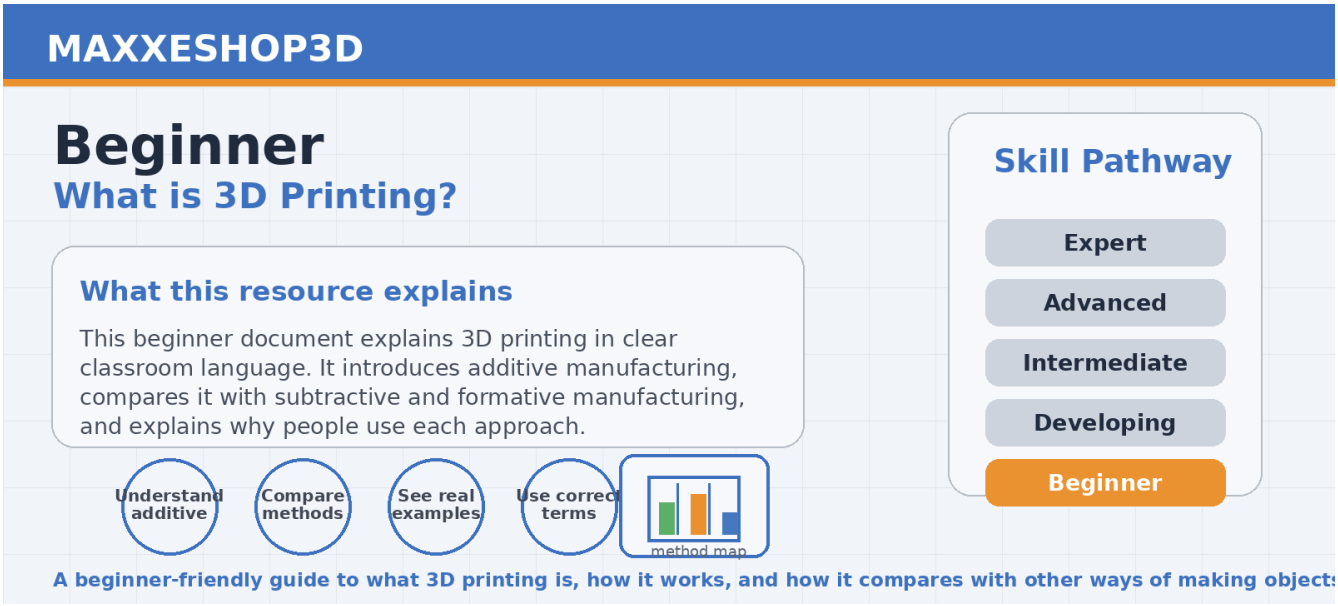


Beginner Level • What is 3D Printing?

A beginner-friendly guide to what 3D printing is, how it works, and how it compares with other ways of making objects

This beginner document explains 3D printing in clear classroom language. It introduces additive manufacturing, compares it with subtractive and formative manufacturing, and explains why people use each approach.

Resource overview

3D printing is a way of making an object by building it up in many thin layers from a digital design. For many students, this is the first time they meet a manufacturing method that begins with a computer model and ends with a real part. This document explains that idea in detail and shows why 3D printing is often described as additive manufacturing.

To understand 3D printing properly, it helps to compare it with other manufacturing families. Some methods remove material from a larger block. Other methods shape or form material by pressing it into a mould or die. 3D printing is different because it adds material only where the object needs to be built.

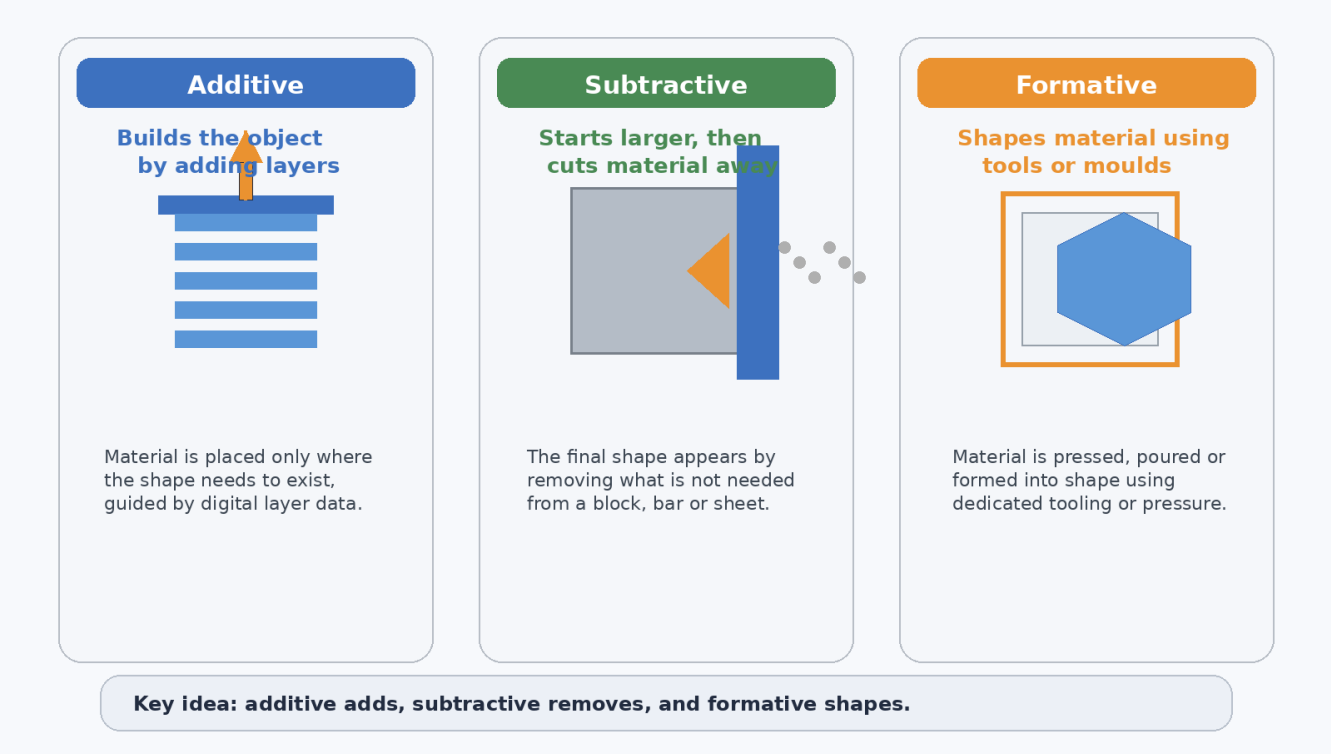
Indicative level	Beginner
Suggested use	Introductory STEM lesson or first manufacturing overview
Best suited to	Students new to 3D printing and new to manufacturing vocabulary
Learning focus	Explain what additive manufacturing means and compare it to other broad methods
Related resource areas	Fundamentals • Terminology • Design

What 3D printing means

At beginner level, students should learn that 3D printing is not just 'a machine that makes things'. It is a manufacturing process with a special idea behind it: the object is built a little at a time, layer by layer, from digital instructions.

This makes 3D printing different from many traditional methods. Instead of cutting a shape out of a block or pouring material into a mould, the printer adds material in the pattern needed to form the final object.

Diagram 1 • Comparing additive, subtractive and formative manufacturing



This diagram supports the beginner explanation by showing the three main manufacturing families side by side.

Comparing manufacturing approaches

Manufacturing approach	How it works	Where it suits
Additive manufacturing	Builds the part by adding material in layers only where the design needs it.	Prototypes, custom parts, classroom models and short-run items.
Subtractive manufacturing	Starts with a larger block or sheet and removes material to reach the final shape.	Machining, cutting, carving and precise production work.
Formative manufacturing	Shapes material using moulds, dies, pressure or forming tools.	Mass production, repeated parts and high-volume manufacturing.
Digital starting point	Usually begins with a 3D model that is sliced into printable layers.	Useful when design changes need to happen quickly.
Tooling needs	Often uses little or no dedicated tooling for each new design.	Helpful when only one or a small number of parts are needed.
Material use	Places material where the object will exist, though support material may also be used.	Can reduce waste compared with cutting from a solid block.

How additive manufacturing builds an object

The word additive is important because it explains the main idea of 3D printing. The machine does not begin with a finished block that must be carved down. Instead, it begins with raw material such as filament or resin and places that material in carefully controlled positions until the shape grows into the finished part.

A helpful mental picture is to imagine building a wall from many rows of bricks, except the rows are much thinner and the placement is controlled by a digital file. Each new layer depends on the one below it. This is why the early layers matter so much and why printers follow a step-by-step sequence rather than making the object all at once.

This layer-by-layer approach makes 3D printing easy to connect with computer design. A student can change a digital model, send the new design to the printer, and produce a different object without needing to carve a new mould or reset a complex cutting process.

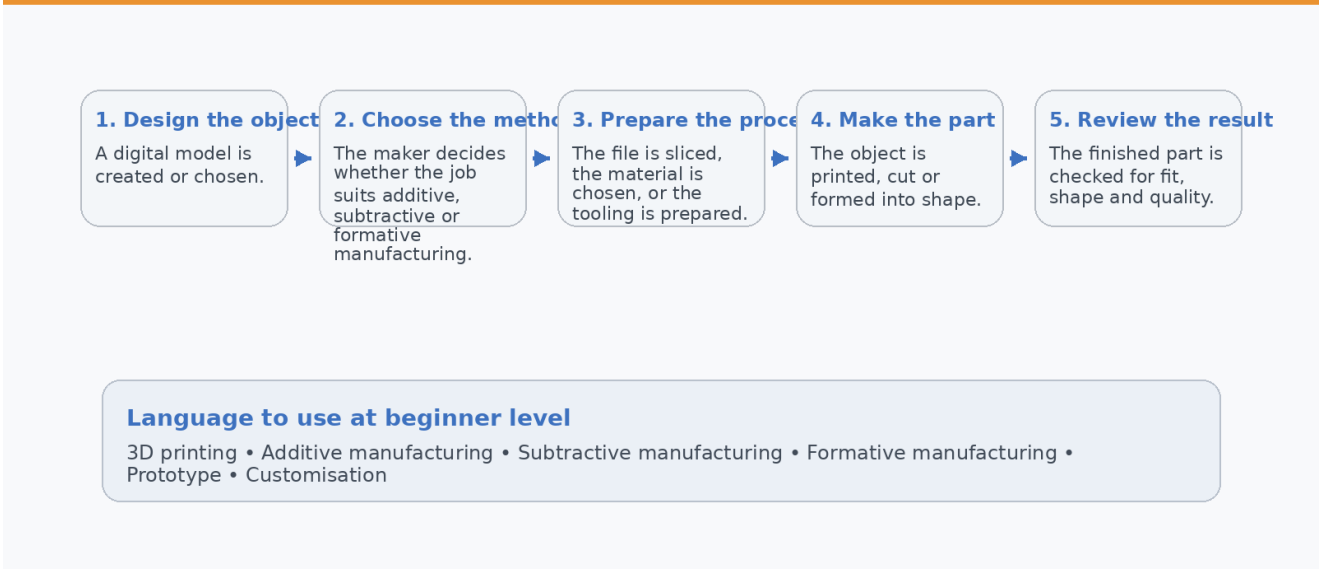
How subtractive and formative methods differ

Subtractive manufacturing works in the opposite direction to additive manufacturing. Instead of building up a shape, it starts with more material than is needed and removes what is not wanted. Cutting timber from a board, machining metal from a block, or carving a shape from foam are all familiar ways of thinking about subtractive work.

Formative manufacturing is different again. In formative methods, material is pressed, poured, stamped, moulded or otherwise shaped into its final form. Injection moulding, casting, vacuum forming and sheet bending are examples. In these processes, the material is guided into shape by tools, moulds or pressure rather than by being cut away or layered upward.

These differences matter because each method has strengths. 3D printing is excellent when designs change often or when only a few parts are needed. Subtractive methods can be excellent for accuracy and surface finish. Formative methods are powerful when the same part must be repeated many times.

Diagram 2 • Beginner manufacturing decision workflow



The workflow diagram above shows how method choice sits inside a broader manufacturing decision at beginner level.

Advantages of 3D printing for learning and making

One of the clearest advantages of 3D printing is flexibility. A student or designer can change a digital model and print a new version without buying a new mould or resetting a large production line. This makes 3D printing especially useful for learning, testing ideas and making one-off items.

Another advantage is customisation. Because the machine follows a digital file, it can produce parts that are shaped for one person, one class task or one special purpose. It is often much easier to make a customised part with 3D printing than with methods designed around mass production.

3D printing can also be easier to access in schools because it turns manufacturing into a visible and understandable process. Students can watch the part grow, connect the digital model to the real object, and see how manufacturing choices affect the result.

Where 3D printing is not always the best choice

A good beginner explanation should also say that 3D printing is not better at everything. If a factory needs to make thousands of the same plastic item very quickly, a formative method such as injection moulding may be faster and more economical once the mould is ready.

If a job needs a very smooth finish, very tight machining accuracy or the properties of a specific solid material, subtractive methods may be more suitable. A milled or turned part can sometimes achieve results that are hard for a simple classroom 3D printer to match.

This helps students build balanced understanding. The strongest question is not 'Is 3D printing best?' but 'When is 3D printing the right method, and when is another method more suitable?'

Good comparison reminders	Suggested classroom discussion
• Choose the method to match the job, not the trend. • Consider shape, quantity, material, finish and time together. • Remember that a process can be strong in one context and weak in another. • Use comparison language carefully and explain your reasoning.	• Describe one product that suits 3D printing well and explain why. • Describe one product that would likely suit subtractive or formative manufacturing better. • Explain what changes when the design changes often. • Compare the role of quantity in process selection.

Vocabulary focus

3D printing Making an object from a digital design by building it layer by layer.	**Additive manufacturing** Manufacturing that adds material to create a part.	**Subtractive manufacturing** Manufacturing that removes material from a larger starting piece.
Formative manufacturing Manufacturing that shapes material using moulds, dies, pressure or forming tools.	**Prototype** An early sample or test version of a design.	**Customisation** Changing a product so it suits a specific user or purpose.

Why this level matters

This level matters because it gives students the language needed to talk clearly about manufacturing. Once they understand the three broad approaches, they can start making better decisions about why an object was made in a certain way.

It also helps students connect classroom 3D printing to the wider world. They begin to see that printers, machines, moulds and workshop tools are all part of the larger story of how products are designed and produced.

Teacher extension prompt

Ask students to explain the difference between building an object up, cutting it down and shaping it into form. Strong beginner responses should correctly use the words additive, subtractive and formative in full sentences.