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| **1. Stages of making paper** | |
| **Stage** | **Explanations** |
| **Mixing** | Natural cellulose fibres are mixed with water |
| **Heating** | The mixture is heated to break down the cellulose and create a liquid called pulp. |
| **Drainage** | The pulp is fed on a mesh conveyor to drain the surplus water. |
| **Forming** | The damp fibres are then passed through several rollers to press form and dry the pulp. This is then rolled onto big rollers in a continuous sheet. |
| **Cutting** | The rolled paper is then processed at a later date and cut to the size required. |

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| **2. How paper is measured** | | | | |
| **Measurement** | | **Description** | | |
| **GSM** | | Grams per Square Metre – this is the weight in grams of one metre square. | | |
| **Microns** | | Board is measured in microns – this is the thickness of the materials. 1000 microns equal 1mm. | | |
| **Quire** | | A quire is 25 sheets of paper. | | |
| **Ream** | | A ream is 500 sheets of paper. | | |
| **Bundle** | | A bundle is a 100 sheets of paper. | | |
| **Bale** | | A bale is 5000 sheets of paper. | | |
| **A0, A1, A2, A3, A4, A5, A6, A7, A8** | | Paper is measured from A0 to A8. A8 is the smallest and as the numbers goes up the size of the paper doubles. | | |
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| **3. Types of paper based materials** | | | | |
| **Type** | | **Description** | | **Uses** |
| **Cartridge** | | Thick, quality paper with a slight texture | | Pencil/ink drawings and painting |
| **Bleed proof** | | Smooth with a special coating, so the ink sits on top and does not soak in. | | Art work, resists bleeding and feathering. |
| **Grid paper** | | Printed with feint lines to enable plotting graphs. | | Mathematics, architectural and scientific use |
| **Layout paper** | | Translucent to enable tracing. | | Used for working on sketches designs. |
| **Card board** | | Comes in a range of thicknesses and is versatile. | | Make models and basic structures |
| **Corrugated cardboard** | | Lightweight, can be printed on impact resistant. | | Commonly used for packaging. |
| **Foil lined board** | | Stiff card lined with foil. | | Food packaging |
| **Duplex board** | | Card with a wax coated layer. | | Food containers, stationary folders. |
| **Foam board** | | Thin layer of foam sandwiched between two layers of card. | | Models and presentation boards. |
| **Solid white board** | | High quality board with a white finish. | | Hard book covers and product packaging. |
| **Ink jet Card** | | The ink sits on the surface of the paper. Smooth and ensures ink coverage and absorbency. Comes in matt and gloss finish. | | Inkjet printing. |

**Tasks 1-3 Learn/cover/write and self-check the paper based products stages of making, measuring and list of paper based materials.**

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| **1. Classifications of wood** | |
| **Coniferous** | **Deciduous** |
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| * Ever green all year round. | * Annually loses leafs. |
| * Needle-like leafs. | * Has broad leafs. |
| * Grows cones. | * Grows fruits and nuts. |
| * 30 years to reach maturity | * 100 years to reach maturity |
| * Grows in cooler climates. | * Grows in warmer climates. |

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| **2. Manufactured boards (man-made)** | | | | | |
| **Measurement** | | **Description** | | **Use** | |
| **Medite Premium MDF 3050mm X 1220mm x 18mm**  **MDF** | | Made by compressing and gluing tiny particles together. | | Indoor furniture. | |
| **Plywood**  **Plywood** | | Made by laminating a number of layers (known as veneers or plies) at 90 degree angles. | | Doors and boats (marine ply). | |
| **bb_lg5**  **Blockboard** | | Made by first gluing strips of softwood side by side, and then sandwiching them between veneers or plies. | | Table tops. Work benches | |
| **chip_veneer**  **Chipboard** | | Made by compressing and gluing wood chips together. | | Flooring and veneered kitchen tops. | |
| **hardboard-765697**  **Hardboard** | | Made by compressing and gluing small wood fibres together. | | Drawer bottoms backs of cabinets. | |
| **3. Wood and its uses in construction** | | | | | |
| **Type** | | **Classification/ properties** | | **Uses** | |
| **Pine** | | **Coniferous -** Pine is a soft, white or pale yellow wood which is light **weight**, straight grained and lacks figure. It resists shrinking and swelling. | | External cladding, roof rafters, window frames/ sills and doors. | |
| **Chipboard** | | **Man-made -** This creates a rigid board with a relatively smooth surface. Chipboard is available in a number of densities: -normal, medium and high-density. | | Internal cladding and veneered kitchen worktops. | |
| **Cedar** | | **Coniferous –** light weight**,** knot free, straight grained and contains natural oils resistant to weather and insects. | | External cladding | |
| **Oak** | | **Deciduous -** strong, hard, tough, open-grained, corrodes steel screws and fittings | | External cladding,  flooring, door, timber house frame etc. | |
| **Mahogany** | | **Deciduous -** fairly strong, durable, some interlocking grain | | Front door internal furniture. | |
| **Plywood** | | **Man-made -** increased stability, high strength, flexibility, fire resistance | | Internal cladding | |
| **Larch** | | **Coniferous -** Natural strength and durability Larch heartwood is strong and is durable outside without the use of preservatives | | External/ internal cladding, fencing and boat building. | |
| **Beech** | | **Deciduous -** close-grained, hard, tough, strong, warps easily | | Window frames/ sills, flooring. Tool handles. | |
| **Ash** | | **Deciduous -** strong, durable the grain is fairly straight, but the wood can be course. | | Flooring and tool handles. | |
| **MDF** | | **Man-made –** Uniform in size and thickness, takes a good finish and is easy to work with. | | Laminated flooring or kitchen cupboards. | |

**Tasks 1-3 Learn/cover/write and self-check the wood, classifications and properties.**

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| **1. Improving the look of cheaper timber based materials.** |
| **Adding a layer of veneer can improve the look of a cheap piece of timber.** |
| * + Veneers may be made from real wood, a man made finish or plastic.   + Suggest another benefit of surface finishing a manufactured board. |

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| **2. Knotty problems - Natural timbers can have natural defects.** |
| * + The most common natural defect is a knot.   + Softwoods such as pine, larch and cedar can also seep resin at the knot. A knot solution must be used to seal the knot so the oil does not affect the paint. |
| **3. Common boards** |
| **Important information relating to common manufactured boards below:** |
| |  |  |  | | --- | --- | --- | | **Medium density fibreboard or MDF** | **Chipboard or particle board** | **Plywood** | | Very dense board which makes it tough | Good compressive strength | Made up of alternative rotated layers of glued wood veneers | | Its smooth surface makes it suitable for veneers and finishes | Edges chip easily | Available in various forms including marine ply for greater water resistance | |

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| **3. House construction and their material uses** |
| **Below is a diagram of what materials are used on various parts of a house.** |
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**Tasks 1-3 Learn/cover/write and self-check the wood, classifications and properties.**

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| **1. Where metal comes from.** |
| **The word ‘metal’ comes from the ancient Greek word *‘metallon*’ which means to mine, excavate or extract from the ground. The Earth’s crust contains many types of rock.** |
| * + Metallic minerals are found naturally in rock or ore.   + Ore is obtained by mining and the metals within it are extracted.   + The method used for extraction depends on the metal’s reactivity with air, water or acids.   + The more reactive the metal, the more expensive it is to extract. |

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| **2. Extraction processes** |
| **Some metals exist as oxides.** |
| * + Metals such as copper, iron and zinc are oxides. These are heated with carbon to extract the metal.   + Electrolysis is used to extract metals such as aluminium. |

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| **3. Iron ore** |
| **Iron can be extracted from iron ore by using a blast furnace and the process of smelting.** |
| * + Smelting extracts common industrial metals such as iron.   + The extreme heat draws off the metals in a liquid state called ‘hot metal’.   + The impurities are removed and the iron mixed or ‘alloyed’ with a small amount of carbon to create steel.   + The amount of added carbon affects the strength of the steel. |

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| **4. Ferrous metals** |
| **Ferrous metals contain iron and may rust.** |
| * + Iron and steel can corrode – this is known as rust.   + Rust is a compound called iron oxide and is formed when iron and oxygen react in the presence of moisture or water.   + Most ferrous metals are magnetic.   + Name **two** types of protective layer that could be added to metal to prevent rust. |

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| **5. Ductility and malleability** | |
| **Ductile metals** | **Malleable metals** |
| * + Will stretch without being damaged.   + Can be drawn or stretched out into long wires.   + Copper is highly ductile and can be drawn into long, thin wires. | * + Can be hammered into a shape  without breaking.   + Can be rolled or pressed into sheets.   + Will deform under compression. |

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| **6. Hard and tough** | | |
| **Hardness** | **Toughness** | |
| * A material’s ability to withstand abrasion. * A very hard metal is likely to crack or shatter upon impact or force. Cast iron would be described as hard and brittle. | | * Toughness – metal requires  strength and ductility. * This is how well a metal can  absorb energy and resist  fracturing without deforming. |

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| **7. Tensile strength** | |
| **Tensile strength is the amount of tensile stress (stretching) a material can withstand before breaking or failing.** | |
| * + Testing for tensile strength is crucial in industry.   + Suggest **two** uses for metals with high tensile strength. |  |

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| **8. Steel** |
| **Steel is a ferrous metal available in different forms.** |
| * + Steel has a high resistance to corrosion, staining and friction which makes it suitable for a wide range of uses.   + These elements give steel its characteristic properties of hardness and toughness.   + High speed steel is formed by alloying elements of carbon, tungsten, vanadium, cobalt, chromium or molybdenum. |

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| **8. Non-ferrous properties** | |
| **Non-ferrous metals don’t contain iron. They are often more expensive than ferrous metals owing to their desirable properties which include:** | |
| * + Lightweight   + Good conductivity   + Ductile and malleable   + Resistant to corrosion | **The process of galvanising adds a protective coat of zinc to iron and steel to help prevent rusting.** |

**Tasks 1-8 Learn/cover/write and self-check metals part 1.**

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| **1. Electrical conductivity** |
| **Conductivity is how easily an electrical current can flow through a metal.** |
| C:\Users\desig\AppData\Roaming\PixelMetrics\CaptureWiz\Temp\49.png  As copper is such an efficient conductor, it’s most common use is in electrical cabling. |

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| **2.Thermal conductivity** |
| **Thermal conductivity measures the ability of a metal to conduct heat.** |
| C:\Users\desig\AppData\Roaming\PixelMetrics\CaptureWiz\Temp\49.png  Copper is also an excellent conductor of heat and is commonly used in air conditioning, water tanks, saucepan bases and water heaters. |

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| **3. Alloys** |
| **Metals are rarely used in their pure form. Alloys are made by combining two or more elements.** |
| * This helps improve the working properties and appearance. * Brass and steel are common alloys. * Stainless steel is made by combining iron, with a small amount of carbon and chromium; this protects the alloy from oxygen. |

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| **4. Uses of metals** |
| **A vast range of metals may be used to create a single product. The diagram below shows a variety of uses for metal.** |
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| **5. List of metals and their classifications** | | | |
| **Ferrous metals** | | **Non-Ferrous metals** | **Alloys** |
| * *Iron* * *Steel* * *Mild steel* * *High speed steel* * *Carbon steel* * *Engineered steel* | | * *Aluminium* * *Aluminium Alloys* * *Copper* * *Brass* * *Lead* * *Zinc* | * [*Duralumin*](https://en.wikipedia.org/wiki/Duralumin) * *Brass* * *Bronze* * *Titanium* |
| **Alloys** | | | |
| **Alloying agent** | **Properties** | | **Uses** |
| **Chromium** | Resists wear and increases corrosion resistance. Increases hardness and toughness. | | Stainless steel: Kitchen utensils, medical instruments. |
| **Vanadium** | Increases strength and toughness of steel, including wear resistance. | | Crank shafts, some hand tools & surgical instruments. |
| **Nickel** | Increases strength and hardness, resistance to corrosion. | | Engine parts, turbine blades, measuring tapes. |

**Tasks: 1-5 Learn/cover/write and self-check metals and alloys.**

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| **1. What are polymers?** | |
| **Polymers are mostly synthetic materials.** | |
| * + They are usually derived from finite resources such as coal, natural gas or crude oil.   + More renewable and sustainable materials such as vegetable starches are being used to make bio-plastics. |  |

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| **2. Classification of plastic** | | | |
| **Plastics are categorised into two types.** | | | |
| Thermo plastic (thermoforming) | | Thermosetting plastic | |
| Also known as thermoplastics, when heated the plastic becomes soft and flexible. | | Also known as thermosets, this plastic cannot be reformed once set in to shape. | |
| Thermoplastics can be remoulded without affecting the material’s physical properties. | | Thermosets have strong chemical bonds between the molecules, which do not separate on heating. | |
|  | | High heat resistance. | |
| **Molecular structure** | | | |
| **Thermoforming plastics** | | **Thermosetting plastics** | |
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| Long chains of loose molecules that have no fixed structure or pattern. | | Individual monomers join to form a large polymer. These long chains of molecules are cross linked resulting in a rigid molecular structure. | |
| **3. Thermoplastic pros and cons** | | |
| **Thermoplastics can be repeatedly heated and moulded.** | | |
| * + Thermoplastics are not suitable for use in areas of heat or UV sensitivity.   + A good surface finish can be  achieved for superior aesthetics.   + They can be recycled.   + Each time the plastic is reheated  it will try to return to its original shape – this is known as plastic memory. |  | |

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| **4. Thermosets pros and cons** | |
| **Thermosets are hard and durable with good structural rigidity.** | |
| * + Able to withstand higher  temperatures.   + Waterproof when solid, so ideal  for use in adhesives.   + A good electrical insulator.   + Cannot be remoulded. |  |

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| **5. Moulding and forming** |
| **Plastics can be formed using a variety of processes** |
| * + **Blow moulding** – forming hollow plastic items.   + **Extrusion** – creating objects with a cross section profile.   + **Injection moulding** – injecting softened plastic into a mould.   + **Vacuum forming** - sheet of softened plastic forced onto a mould. |

**Tasks: 1-5 Learn/cover/write and self-check plastic classifications.**

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| **1. Polyethylene - This is the most common thermoplastic with over 80 million tonnes produced globally each year.** |
| **There are several types of polyethylene including:**     * + - *Polyethylene terephthalate (PETE)*     - *High density polyethylene (HDPE)*     - *Low density polyethylene (LDPE)*   Polyethylene can be rigid with good strength to weight ratio. It has good ductility and impact strength. Its stability makes it a suitable plastic for blow-moulding. |

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| **2. Polyvinyl chloride - PVC is widely used for packaging, pipes, outerwear, electrical tapes and children’s toys.** |
| * + PVC can be rigid and commonly used for making pipes.      * + It is tough and easily extruded.   + With the addition of plasticisers, it becomes flexible. |

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| **3. Polypropylene - A very versatile polymer, polypropylene is used for solid plastics, films and fibres.** |
| * + It has low density, making it lightweight.      * + It is ductile, enabling it to stretch for use in fibres and films.   + It’s chemically resistant and easily cleaned which makes it very suitable for food containers. |

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| **4. High Impact Polystyrene - HIPS is shatterproof and a good insulator.** |
| * + It’s flexible and lightweight so ideal for vacuum forming.   + Impact resistant, it is suitable for food containers   particularly yoghurt pots and fast food containers.   * + HIPS is easily mouldable and has a good gloss finish. |

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| **5. Acrylic Polymethyl-Methacrylate - This versatile and hard wearing plastic, comes in a variety of thicknesses and colours.** |
| * + It’s a tough plastic, but becomes brittle if very thin.   + It can also be spun into threads and woven. |

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| **6. Epoxy resin Epoxy resins are a class of reactive polymers.** |
| * + Supplied as two liquids; a *resin* with a *hardener* which acts as a catalyst to set the resin.   + Epoxy resins are used as adhesives, for example Araldite®.   + With a good strength to weight ratio, epoxy adheres well to fibreglass and carbon fibre, reinforcing it. |

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| **7. Polyester resin - Polyester resin is a viscous, pale polyester solution and the addition of a catalyst, hardens the resin.** |
| * + The hardened resin is tough with high abrasion resistance which makes a high-performance coating for areas of high wear, for example flooring.   + Clear polyester resin is suitable for object embedding, clear sculpture casting and jewellery making.   + Resin replicas e.g. anatomical models can also cast be cast and painted. |

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| **8. Composite adhesive - Polyester resin is commonly used with composite materials such as fibreglass.** |
| * + Lightweight and weatherproof, it’s used to adhere layers of fibreglass  in the making of boat hulls, vehicle parts and panels for caravans. |

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| **9. Formaldehyde - An early compound, thermoset products made using formaldehyde include:** | |
| * + Melamine formaldehyde   + Phenol formaldehyde   + Urea formaldehyde | **Phenol formaldehyde (created in 1909) was known as Bakelite.**   * + Very rigid and hard, it was often used for electrical components and household items such as clocks, radios and telephones. |

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| **10. Melamine formaldehyde - Melamine is a hard thermoset.** | |
| * + A heavy material, it has good resistance to heat, chemicals and moisture.   + It has good resistance to scratches,  but it is prone to chipping. | * + Available in a range of colours and thicknesses, it is often used for picnic wear and as a laminate for  kitchen surfaces. |

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| **11. Urea formaldehyde - Urea formaldehyde is a good electrical insulator.** | |
| * + With good heat resistance it is used for  manufacturing electrical fittings.   + The textiles industry treats some fabrics with UF resins to promote easy care properties such as anti-wrinkling. | * + The paper industry uses UF to improve tear strength.   + The timber industry uses UF resin to bind particles in the making of manufactured boards such as MDF. |

**Tasks: 1-11 Learn/cover/write and self-check the various plastic types and uses.**

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| **1. Textile categories - Textiles can be manufactured to exhibit a variety of properties depending on the blend of fibres.** | |
| * + Natural fibres   + Synthetic fibres   + Blended and mixed fibres | * + Woven and non-woven fabrics   + Knitted textiles |

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| **2. Fabric types** | |
| **Natural fabrics** | **Synthetic fabrics** |
| * Wool, Cotton and Silk. | * Polyester, Elastane (Lycra) * Nylon |

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| **3. Cotton - The fruit of a cotton plant is a capsule called a ‘boll’.** |
| * + The mature seed splits open to reveal the fibres.   + Once harvested, the fibres are spun into yarn.   + Cotton is soft, strong and easily washable. |

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| **4. Silk - Silk is a natural, raw fibre sourced from the cocoon of the larvae of a silkworm.** | |
| * + The shimmering appearance comes from the  fibres’ triangular like structure.   + A luxury material, its fine finish is soft and  gentle to the touch.   + Silk drapes beautifully & retains its shape well. |  |

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| **5. Wool - Wool fibre is commonly sourced from sheep fleece.** | |
| * + Depending on the source of the wool, it can feel coarse or soft.   + It can be easily spun, woven or knitted.   + Wool is naturally crease resistant and absorbs dyes very successfully.   + Wool absorbs vapours and keeps a layer of dry air next to the skin, which helps retain body heat, keeping you warm. |  |

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| **6. Synthetic fibres - Synthetic fabrics are made from different types of polymer, derived from petrochemicals.** | |
| * + Dyes are added at the manufacturing stage, so a wide range of colours can be easily produced. | **Polyester & Polyamide (Nylon) are:**   * + Hardwearing, with good strength.   + Non-absorbent and wash well.   + Easily blended with other fibres. |

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| **7. Stretch - Elastane, Spandex or Lycra® is a synthetic fibre and used where elasticity is required.** |
| * + It can be spun with other textiles to give form fitting properties which are ideal for under garments and swimwear. |
| **8. Polycotton - A fabric made from a blend of polyester and cotton.** |
| * + Lightweight, soft and moisture absorbing.   + A durable fabric, it’s suitable for bed sheets, pillow cases and clothing. |

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| **9. Woven textiles - Yarns are woven together to form fabric.** | |
| * + The commonly used types are plain weave and twill weave.   + A loom weaves two threads – the warp and the weft - at right angles to each other.   + The self-finished edge is known as the selvedge, which stops the fabric from fraying. |  |

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| **10. Plain woven textiles - Plain weave is straightforward to produce and stronger than more decorative weaves.** |
| * + No matter what thickness yarn is used, plain weave forms a stable fabric construction.   + This is commonly used with fabrics such as calico, muslin, gingham, taffeta and voile.   + It’s typically used with home furnishings and tablecloths. |

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| **11. Non-woven textiles - A sheet or web of fibres are bonded thermally, chemically or mechanically.** |
| * + Made directly from fibres, no weaving or knitting is required.   + Non-woven fabrics have specific properties such as absorbency, sterility, stretch, softness, flame retardancy, cushioning and filtering. |

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| **12. Felted fabric - Felt is a dense, non-woven fabric.** |
| * + Matted fibres are pressed together with heat, moisture and pressure.   + Felt is usually made of wool, but when mixed with synthetics it becomes more resilient.   + Using heat and moisture, it can be shaped and formed. |

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| **13. Knitting - A series of interlocking loops produces a knitted fabric.** | |
| * + Weft knitting – the interlocking loops are formed horizontally, which enable it to stretch, but may lose shape.   + Warp knitting – the loops interlock vertically, so the knit keeps it shape and is less likely to unravel or ladder.   + Weft knits are suitable for close fitting garments as the stretch allows the wearer to move comfortably. | **Weft**  **Warp** |

**Tasks: 1-13 Learn/cover/write and self-check the variety of fabrics.**