



**WOODS**

There are three types of wood, Softwood, Hardwood and Manufactured Boards.

**Softwood**

Coniferous trees (trees that keep their needle-like leaves throughout the year) provide softwood. They can grow quickly with straight trunks. They are often grown in plantations and are replaced when they are cut down. The wood is quite cheap and is used in the building industry for windows and doors etc. When the trunk is converted the waste is used for making paper and card.

**Hardwood**

Deciduous trees (trees that lose their large leaves every winter) provide hardwood. They grow slowly and sometimes have twisted trunks. They are often not replaced when cut down. The wood is costly and is used for fine furniture and wooden toys, etc.

**Note:** The difference between softwood and hardwood is a biological difference, not one of softness and hardness. The softest wood is Balsa - it is a hardwood!

**Manufactured Boards**

These are made from the waste wood left over from conversion. They use thin sheets (plywood), small blocks (blockboard), wood chips (chipboard) and wood fibres (fibreboard). They are generally cheaper than solid wood and can be made into large sheets

Softwood

NAME	PROPERTIES	USES	COST
Scots Pine (Deal)	Straight grained, but knotty, quite strong and easy to work	Building construction. When used outside it needs protection. Takes paint well.	Low
Parana Pine	Straight grained with few knots, quite strong and durable, warps easily	High quality interior construction and furniture	High
Spruce (white-wood)	Quite strong, with small knots, resistant to splitting but not durable	Fitted furniture, e.g. kitchen cabinets.	Low
Cedar	Straight grained that is knot free. Very light in weight. Very durable, inside and outside. Quite soft.	Used outside for shed construction and quality fencing.	High

Hardwood

NAME	PROPERTIES	USES	COST
Ash	Light in colour, flexible and tough, steam bends well, varnishes well.	Tool handles, cricket bat handles, ladders, veneers.	Med
Beech	Mid-brown colour, hard, strong and tough, tends to warp, steam bends well.	High quality furniture, toys, tool handles, veneers	Med
Oak	Light brown, hard, tough, heavy and durable outside. Gets harder with age.	High quality furniture, garden furniture, boat building, veneers	High
Mahogany	Red in colour, medium weight, quite strong, durable inside, warps easily	High quality furniture, shop furniture, boat fittings, veneers.	High

Manufactured Board

NAME	PROPERTIES	USES	COST
Plywood	Strong in all directions, quite stable but can warp. A water-proof ply is available.	Tabletops, worktops door fronts, drawer bottoms, small boats (waterproof ply)	Med
MDF	Does not warp easily, cuts and planes well without splitting, needs a finish.	Tabletops, worktops, veneered furniture, clock cases.	Med
Blockboard	Does not warp easily. Very strong, rigid and rather heavy. Edge finishing is difficult.	High quality furniture, stage flooring, fire doors.	High
Chipboard	Heavy, can warp easily, joining pieces together is not easy, needs a finish.	Cheap plastic coated furniture, roofing boards, partitions	Low
Hardboard	Not very strong, warps easily, needs a finish.	Door panels, cheap drawer bottoms, cabinet backs.	Low

1. What sort of trees do hardwoods and softwoods come from
2. What are manufactured boards made from?
3. (Blank)
4. Which softwood might you choose to make a dog kennel from?
5. Which hardwood might you choose to make a child's toy truck?
6. Explain how plywood is constructed.
7. Which manufactured board might you choose to make a long shelf for heavy books?
8. What is the environmental advantage of making and using chipboard?

## Polymers (Plastics)

There are two main classes of plastic.

**Thermoplastics** - can be reshaped by heating. They will try and return to their original shape if re-heated.

**Thermosetting Plastics** - cannot be reshaped by heating and can withstand higher temperatures than thermoplastics.

All modern plastics are made mainly from oil, coal and extracts from plants. They are synthetic (not natural - man-made) and come in hundreds of types, each with their own set of properties. Many have been made to order by materials scientists, e.g. The drinks industry wanted a lightweight plastic that would not crack when dropped or when under pressure, to make bottles for fizzy drinks. Scientists produced Polyethylene terephthalate (PET). (Can you pronounce this?) Most property changes are made by adding additives to the basic plastic.

The following are common additives:

**Plasticisers** - make the plastic less brittle.







**Pigments** - colour the plastic




**Fillers** - powdered additives, e.g. mica reduces electrical conductivity, asbestos allows higher temperature use, etc.

**Stabilisers** - protect plastic from ultra violet light that can make it become brittle.

**Flame retardants** - make the plastic less likely to catch fire.

### Thermoplastics

	PLASTIC	PROPERTIES	USES
USED IN SCHOOL	Polymethyl-methacrylate (Acrylic or PMMA)	Rigid, hard, can be clear, very durable outside, polishes to a high shine.	Illuminated signs, windows, baths, 
	Polyvinyl chloride (PVC)	Rigid, quite hard, good chemical resistance, tough.	Pipes, guttering, window, frames, 
	Polyethylene (polythene)	Flexible, soft, good chemical resistance, feels waxy	Food bags, buckets, bowls, bottles, 
	Polyamide (nylon)	Tough, self lubricating, resists wear, good chemical resistance	Gear wheels, bearings, combs, 
	Polystyrene	Lightweight, hard, rigid, can be clear, good water resistance	Model kits, utensils, containers, packaging, 
	Expanded Polystyrene	Very lightweight, floats, good heat insulator	Insulation, packaging, 

	PLASTIC	PROPERTIES	USES
USED IN INDUSTRY	Polyethylene terephthalate (PET)	Tough, clear, lightweight,	Fizzy drinks bottles, 
	Polypropylene	Lightweight, flexible, resists cracking and tearing	Climbing ropes, crisp packets, 
	Acrylonitrile butadiene styrene (ABS)	Very tough, scratch resistant, good chemical resistance	Casings for cameras, kettles, vacuum cleaners, 

### Thermosetting plastics

	PLASTIC	PROPERTIES	USES
USED IN SCHOOL	Polyester resin (mixed with glass fibre - GRP)	Hard, rigid, brittle, tough when mixed with glass or carbon fibres	Boat and car bodies, paper weights
	Epoxy resin (Araldite)	Strong, good chemical and heat resistance, sticks to other materials well	Adhesive encapsulating electronic components
USED IN INDUSTRY	Polyethylene terephthalate (PET)	Rigid, hard scratch resistant, water and stain resistant	Table ware, laminate top coating
	Urea formaldehyde	Rigid, hard, strong, heat resistant, does not bend when heated, good electrical insulator	Electrical plugs and sockets, door knobs

1. What are the two classes of plastic and what is the difference between them?
2. Why are there many types of plastic?
3. Give an example of how a materials chemist can change the properties of a plastic.
4. Why would you add a stabiliser to a plastic?
5. Which plastic would you choose for making a window frame and why?
6. Which plastic would you choose to protect a china ornament sent by post?
7. Which plastic would you use for making a house number sign and why?
8. Why is nylon a good plastic for making combs?

### Metals

There are two classes of metals:

**Ferrous** - metals that contain iron and are affected by magnetism (apart from stainless steel).

**Non-ferrous** - metals that do not contain iron and are not affected by magnetism.

Metals can also be grouped into:

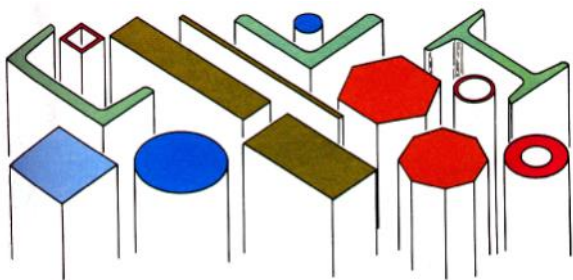
**Pure metals** - metals made up from only one chemical element e.g. copper or aluminium.

**Alloys** - metals made up from a mixture of elements, e.g. copper + zinc (brass) or lead + tin (solder)

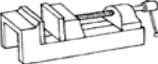




### Alloying

Metals are alloyed to improve the qualities of the individual pure metals e.g. both copper and tin as pure metals are both soft metals that are easily bent and scratched. When alloyed together ( 90% copper plus 10% tin) they produce bronze which is hard, rigid and resists scratching. Bronze is used for our 'copper' coins.


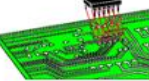


### Available forms



### Ferrous Metals

NAME	COMPOSITION	PROPERTIES	USES
Cast Iron	Iron + 3.5% carbon	Smooth skin with soft core, strong when compressed, self lubricating, cannot be bent or forged.	Vices, lathe beds, garden bench ends, car brake drums, etc 
Mild Steel	Iron + 0.15 - 0.35% carbon	Ductile, malleable & tough, high tensile strength, poor resistance to corrosion, easily welded.	Car bodies, washing machine bodies, nuts & bolts, screws, nails, girders, etc. 
High Carbon Steel (tool steel)	Iron + 0.8 - 1.5% carbon	Very hard, rather brittle, difficult to cut, poor resistance to corrosion.	Tool blades e.g. saws, chisels, screwdrivers, punches, knives, files, etc. 
High Speed Steel	Iron + tungsten chromium vanadium	Very hard, heat resistant, remains hard when red	Drills, lathe cutting tools, milling cutters, power hacksaw blades etc. 
Stainless Steel	Iron + chromium nickel magnesium	Tough and hard, corrosion resistant, wears well, difficult to cut, bend and file.	Cutlery, sinks, teapots, dishes, saucepans, etc. 

### Non Ferrous Metals

NAME	COMPOSITION	PROPERTIES	USES
<u>Aluminium</u>	pure metal	Good strength/weight ratio, malleable and ductile, difficult to weld, non-toxic, resists corrosion. Conducts heat and electricity well. Polishes well.	Kitchen foil, saucepans, drinks cans, etc. 
Copper	pure metal	Tough, ductile and malleable. Conducts heat and electricity well. Corrosion resistant, solders well. Polishes well.	Electrical wire, central heating pipes, circuit boards, saucepan bases 
Brass	copper + zinc	Quite hard, rigid, solders easily. Good conductor of heat and electricity. Polishes well.	Water taps, lamps, boat fittings, ornaments, door knockers. 
Tin	pure metal	Weak and soft, malleable and ductile, excellent corrosion resistance, low melting point.	Solder (with lead) Coating over mild steel (tin can) 
Zinc	pure metal	Poor strength/weight ratio, weak, ductile and malleable, low melting point. Casts well.	Coating over mild steel (galvanising) Die castings used in cars e.g. Carburettor 