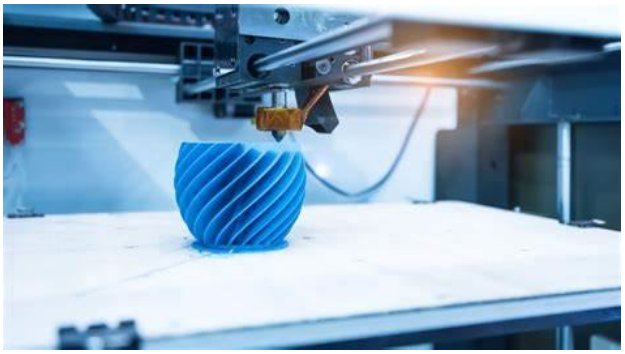
Year 7 – 3D Printing, CAD & Prototyping



Key Vocabulary

1. **3D Printing** - A method of creating a physical object from a digital model by adding material layer by layer.
2. **Additive Manufacturing** - A process that builds objects by adding material, as opposed to subtractive manufacturing, which removes material.
3. **CAD (Computer Aided Design)** - Software used for creating precise drawings and technical illustrations, essential for 3D modelling.
4. **Disruptive Technology** - Innovations that significantly alter or replace traditional industries or processes, like 3D printing in manufacturing.
5. **Isometric Drawing** - A sketching technique that represents three-dimensional objects on two-dimensional paper, showing depth using 30-degree angles.
6. **Orthographic Projection** - A method of creating a two-dimensional representation of a three-dimensional object, typically using multiple views: elevation, side elevation, and plan view.
7. **Slicing Software** - A program that converts CAD models into G-code, which instructs 3D printers on how to create the object layer by layer.
8. **STL (Stereolithography)** - A file format used for 3D printing, containing information on a 3D model's surface geometry.
9. **Polymers** - A type of material made of long molecular chains, commonly used in 3D printing (e.g., ABS and PLA).
10. **Resolution** - The level of detail or clarity in a 3D print; higher resolution means better quality but can take longer to produce.
11. **Personal Protective Equipment (PPE)** - Gear worn to minimize exposure to hazards, such as goggles, gloves, and masks.

Objectives

Drawing in 2D & 3D

- Identify different 3D shapes.
- Understand different sketching techniques to draw in 2D and 3D.
- Be aware of how these techniques are used in the real world.

3D Printing - Learning Objectives:

- Understand the process of 3D printing.
- Introduce the concept of 'disruptive technology'.
- Understand the advantages and disadvantages of 3D printing.
- Be aware of a range of 3D printing methods and the materials used.

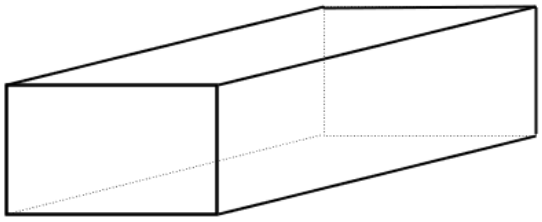
- Identify different methods of 3D printing and the materials used.
- Understand the processes involved in creating a 3D printed artifact.
- Identify the major component parts of a desktop 3D printer.

- Understand the stages between CAD modelling and making 3D printed components.
- Accurately create components using CAD software.
- Export components as STL files.

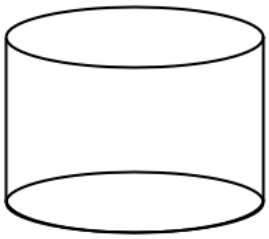
Prisms

A prism is a solid which has the **same cross-section** along its length.

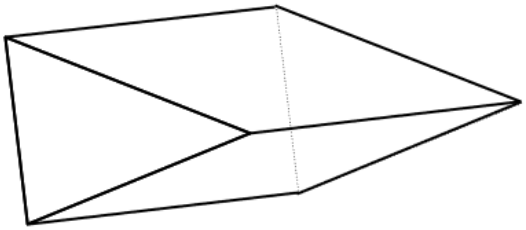
Rectangular prism or cuboid



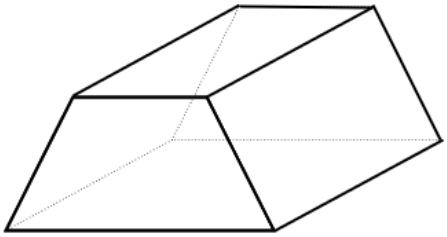
Circular prism or cylinder



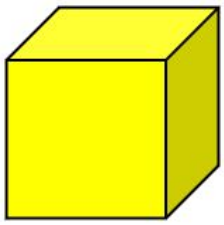
Triangular prism



Trapezoidal prism

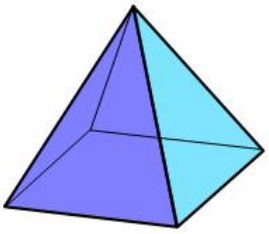


Cube

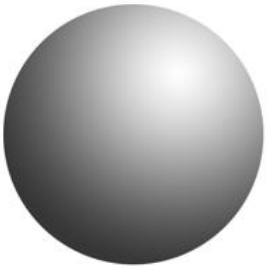


Cuboid

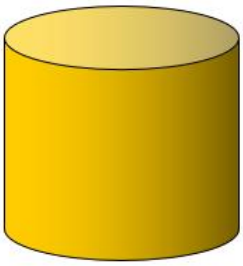
Square-based pyramid



Sphere



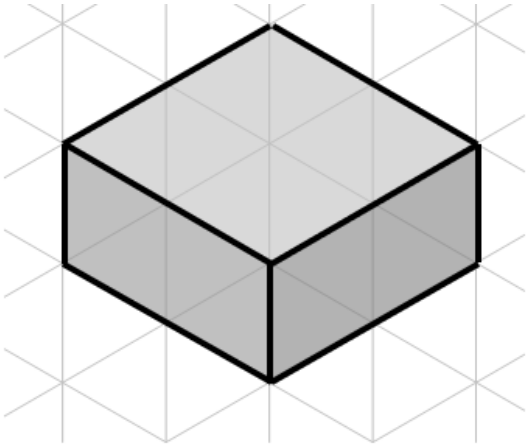
Cylinder

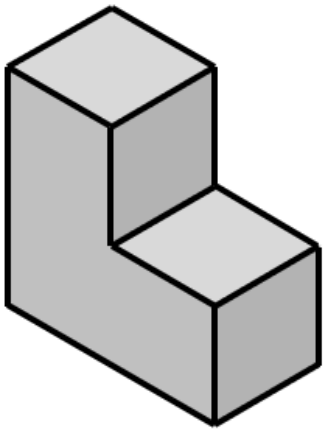


Cone

Isometric Drawing

It has diagonal lines to help represent depth of 3D solids clearly.
All lines in Isometric are either at 30 degrees or are vertical





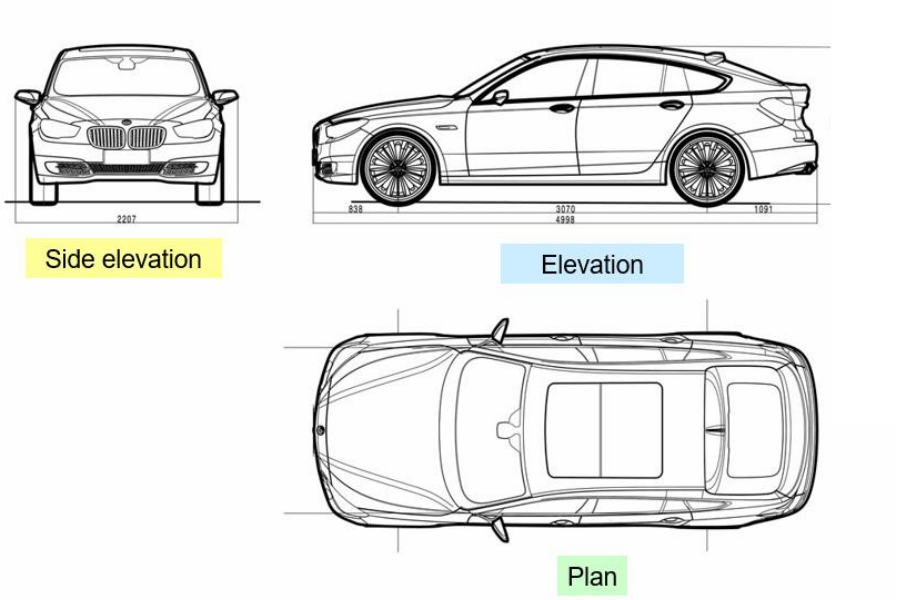
Orthographic Projection

Engineers, architects and manufacturers produce blueprints of houses, buildings and products which enables them to construct and manufacture easily. These drawings have important measurements and information. There are 3 main views that are used

Elevation – Usually the view with the most detail.

End Elevation/Side Elevation – Viewing from the end/side

Plan/Top View – Looking down from above (Bird's eye View)



3D Printing

3D printing, also known as additive manufacturing, is a method of creating a physical object from a digital model using CAD software. Unlike **subtractive manufacturing, which removes material**, 3D printing adds material layer by layer.

CAD

CAD stands for Computer Aided Design. Onshape is the program used at KS3 for 3D modelling.

Disruptive Technologies
3D printing is a 'disruptive technology' as it can transform industries by replacing traditional manufacturing processes.

Materials Used in 3D Printing:
Materials used in 3D printing, include polymers like ABS and PLA, metals, food, and even biological materials (bioprinting).

Uses for 3D Printing:
3D printing is increasingly used in various fields, from medical implants to prototypes in engineering.

The advantages of 3D printing include:

- Quick manufacture of objects or parts
- Single step manufacture process
- Freedom to create complex designs
- Easy customisation and personalisation

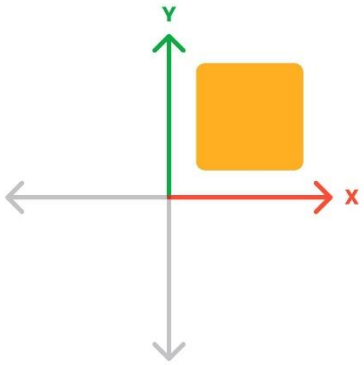
Disadvantages include:

- Build size is often restricted to smaller items
- Relatively high cost
- Resolution can be poor on some machines
- Post-processing can be required

- Complex jobs can take a long time to build.

Slicing Software:

Slicing software, prepares CAD models for printing by converting them into G-code. The G-code produced is thousands of X,Y,Z coordinates (example X35,Y100,Z90) which makes the machine move to the specific point. Similar to plotting X and Y coordinates in Maths.



STL

The name STL is an acronym that stands for stereolithography. The this the file type a CAD model must be saved in before adding it to your slicing software.

Health & Safety

Health and Safety in the Design and Technology Workshop

Safety is a top priority in any workshop. Establishing clear rules and guidelines helps to protect everyone involved. Here are some important workshop rules to keep in mind:

1. You must never enter the Design Technology room unless there is a teacher present.
2. All bags should be placed under the table at all times.
3. You must treat all workshop equipment with respect and leave the room tidy.
4. Horseplay and any unruly or inattentive behaviour will not be tolerated in the workshop.
5. Machines, tools and equipment must be used in the correct manner and never misused.
6. Aprons must be worn and fastened correctly.

7. Protective goggles, ear defenders and/or masks must be worn when the warning signs specify or when the teacher instructs you to.
8. Students MUST always walk around the D&T Room with caution when carrying materials, tools or projects.
9. All sharp objects MUST be carried with points facing down. (e.g. Chisels, saws etc.)
10. When operating machinery, loose jewellery (Necklaces, earrings, bracelets, rings, watches etc.) must be removed or made safe.
11. Long hair must be restrained (Either tied back, under a hairnet or pinned back) at all times.
12. Machines must not be left unattended at any time during operation, unless instructed to do so.
13. Machinery is to be operated by only one person at a time.
14. Protective guarding must be used if fitted to the machine.
15. Ensure trolley wheels are locked before using any machines.
16. You must not distract another student whilst a machine is in operation.
17. When a machine or piece of equipment is operational, never attempt to touch any of the moving parts. In an emergency, power should be switched off first.
18. Never touch sharp items (Even if the machine is not operational)
19. All spillages must be attended to and cleared immediately.
20. All breakages/damage must be reported to the teacher immediately.
21. Exhaust/dust fume extractors must be used at all times when appropriate.
22. You must put away all equipment and leave the room as you would like to find it

Personal Protective Equipment (PPE)

PPE is crucial in minimising exposure to hazards in the workshop. It includes various protective gear that helps prevent injuries. Below are some types of PPE commonly used in Design and Technology:

- **Dust Masks**: Used when sanding or sweeping to prevent inhalation of dust.
- **Respirators**: Protect against inhaling toxic fumes.
- **PVC Aprons:** Protect clothing and skin from chemicals.
- **Earmuffs and Earplugs**: Safeguard ears from excessive noise.
- **Gloves**: Protect hands from sharp edges and rough materials.
- **Safety Glasses/Goggles:** Protect eyes and face when using tools.

Safety Symbols and Colours

Recognizing safety symbols and colours is essential for maintaining a safe workshop environment. Be aware of these symbols and their meanings:

- Red: Danger or stop.
- Yellow: Caution or warning.
- Green: Safety or go.
- Blue: Mandatory action.

SAFETY COLOUR	MEANING	SHAPE	EXAMPLE
RED	• Fire-fighting equipment		
	• Prohibition		
YELLOW	• Hazard • Caution • Possible Danger		
GREEN	• First-Aid • No danger • Safe condition • Positive action		
BLUE	• Mandatory • Information		

Approach to Safety

When working in the workshop, always take your 'TIME' to assess the situation:

- **Task:** Look at the job you are doing.
- **Individual:** Consider your own safety and well-being.
- **Machine**: Understand the equipment and tools you are using.
- **Environment:** Be aware of the surroundings and potential hazards.

Workshop Safety Features

Workshops are equipped with safety features to protect users:

- **Electrical Safety Features:** Isolation switches and emergency stop buttons.
- **Dust Extraction:** Reduces the risk of inhaling harmful dust.
- **Machine Guards:** Protect users from moving parts.
- **Fire Extinguishers:** Ensure a quick response to fires.