uses	Forms
Aluminium (Pure)	Good strength to weight ratio, malleable, conducts heat and electricity well, ductile.	Shiny silvery grey colour which polishes well.	Kitchen foil, drink cans, boat hulls, sport equipment.	Ingots, wire, bar, pipe, sheet
Tin (Pure)	Malleable, soft, weak, ductile, resistant to corrosion.	Bright silvery.	Usually used for coating steel to form tin plate. Also tin cans. Alloyed to make bronze.	Ingots, wire, bar, pipe, sheet
Copper (Pure)	Tough, ductile, malleable, conducts heat and electricity well, solders well.	Deep orange brown colour but tarnishes green with exposure to oxygen.	Electric wires, pipes, circuit boards, jewellery, roofing, cooking pans.	Ingots, wire, bar, pipe, sheet
Zinc (Pure)	Weak, ductile, malleable, poor strength to weight ratio, casts well.	Silvery grey. Tends to have a matt surface finish.	Guttering, roofing, coins, watering cans, bins.	Ingots, wire, bar, pipe, sheet. Coating (galvanising)

Properties of Alloys

Alloy	Composition	Properties	Uses
Bronze	• 90% copper • 10% tin	• Hard and strong • Doesn't corrode easily • Has shiny surface	• To build statues and monuments. • In the making of medals, swords and artistic materials.
Brass	• 70% copper • 30% zinc	• Harder than copper	• In the making of musical instruments and kitchenware.
Steel	• 99% iron • 1% carbon	• Hard and strong	• In the construction of building and bridges. • In the building of the body of cars and railway tracks.
Stainless steel	• 74% iron • 8% carbon • 18% chromium	• Shiny • Strong • Doesn't rust	• To make cutlery and surgical instruments.
Duralumin	• 93% aluminum • 3% copper • 3% magnesium • 1% manganese	• Light • Strong	• To make the body of aeroplanes and bullet trains.
Pewter	• 96% tin • 3% copper • 1% antimony	• Luster • Shiny • Strong	• In the making of souvenirs.





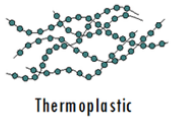
Primary Processing of Metals and Alloys

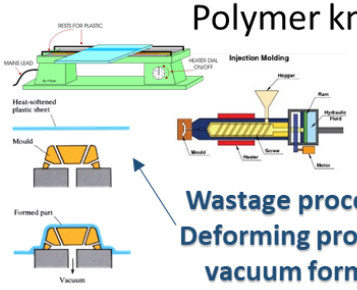
Metals are mined from the earth and then go through an extraction process
Extraction happens by putting the ore in a blast furnace
The metal is then separated from the waste material

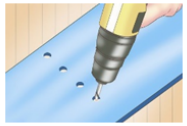
Lustrous	Are shiny when polished or freshly cut
Malleable	Do not break – they bend
Flexible	Can be hammered into sheets
Ductile	Can be drawn into a wire
Thermal conductor	Allows heat energy to flow through
Electrical conductor	Conducts electricity

Year 10 materials knowledge organiser

Polymer knowledge organiser





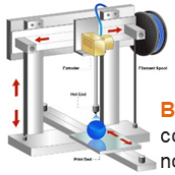


Wastage process – sawing and drilling holes
Deforming process – line bending, moulding, vacuum forming and injection moulding.
Addition process – solvent cements, welding and 3D printing

Additives

Additives are added to plastics to *alter* and *improve* their properties.

FILLERS
• Reduce the bulk of the plastic (makes them cheaper, or can increase strength or hardness) examples are; sawdust and limestone.
FLAME RETARDANT
• Reduce risk of combustion, they create a chemical reaction which can stop combustion.
ANTI-STATIC
• Reduces the effects of static charge that can build up through use.
PLASTICISER
• Reduces the softening temperature and makes them flow easier.
STABILISER
• Reduces the effect of UV light, stops the plastic degrading in sunlight.

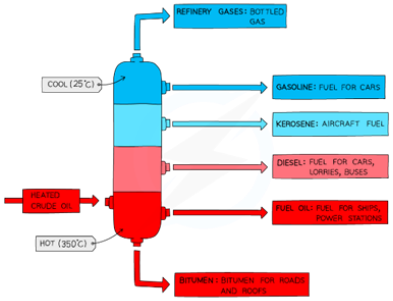


bioplastic
Plastics from renewable sources, such as corn starch.

Bioplastics are being continually developed to combat the environmental concerns related to the non-biodegradable properties of plastic polymers.

Common stock form	Polymer	Common use
Sheet 	Acrylic	Menu holders in bars and restaurants
Granules	Polypropylene	Pen lids and bottle tops
Powder 	Polythene	Dip coating metal objects such as coat hooks
Foams	Plastazote	Swimming pool floats
Film 	PVC	Food wrapping
Filament	PLA/ABS	3D prints

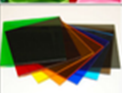
Thermosetting plastics	Thermosetting plastic samples	Thermosetting plastic uses
Thermosetting plastics are more rigid, once they are formed or 'set', they can't be reformed. The long polymer chains have many more cross links between them which stops the lomecular chains in the plastic moving. Thermoset plastics generally are harder and more brittle than thermoplastics and fantastic electrical insulators and have good resistance to heat and chemicals. Thermosetting plastics tend to burn than melt when heated which makes it hard to recycle. This material is currently being developed to make it more recyclable.	**Epoxy resin (ER)** Stronger than other resins, better strength to weight ration, expensive, heat resistant , and a good electrical insulator. Supplied as two liquids: a resin and a hardener.	Bonding different materials together, electronic circuit boards, waterproof coatings, used in fibreglass and carbon fibre lamination 
	Melamine formaldehyde (MF) Food safe and hygiene, lightweight, hard, brittle but not microwave safe. Formed and moulded into a variety of shapes, smooth, available in many colours and can be printed.	Kitchenware and heat resistant surfaces bonded to worktops and flat packed furniture 
	Urea formaldehyde (UF) Heat resistant, very good electrical insulator, hard, brittle, easily injection moulded. Very smooth finish, mainly white, limited colours.	Electrical fittings, casing, buttons and handles. Also used as an adhesive or to treat fabrics to enhance easy-care properties. 
	Polyester resin (PR) Reasonably strong, heat resistant and a good electrical insulator. Supplied as two liquids, a resin and a hardener. Sets very clear.	Encapsulation of artefacts, water-proof coatings, flooring, used in the lamination of fibreglass. 
	Phenol formaldehyde (PF) Formerly known as an early plastic called Bakelite. Very rigid, hard and brittle. An excellent electrical insulator. Usually injection moulded.	Electrical components, mechanical parts, casting resin, old Bakelite style household artefacts such as clocks, telephones and radios 



Primary Processing of Plastics

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

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

Thermoforming plastics	Thermoforming plastic samples	Thermoforming plastic uses
Thermoforming plastics or thermoplastics are more flexible, especially when heated. This is owing to their physical structure; polymer chains are loosely entangled with very few cross-links. This allows the chains to easily slide past each other when heated. Thermoplastics can be formed into complex shapes and can also reform multiple times. Thermoplastics are commonly used in processes such as vacuum forming, injection and blow moulding. This group of plastic is easier to recycle.	**High density Polythyrene (HDPE)** Lightweight, rip and chemical resistant, premium price and paid when recycled. The material takes colour well and can be textured.	Milk bottles, pipes, storage crates, hard hats and wheelie bins 
	Low Density Polyethylene (LDPE) Very flexible and tough with a high strength to weight ratio. It is blow mouldable and easily extruded into rolls of film. ?Usually clear, thin film with smooth finish.	Plastic carrier bags, refuse sacks, piping, bottles and some plastic food wraps. 
	Polypropylene (PP) Flexible, tough, lightweight, chemically resistant, easily cleaned and safe with food. Available in sheets or shapes and easily coloured	Kitchen, medical and stationary products, ropes, water bottle lids, food plastic containers 
	Acrylic Tough but brittle when thin. Easily scratched, formed and bonded. Common in school workshops used to laser cut and line bend.	Car lights, display stands, trophies, table tops, modern baths, jumpers, hats and gloves 
	Polyethylene terephthalate (PETE) Formerly known as an early plastic called Bakelite. Very rigid, hard and brittle. An excellent electrical insulator. Usually injection moulded.	Bottles, food packaging, sheeting and some food wraps