

## MAXXESHOP3D

## Developing

### What is 3D Printing?

#### What this resource explains

This developing document expands the basic idea of 3D printing into fuller explanations of process, material use, design flexibility and method selection.



A developing-level guide to how additive, subtractive and formative manufacturing solve different production problems

#### Skill Pathway

Expert

Advanced

Intermediate

Developing

Beginner

## Developing Level • What is 3D Printing?

A developing-level guide to how additive, subtractive and formative manufacturing solve different production problems

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### Resource overview

At developing level, students should move from simple definitions into process thinking. 3D printing is still additive manufacturing, but students now need to understand how the process behaves, what kinds of problems it solves, and why manufacturers may choose it over other methods.

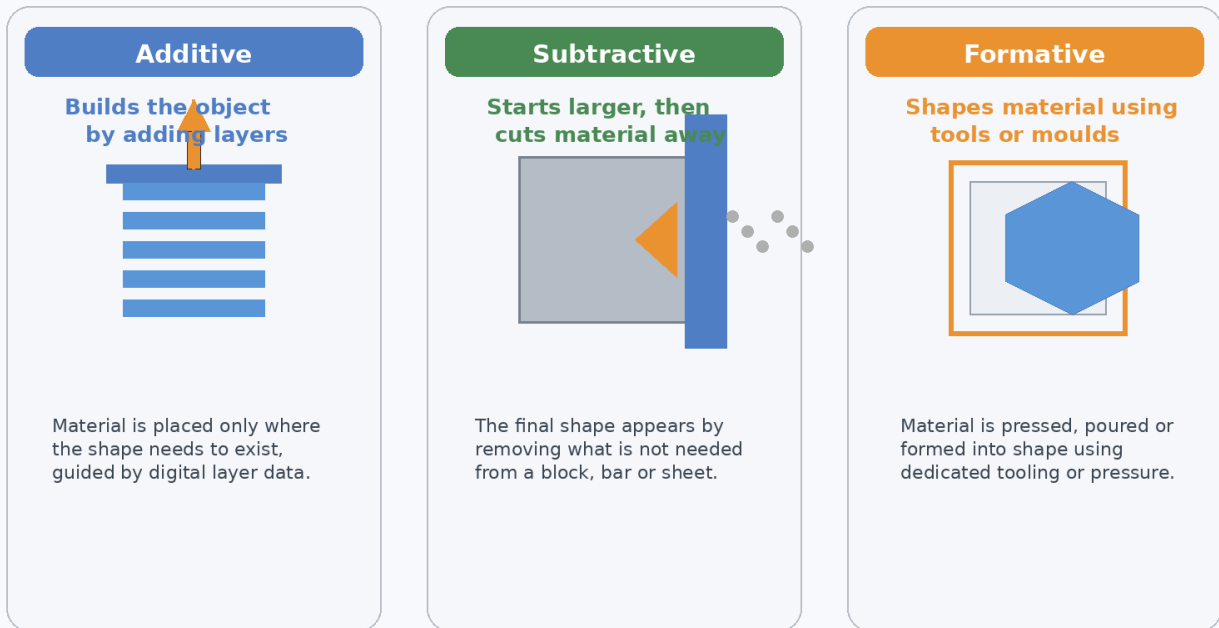
This document compares additive, subtractive and formative manufacturing in more practical terms. It explains how material is handled, how design changes affect production, and why some methods suit one-off items while others suit repeated, large-volume output.

<b>Indicative level</b>	Developing
<b>Suggested use</b>	Follow-on STEM lesson or introductory manufacturing comparison
<b>Best suited to</b>	Students ready to connect manufacturing methods to practical use cases
<b>Learning focus</b>	Explain how method choice affects waste, flexibility, speed and repeatability
<b>Related resource areas</b>	Design Process • Materials • Problem Solving

## 3D printing as a manufacturing choice

A developing learner should recognise that 3D printing is not chosen only because it looks modern or interesting. It is chosen because its layer-based process can be very helpful when a design changes often, when the part is complex, or when only a small number of units are needed.

This level also introduces a more realistic comparison with other methods. A good process choice depends on the shape, the quantity, the material, the time available and the finish required.

**Diagram 1 • Comparing additive, subtractive and formative manufacturing**

**Key idea: method choice changes how material, time and design changes are managed.**

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

# Comparing manufacturing approaches

Manufacturing approach	How it works	Where it suits
<b>Additive manufacturing</b>	Adds material only where the part is built, often from a digital model with minimal special tooling.	Excellent for prototypes, complex internal features and low-volume custom parts.
<b>Subtractive manufacturing</b>	Removes material through cutting, drilling, milling or turning.	Strong for precision, rigid materials and accurate finished surfaces.
<b>Formative manufacturing</b>	Uses moulds, dies or pressure to shape material into repeated forms.	Strong for high-volume production and repeatable part output.
<b>Design changes</b>	Usually easier to update because the digital file can be changed directly.	Useful when a design is still being improved.
<b>Setup cost</b>	Often lower at small scale because dedicated tooling is limited or unnecessary.	Helpful for schools, small batches and concept testing.
<b>Production scale</b>	Usually slower per part than mass-production methods when very high quantities are needed.	Best understood as flexible rather than automatically fastest.

## 3D printing is a digital-to-physical workflow

A useful way to understand 3D printing at developing level is to see it as a digital-to-physical chain. A 3D model is created or selected, then the file is prepared for the machine, then the material is deposited or cured layer by layer until the object appears. This means the final part is strongly connected to the quality of the digital design and the settings used to prepare it.

Because the workflow begins with digital data, design changes can happen quickly. A student can adjust a size, remove a feature, add a label or test a new shape and then print an updated version. That is one of the reasons 3D printing is so useful in education and product development. It turns design revision into a manageable and visible process.

This is different from methods that depend heavily on physical tooling. If a mould or forming tool already exists, changing the design may become much harder and more expensive. In additive manufacturing, the file often becomes the main source of flexibility.

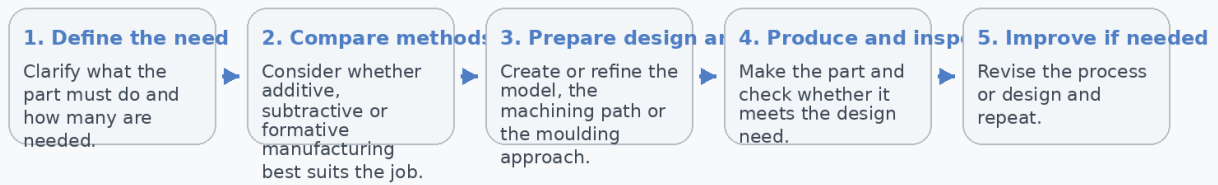
## Material use and waste are important comparison points

Developing students should understand that manufacturing methods handle material differently. In subtractive manufacturing, the starting piece is often larger than the final object, and the unwanted material is removed. Some of that removed material may be recyclable, but the process still begins by taking away more than is kept in the final shape.

In additive manufacturing, material is generally placed where the part needs to exist, although support material or failed prints can still create waste. This often makes 3D printing attractive for complex or unusual shapes because the maker does not need to carve every feature out of a solid block.

Formative manufacturing uses material efficiently in a different way. Once the correct mould or tool is ready, the same shape can often be repeated quickly and consistently. This shows students that efficiency is not a single idea. One method may waste less material, while another may save more time or labour.

## Diagram 2 • Developing manufacturing decision workflow



### Language to use at developing level

Design iteration • Tooling • Low-volume production • Repeatability • Complex geometry • Manufacturing choice

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

## Advantages of 3D printing in design flexibility and complexity

One of the most important advantages of 3D printing is design freedom. Because the part is built layer by layer, the machine can often produce shapes that would be difficult, slow or expensive to cut by traditional means. Curved forms, internal channels, lightweight structures and personalised geometry are easier to attempt when the process is controlled by digital layers.

This makes 3D printing especially useful when the design is still evolving. A team can test several versions of a part, compare them, and continue improving the design without committing to expensive production tooling too early. In many professional workflows, this speeds up development even if the final product is later made by another method.

At developing level, the key idea is that 3D printing offers manufacturing flexibility. It allows designers to try, adapt and refine. That flexibility is often the real advantage, more so than the machine itself.

## Why other methods still matter

A balanced explanation should make clear that subtractive and formative methods remain extremely important. Subtractive manufacturing can offer excellent precision, strong material properties and very smooth or accurate results. Formative methods can be exceptionally efficient when a company needs large numbers of identical parts.

This means method choice is really about the job. A custom bracket, teaching model or low-volume prototype may suit 3D printing. A precision-machined metal shaft may suit subtractive work. A plastic bottle cap produced in huge quantities may suit a formative process such as moulding.

Good manufacturing thinking therefore asks practical questions: How many parts are needed? How often will the design change? What finish and accuracy are required? What material is needed? Those questions help students move beyond hype and toward genuine engineering judgement.

### Good comparison reminders

- 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.

### Suggested classroom discussion

- 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

<p><b>Design iteration</b></p> <p>Improving a design through repeated changes and testing.</p>	<p><b>Tooling</b></p> <p>Special equipment such as moulds, dies or jigs used in production.</p>	<p><b>Low-volume production</b></p> <p>Making a small number of parts rather than a mass-produced run.</p>
<p><b>Repeatability</b></p> <p>The ability to make parts in a consistent way again and again.</p>	<p><b>Complex geometry</b></p> <p>Shapes that are difficult to produce by simpler methods.</p>	<p><b>Manufacturing choice</b></p> <p>The decision about which process best suits a job.</p>

## Why this level matters

This level matters because it helps students move from naming processes to making reasoned comparisons. They begin to understand that manufacturing is a decision-making activity, not just a list of machines.

It also prepares learners for real product development thinking. In industry, the best process is chosen because it suits the need, not because it is the newest or most exciting option.

### Teacher extension prompt

Ask students to compare a one-off customised part with a mass-produced part and explain which manufacturing method each would likely use. Strong developing responses should refer to quantity, design change and tooling.