Section Five — Knowledge Organiser

There's a lot to keep in mind when working with wood, metals and polymers. But have no fear, this Knowledge Organiser has all the key info laid out for you — just make sure you've learnt the details too.

Properties and Uses

The properties of a material affect how it's used. E.g.

	Material	Properties	Example Use
Wood	Hardwoods (e.g. beech, oak, maple)	Hard, durable, child-safe, attractive	Wooden toys
Wood	Manufactured boards (e.g. MDF)	Strong, uniform texture, can be shaped/finished	Flat pack furniture
Metals	Stainless steel	Strong, rust-resistant, high melting point, safe with food	Cooking utensils
Metals	Tool steel	Hard, tough, strong	Hand Tools
Polymers	Thermoforming plastics (e.g. polypropylene)	Tough, colourful, strong, flexible, easily moulded, moisture-resistant	Seating
Polymers	Thermosetting plastics (e.g. urea formaldehyde)	Easily moulded, heat/fire-resistant, electrical insulator	Electrical fittings

Modified Materials

Modifying materials changes their properties (making them suitable for different purposes), e.g.

- **Seasoned wood** (dried out) — stronger, less likely to rot.
- **Annealed metal** (heated then cooled) — more malleable/ductile, less brittle.
- **Stabilised polymers** (UV stabiliser chemical added) — protected from UV damage, suitable for outdoors.

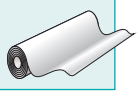
Stock Forms

The shapes/sizes/forms material is bought in. All come in standard dimensions/thicknesses.

Timber
- Planks
- Strips
- Boards
- PSE
- Rough sawn
- Mouldings

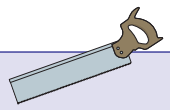
Metals
- Sheets
- Strips
- Bars
- Rods
- Tubes
- Angles
- Channels
- Girders

Polymers
- Tubes
- Rods
- Granules
- Foam
- Sheets
- Powders
- Films



It's easier and cheaper for manufacturers to buy stock forms, rather than making their own.

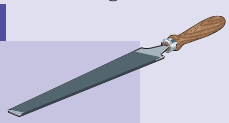
Hand Tools



Cutting Tools
- Rip saw
- Tenon saw
- Hacksaw
- Coping saw

Shaping Tools
- Wood chisel
- Cold chisel
- Gouger

Smoothing and Shaping Tools



- Bench plane
- Files — rough to fine cut
- Abrasive papers — coarse to fine grit

Drills
- Brace
- Hand drill
- Power drill

Used to make holes.

Drill Bits
- Twist bit
- Countersink
- Flat bit
- Hole saw

Use bradawl or centre punch to dent to show where to drill.

Tool safety: hold materials still (e.g. in a vice), keep fingers out of the way, carry tools carefully, wear goggles.

Standard Components

	Description	Types	Uses
Screws	Twisted screw thread grips material tightly	Woodscrews, self-drilling screws, machine screws	Self-assembly furniture, shelves, hinges
Nuts & Bolts	Nut and bolt join materials from both sides	Square or hexagonal bolt heads (can be tightened with spanner)	Car parts, bridges, moving parts (e.g. swings)
Rivets	Metal peg with head (end gets flattened)	Pop rivets (when only one side is accessible)	Joining sheet metal (fast and easy method)
Hinges	Knuckle fixing lets objects move together	Butt hinge, tee hinge, pivot hinge, flush hinge	Doors, gates

KD fittings are temporary joints (not as strong as glued joints).

Knock-Down Fittings

Scan fittings
Screw and cylinder in separate parts are screwed together, e.g. attaching table legs to frame.

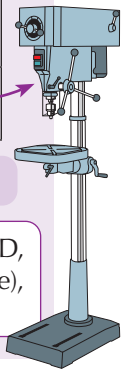
CAM locks
Peg pushed into disk, disk turned to tighten parts, e.g. joining cabinet sides and top.

Single/two-piece blocks
Plastic blocks screwed into parts at right angles, e.g. shelves in wardrobes.

Dowels
Wooden rods (often glued) fit into holes in parts, e.g. shelves in cabinets.

Power and Machine Tools

	Tool	Description
Power Tools	Router	Spinning cutting tool, cuts features into wood
	Planer	Similar to bench plane, removes shavings of wood
	Jigsaw	Interchangeable blades, cuts any material (but slowly)
	Sander	Smooths wood using abrasive paper at high speed
Machine Tools	Sanding Disc	Disc of abrasive paper, removes material to a line
	Saw Bench	Circular blade, cuts wood and boards in straight cuts
	Band Saw	Blade in flexible loop, makes straight or curved cuts
	Pillar Drill	Makes round holes in many materials



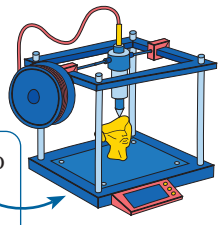
Fences improve accuracy of power /machine tools.

Tool safety: check for loose connections, use an RCD, use protective equipment (e.g. mask, extraction hose), clamp work firmly, check where stop buttons are.

Shaping Techniques

Milling machines remove one layer of material at a time. Can make surfaces completely flat.

Lathes rotate material while a tool cuts it. Wood lathes turn wood, engineers' lathes turn metal.



Additive CAM processes add material to make products, e.g. 3D printing builds up layers of plastic to form a shape.

Press forming shapes metal between two moulds. Annealed metal sheets often used (more malleable).

Casting — molten material poured into mould. Material cools and solidifies into shape.

Die casting is for metals and plastics. The mould is called the 'die'.

Bend materials using:

- Lamination — for wood
- Sheet metal folder — for metal
- Line bender/strip heater — for acrylic

Moulding and Joining

Vacuum forming — heated plastic sheet forced onto a mould by sucking out air, then cools into shape.

Blow moulding — softened plastic inserted into a mould. Air is injected and plastic expands to shape of mould.

Injection moulding — molten material forced into closed mould under pressure.

Extrusion — molten material forced through die under pressure. Forms continuous strips.

Drape forming — heated plastic sheet placed on mould cools into shape.

Adhesives — glues, e.g. PVA, glue guns, solvent cement, epoxy resin, superglue.

Soldering and brazing are for metals only. Welding is for metals and polymers.

Soldering — melting solder onto components.

Brazing — like soldering, but with brass spelter.

Welding — melts joints together, extremely strong.

Treatments and Finishes

Timber

Seal before sanding, sand before finishing, prime before painting.

Paints

Undercoat: first coat, covers up previous colours, helps layers of paint to stick.

Top coats: gloss paints (hard-wearing, waterproof) or polyurethane paints (tougher, with smooth finish).

Varnish is clear, keeps wood grain visible.

Tanalised® wood is treated to last longer outdoors.

Metals

Smooth and degrease before finishing.

- **Dip coating** — fuses fluidised plastic powder to metal surface.
- **Powder coating** — plastic powder sprayed using electrostatic gun, then heated to set.
- **Galvanising** — zinc coating to prevent rust.

Polymers

Self-finishing, but can be buffed/polished to remove scratches or decorated with vinyl decals or printing.

Different materials require different tools and techniques...

You need to know how to work properly with the materials you're using. It's no good using a wood chisel on plastic, or a laminator on a metal sheet — the tools and techniques need to be suitable for the material.