Promoting digital transformation and social innovation in VET for better access of deaf students to the labour market

2022-1-PL01-KA220-VET-000086953

3D4DEAF DUAL TRAINING PACK

Module 1: 3D TECHNOLOGIES

Topic 1: Introduction to 3D design & 3D printing

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Project Number: 2022-1-PL01-KA220-VET-000086953

3D4DEAF

TOPIC:

Introduction to 3D design and 3D printing

SUB TOPICS:

- What is 3D printing
- 3D print involvement areas
- How does 3D printing work for the deaf people

Developed by: Społeczna Akademia Nauk
University of Social Sciences

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Project Consortium

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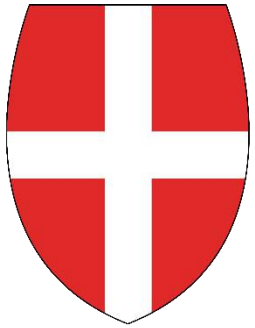

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3D4DEAF

Content of presentation

Key Symbols

Definition

Activity

Tips

Video

Additional resources

Learning outcomes

Module: 3D TECHNOLOGIES Topic: Introduction to 3D design and 3D printing		
KNOWLEDGE	SKILLS	ATTITUDES
• Introduction to 3D design & 3D printing • What is 3D printing and areas that 3D is involved • How does 3D printing work for the deaf people • Future of 3D printing	• Developping 3D imagination and skills • Knowledge of types of softwares and libraries available on-line • Ability to point main 3D printing methods • Implementation of 3D techniques in various fields	• 3D thinking, imagination of form and scale of the object in 3D dimention • Field-oriented sources of tools • Awareness of 3D printing technologies characteristics • Consciousness of growing presence of 3D print

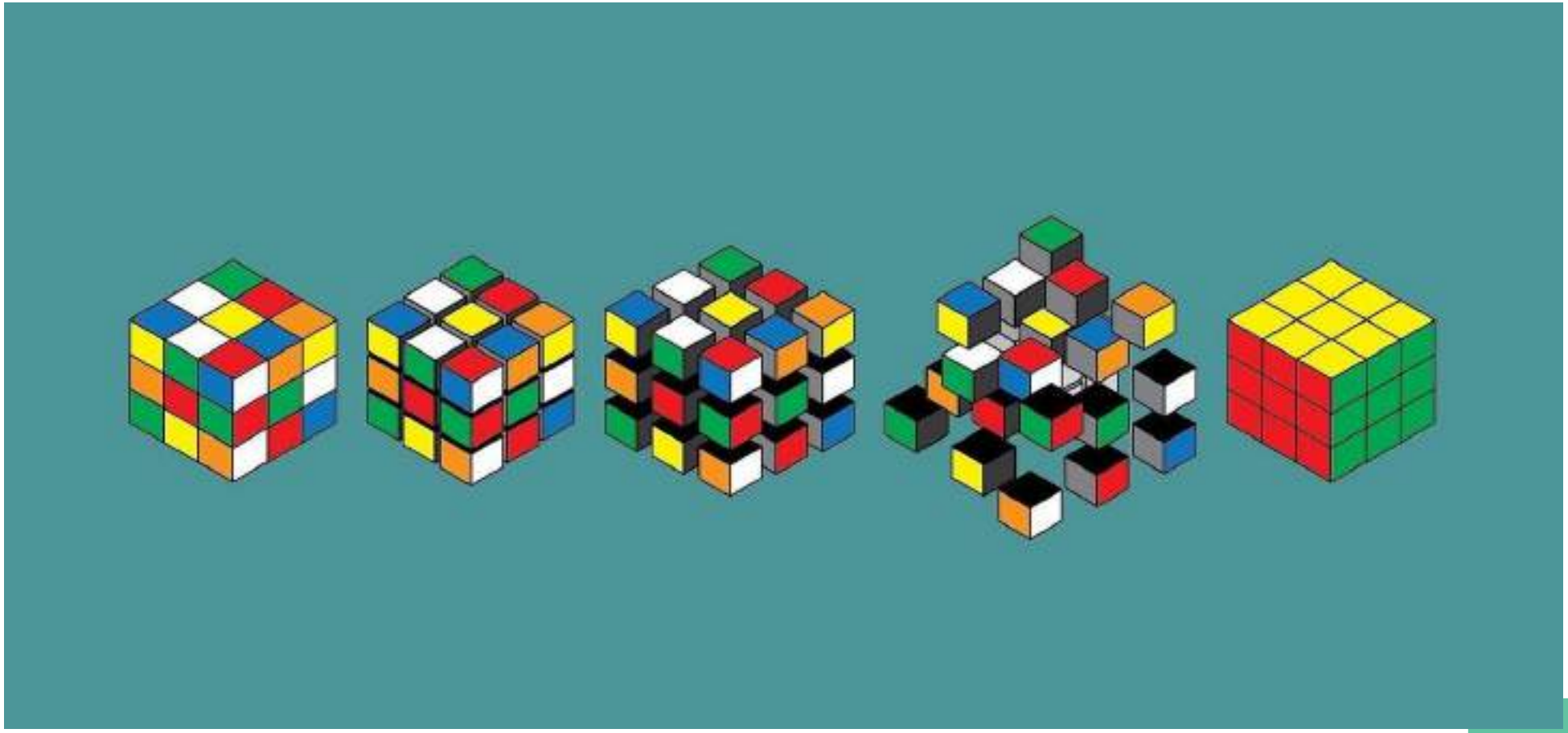
What is 3D printing?

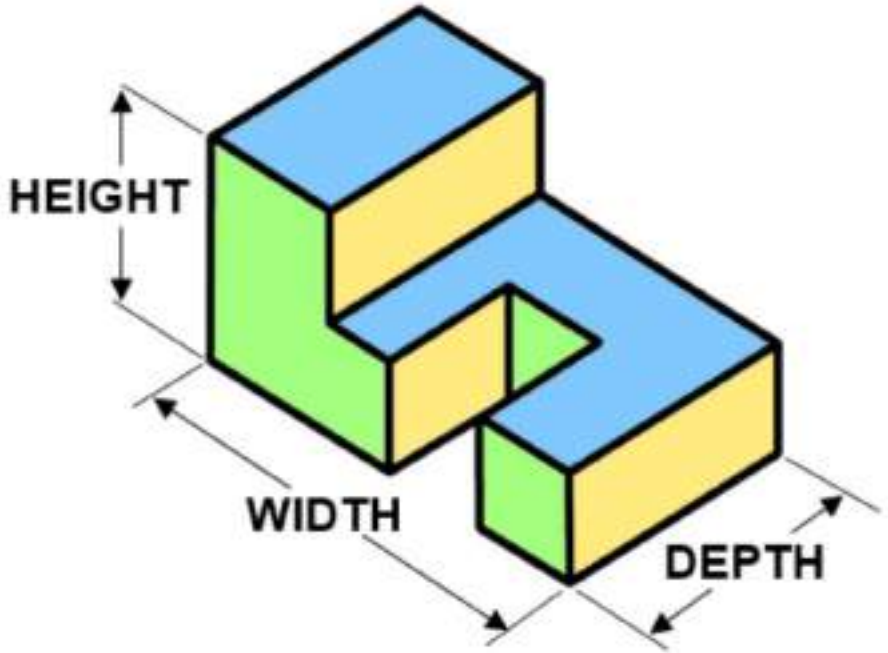
WHAT IS 3D?

3D, or three dimensional, refers to the three spatial dimensions of **width, height and depth.** The physical world and everything that is observed in it are three dimensional.

While many flat images such as films and photographs register visually as two dimensional (2D) to the human brain, nothing can physically exist without all three dimensions.

3D OBJECTS





Human eyes have **3D perception**, also known as **depth perception**. With depth perception, people see the world **in all three spatial dimensions**.

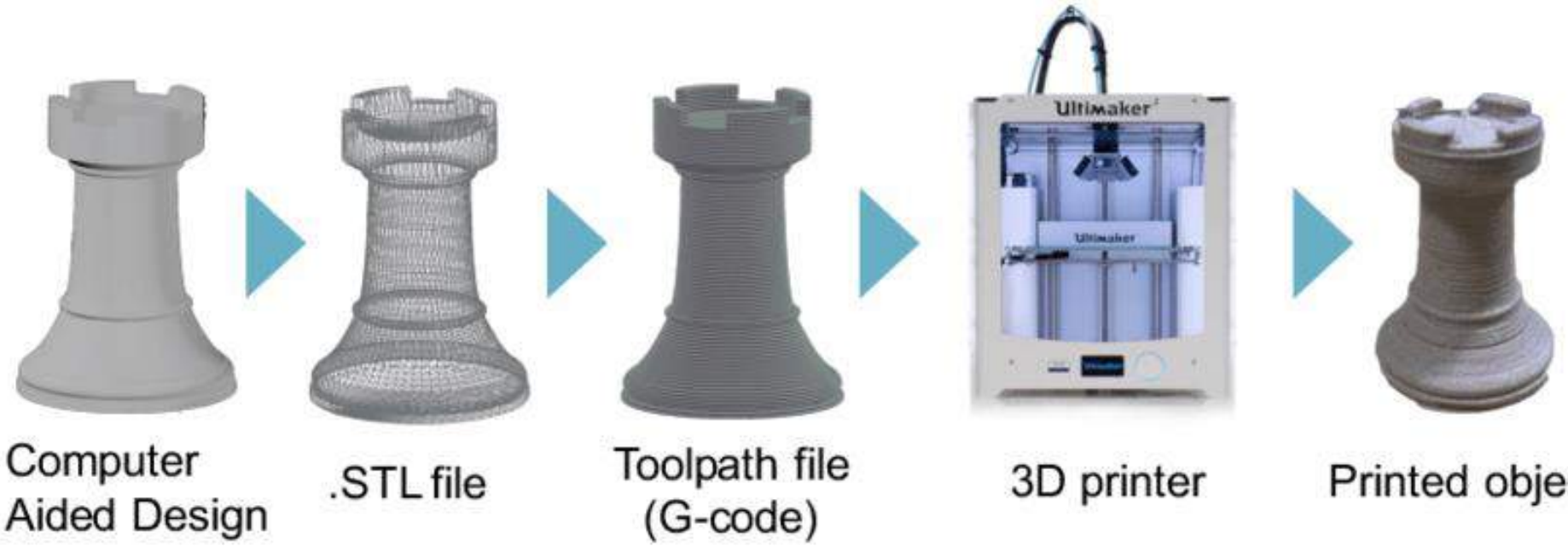
Humans have **stereoscopic vision**, which means that the two eyes don't see the exact same image. The slightly different images register in each eye, enabling the brain to compare differences in visual information, process the image's depth and register all three dimensions at once.

WHAT IS 3D PRINTING?

3D printing or additive manufacturing is a process of **making three dimensional solid objects from a digital file.**

The creation of a 3D printed object is achieved using **additive processes.** In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced cross-section of the object.

PROCESS OF PRINTING 3D OBJECT



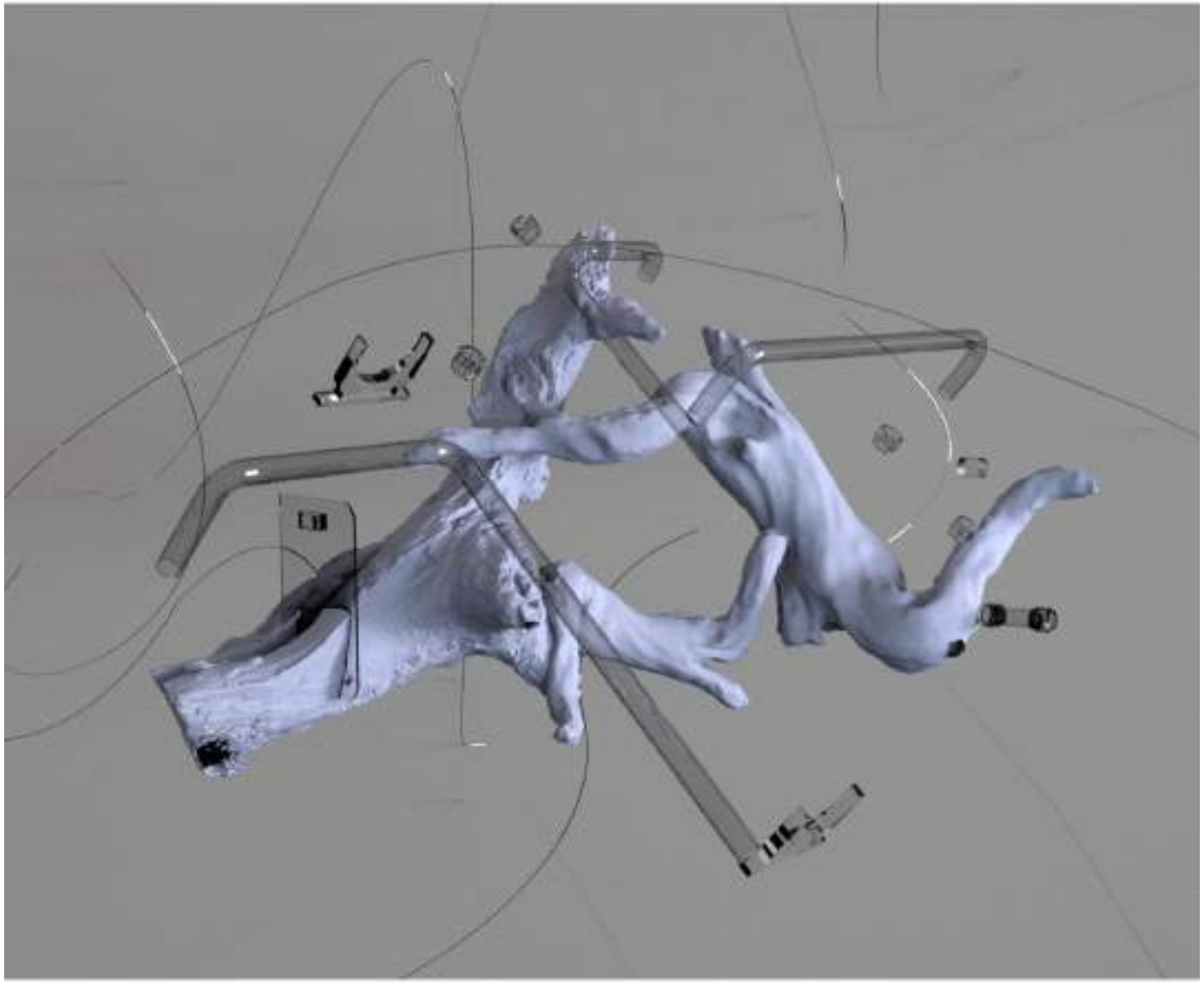
HOW DOES 3D PRINTING WORK?

It all starts with a **3D model.** You can create one from the ground in a software or download it from a 3D library.

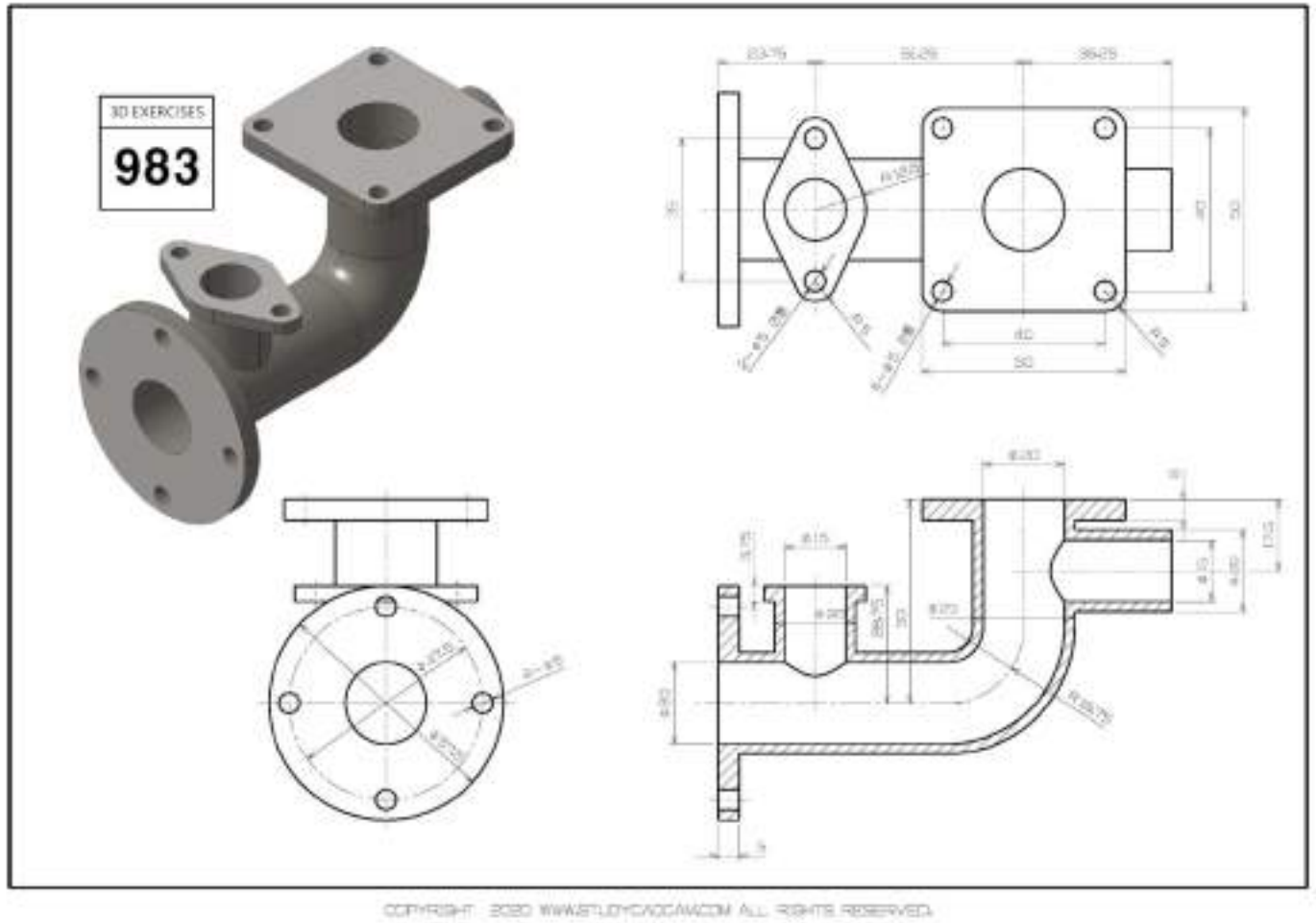
3D SOFTWARE

There are many different softwares available. From industrial grade to open source.

3D software allows users to see their ideas in three dimensions and bring them to life in digital models.



Drawing, sculpting, texture mapping, lighting, and animation capabilities are available in most 3D applications to create models from scratch. Some 3D software is for architecture or engineering, while others are for general purposes.



OVERVIEW OF SOFTWARES

https://3dprinting.com/software/#3D-MODELING-SOFTWARE

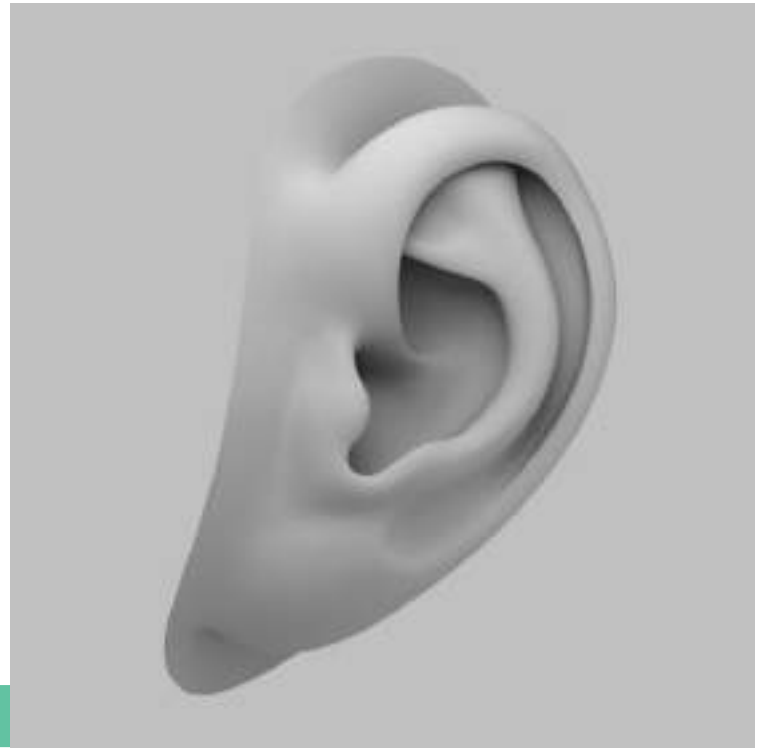
RECOMMENDED 3D LIBRARIES

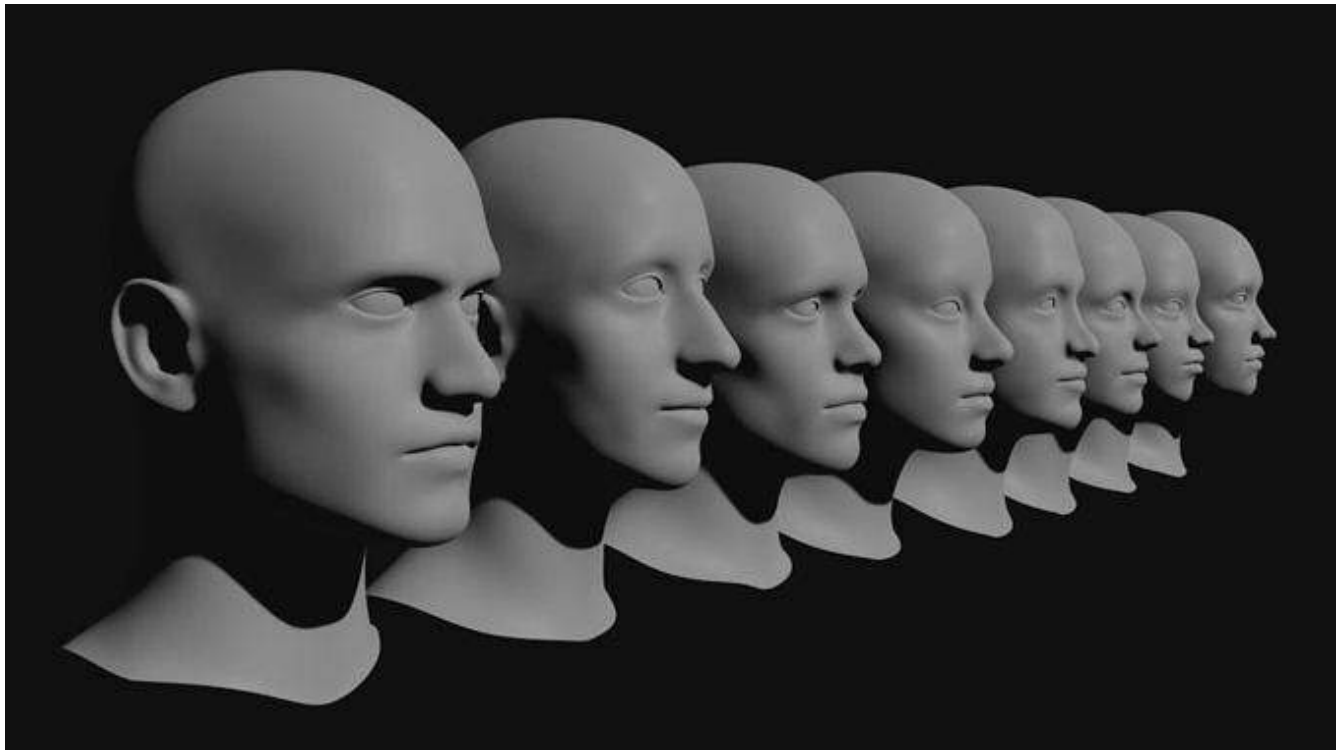
Sketchfab

MakerBot Thingiverse

TURBOSQUID

EXAPLES OF FREE ONLINE 3D MODELS



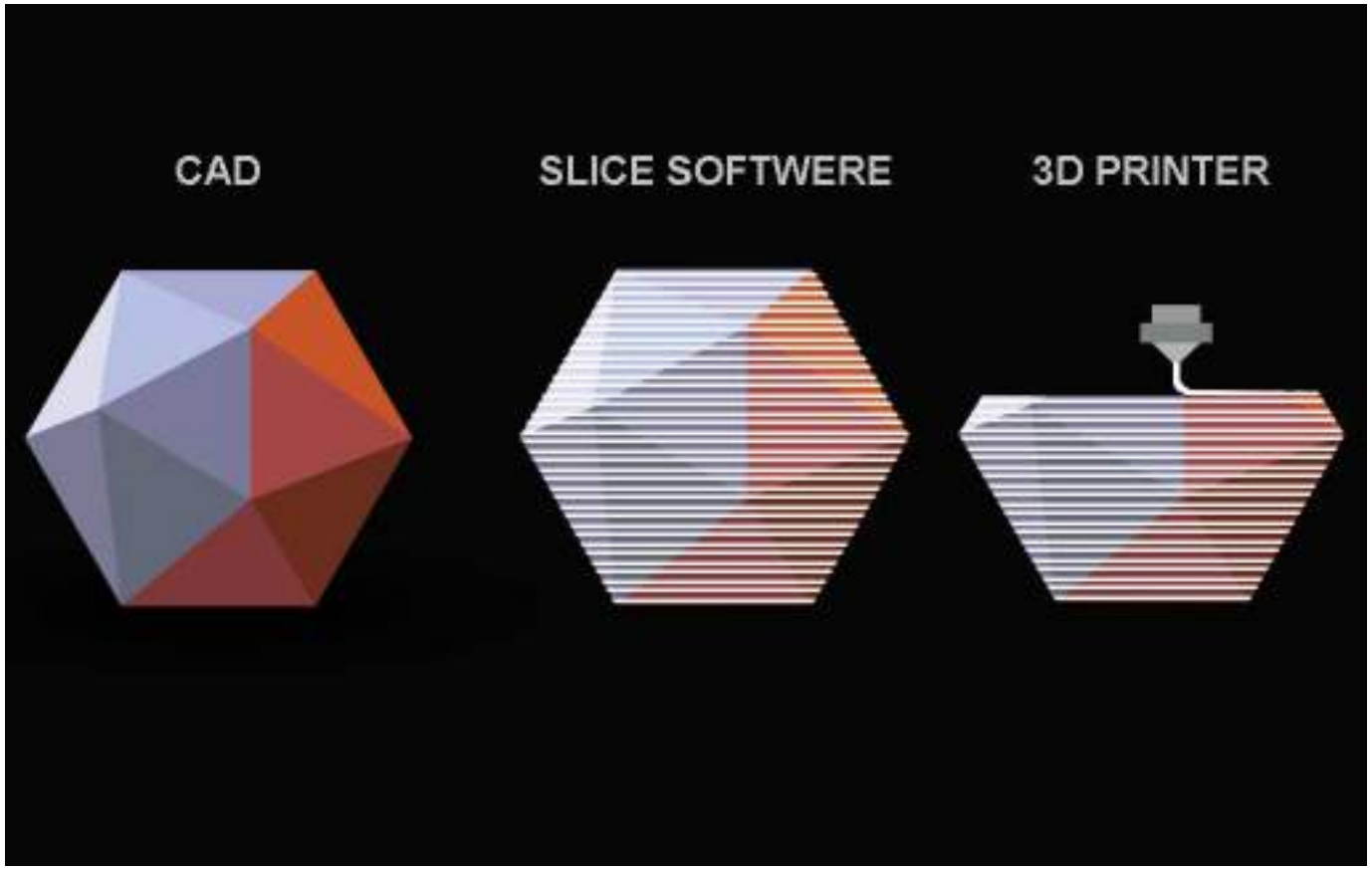


PRINTABLE FILE

For example software Tinkercad offers beginner lessons and has a built-in feature **to export your model as a printable file e.g .STL or .OBJ.**

Now that you have a printable file, the next step is to prepare it for your 3D printer. This is called **slicing.**

PROCESS OF PRINTING 3D OBJECT



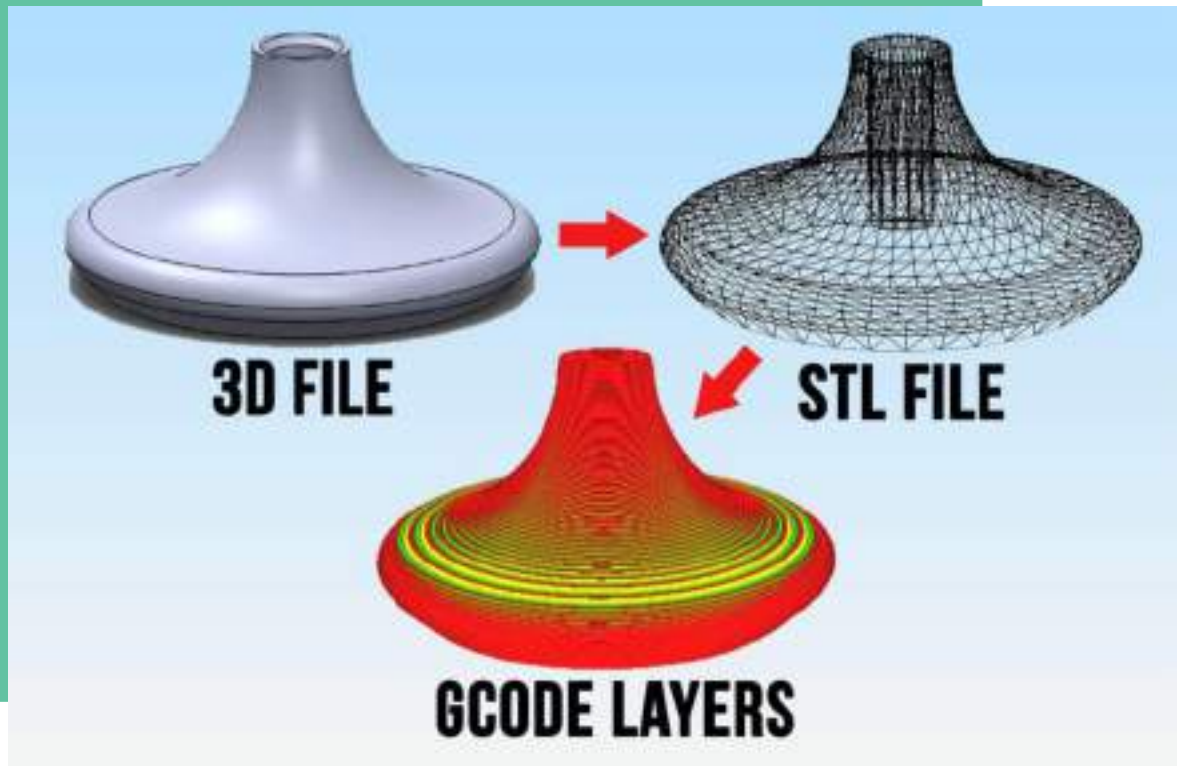
SLICING: From printable file to 3D Printer

Slicing basically means slicing up a 3D model into hundreds or thousands of layers and is done with slicing software and exporting file to **STL or G-code**.

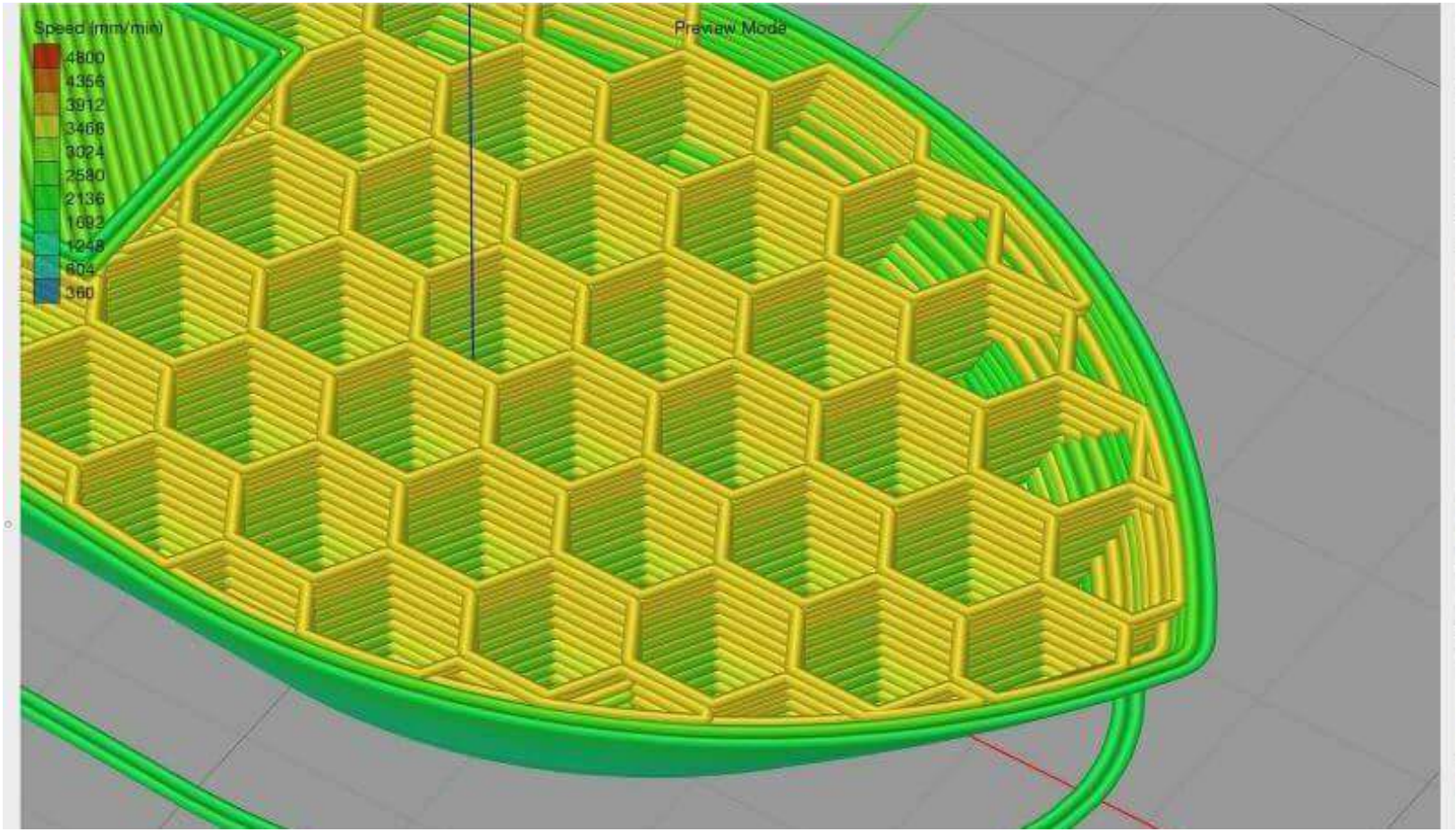
When your file is sliced, it’s ready for your 3D printer. Feeding the file to your printer can be done via USB, SD or Wi-Fi.

Your sliced file is now ready to be 3D printed **layer by layer**.

SLICING



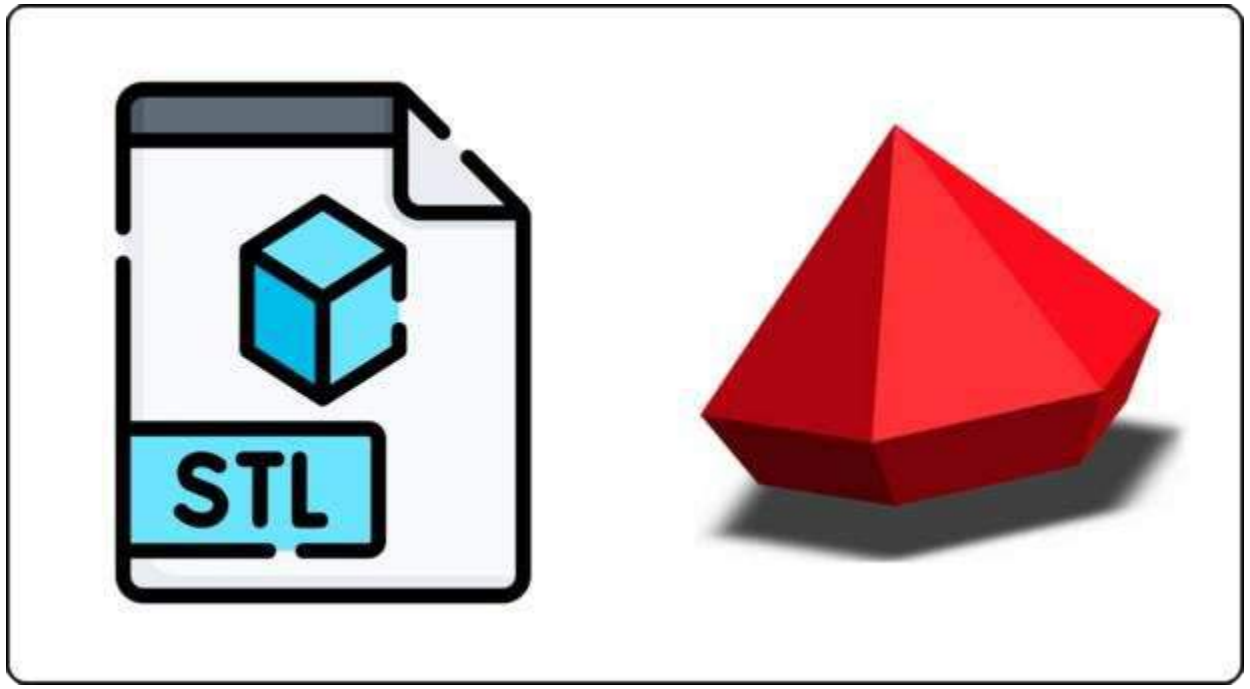
VISUALISATION OF PRINTING SLICES IN 3D



What is the difference between STL and G-code?

STL stands for **STereoLithography**, a 3D printing process and corresponding file type created by Chuck Hull at 3D Systems in the 1980s). The STL file format is the most commonly used file format for 3D printing. When used with a 3D slicer software, it allows the computer to communicate with a 3D printer.

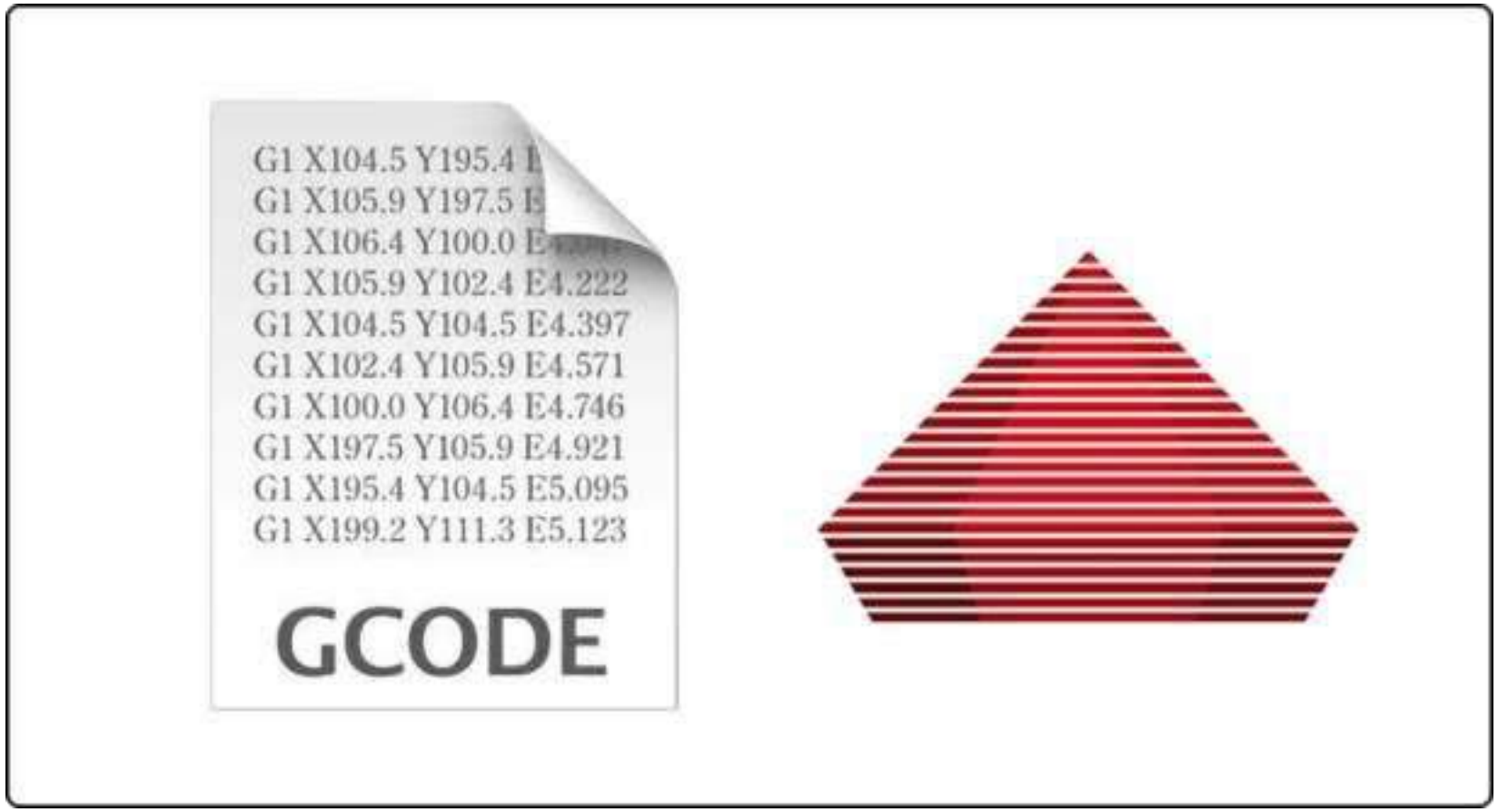
The STL file format has been adopted and supported by many CAD software. Today it is widely used for **rapid prototyping, 3D printing, and computer-aided manufacturing.**



STL files represent 3D models. **They cannot be 3D printed in themselves.** This format describes only the surface geometry of a 3D object without representing color, texture, or other common model attributes.

G-code is a programming language that tells the printer what to do. These actions can include where the printer nozzle goes, extruder temperature, bed temperature, pauses, printer head speed, etc.

G-codes are actually used for a variety of machines, **not just 3D printers!**
Cutting tools like lathes and mills also rely on G-codes.
You can view the G-code file on your computer using a text editor.

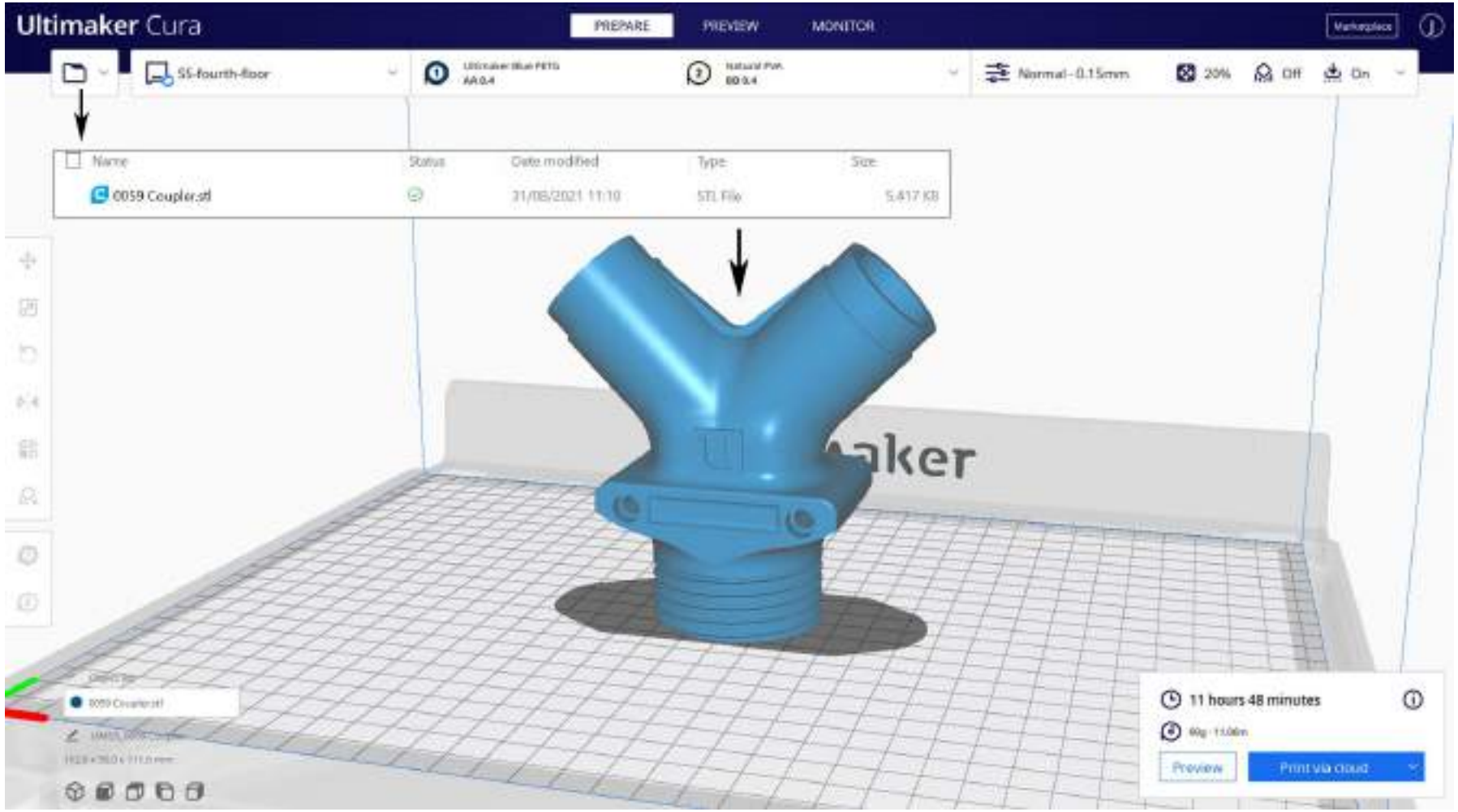


STL file must be sliced into layers, these layers represent G-code.

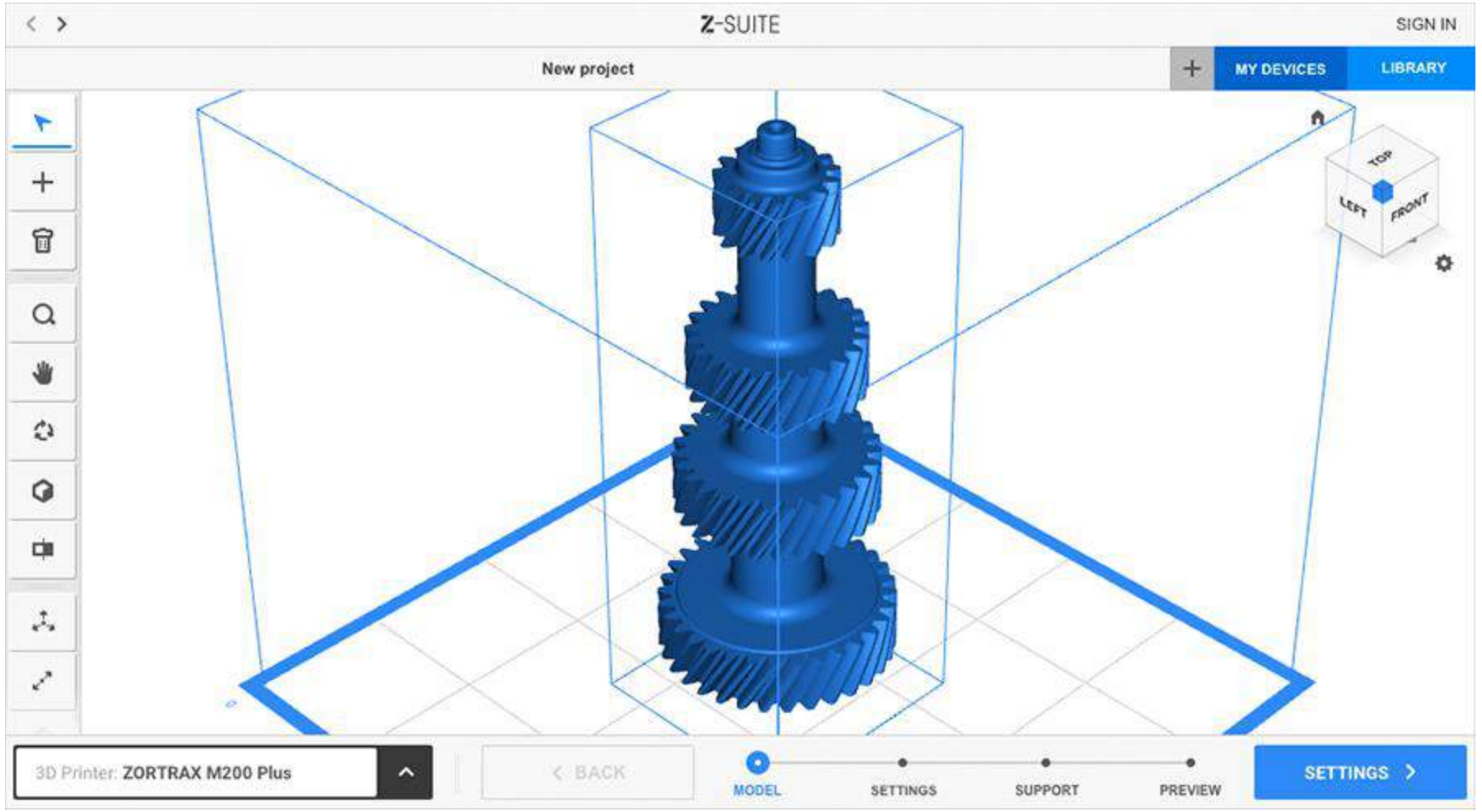
A printer can only read G-code file.

RECOMMENDED SLICING SOFTWARES

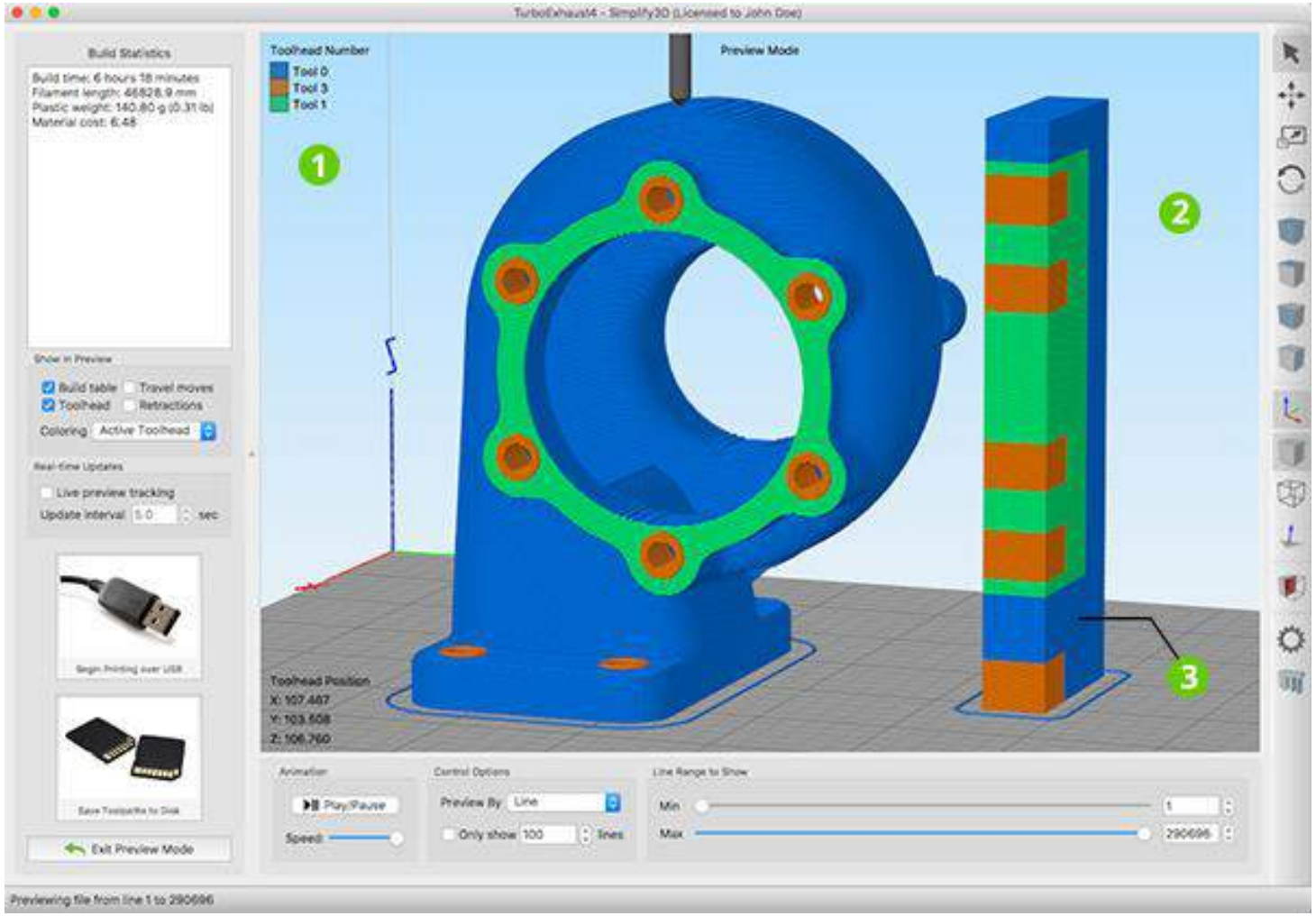
EXAMPLE OF CURA SLICER INTERFACE



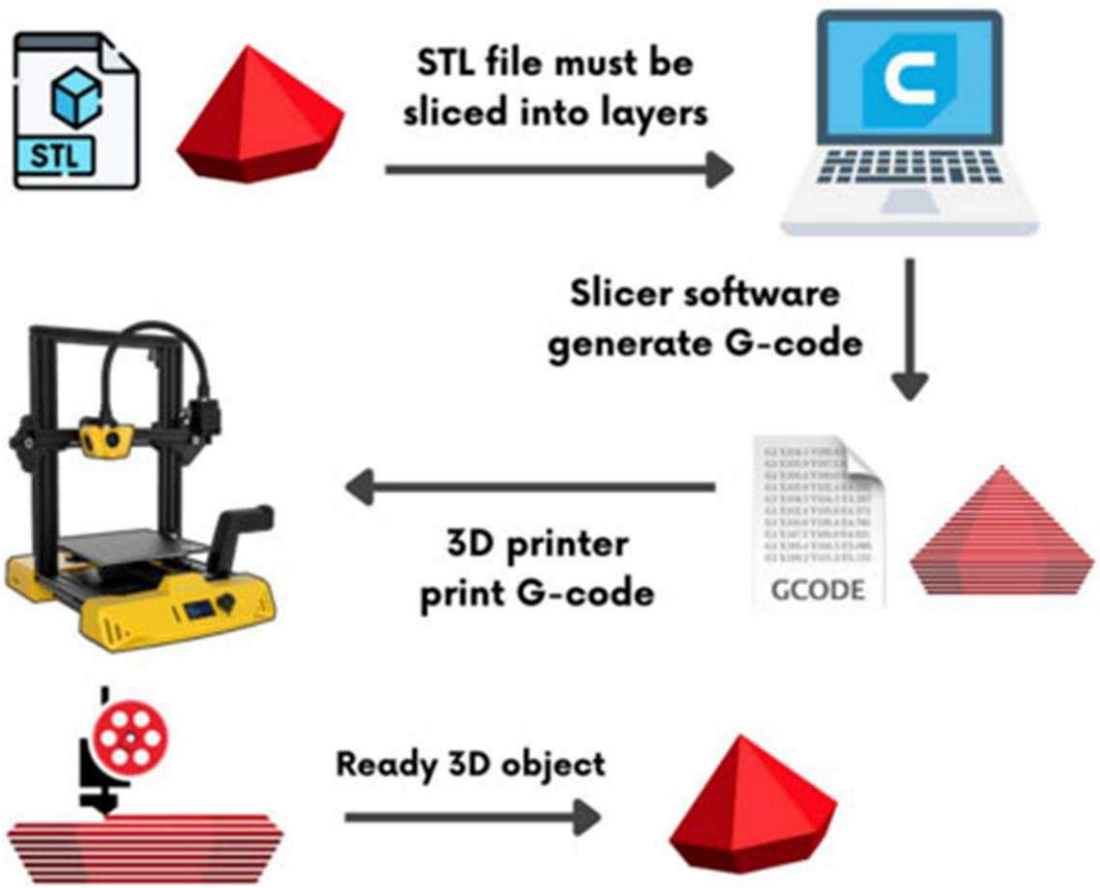
EXAMPLE OF Z-SUITE SLICER INTERFACE

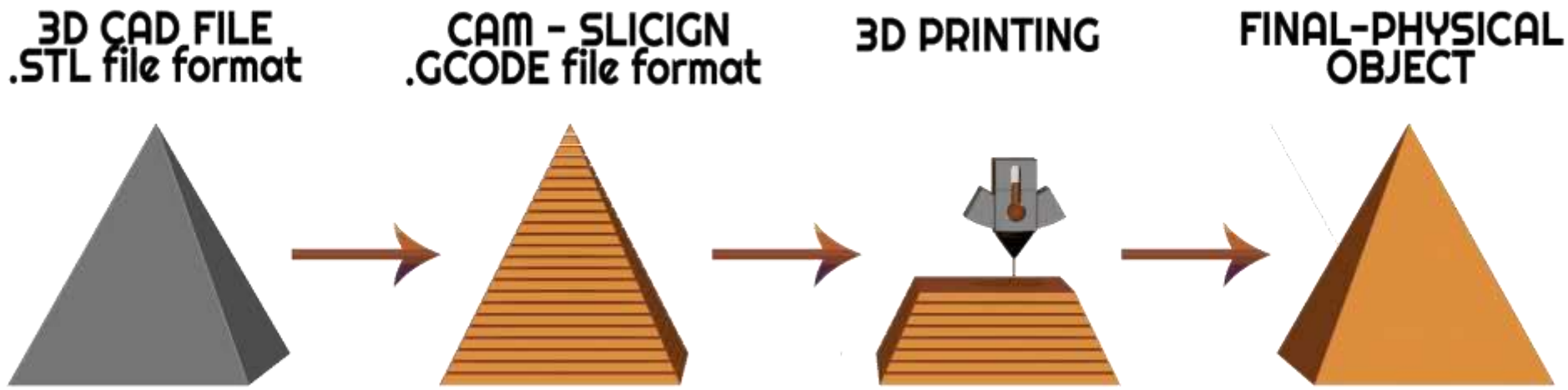


EXAMPLE OF SIMPLYFY 3D SLICER INTERFACE



COMPLETE PROCESS OF 3D PRINTING





STL file must be sliced into layers, these layers represent G-code.

A printer can only red G-code file.

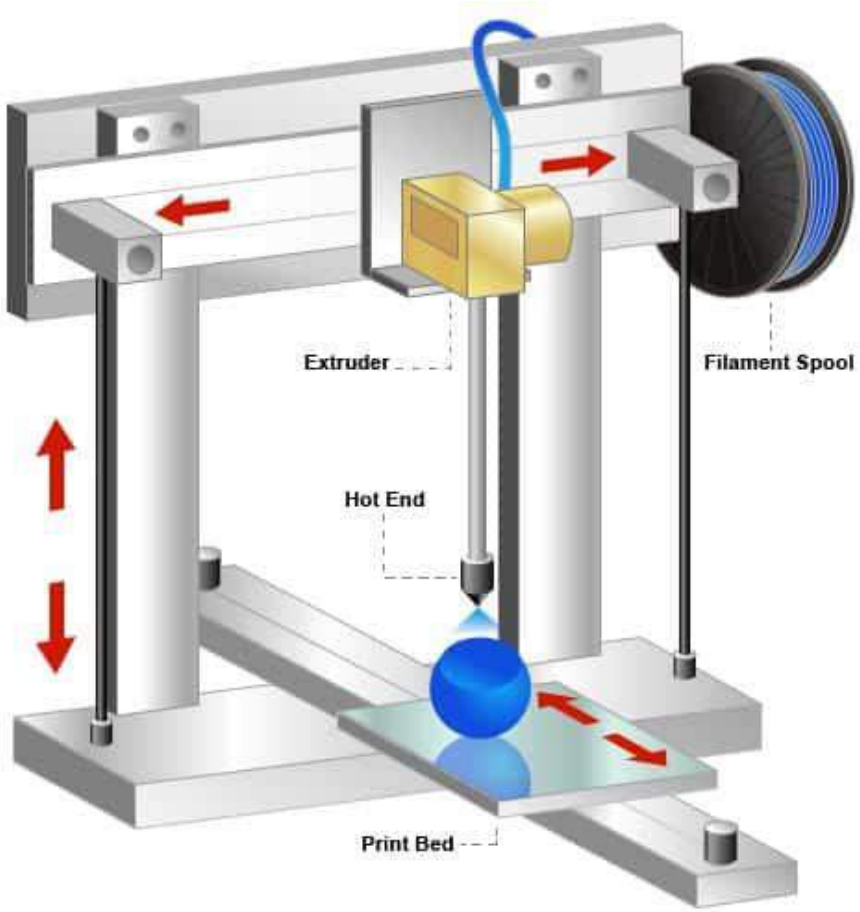
3D PRINT

When the modeling and slicing of a 3D object is completed, it’s time for the 3D printer to finally take over. The printer acts generally the same as a traditional inkjet printer in the direct 3D printing process, where a nozzle moves back and forth while dispensing a wax or plastic-like polymer layer-by-layer, waiting for that layer to dry, then adding the next level.

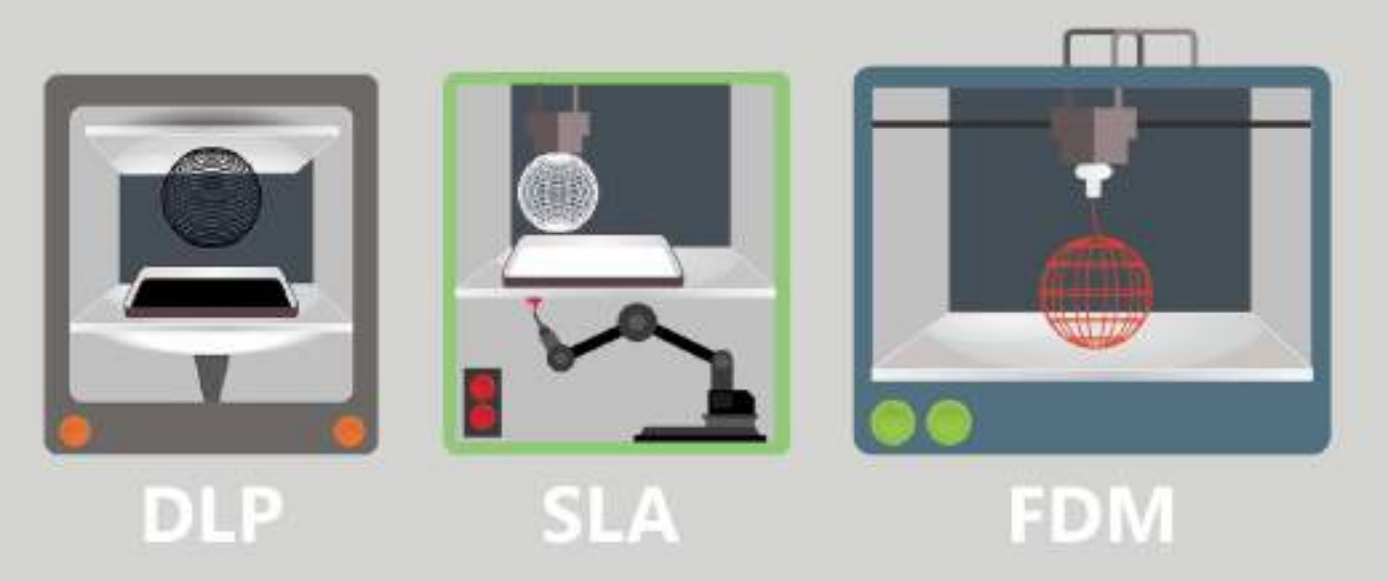
3D PRINTER

3D printing uses specialized equipment to create solid, three-dimensional objects from a digital file.

In short, **3D printers use CAD to create 3D objects from a variety of materials**, like molten plastic or powders.



3D PRINTERS



3D printers can come in a variety of shapes and sizes ranging from equipment that can fit on a desk to large construction models used in the making of 3D-printed houses. There are three main types of 3D printers and each uses a slightly different method.

TYPES OF 3D PRINTERS

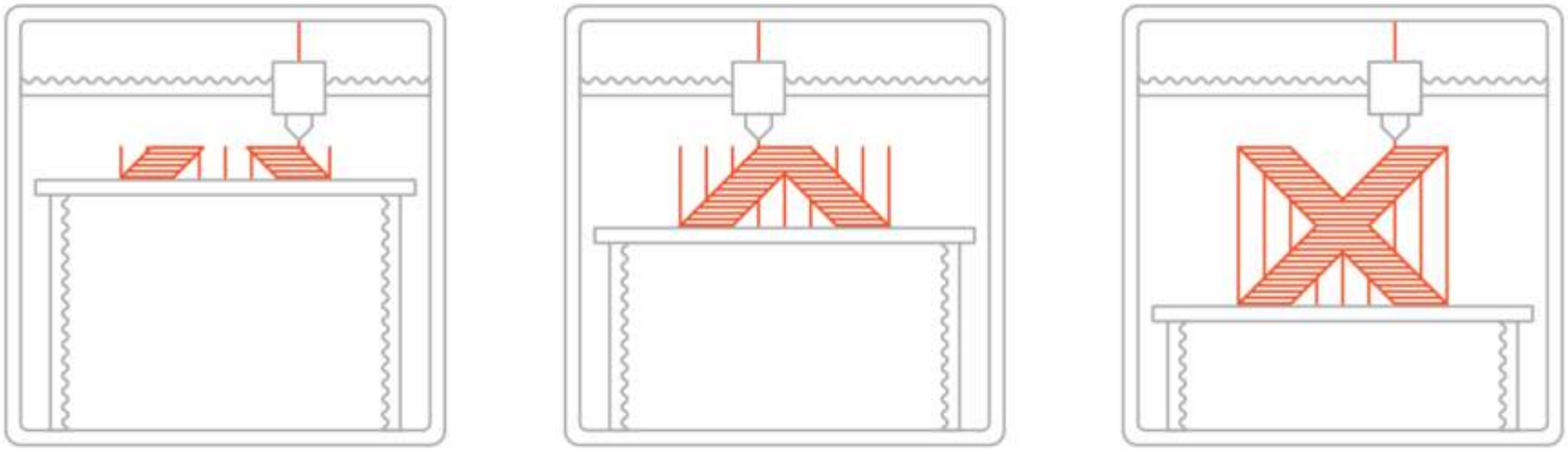
SLA, Stereolithographic printers, are equipped with a laser that forms liquid resin into plastic

SLS, Selective laser sintering printers, have a laser that sinters particles of polymer powder into an already solid structure

FDM, Fused deposition modeling printers, are the most common. These printers release thermoplastic filaments that are melted through a hot nozzle to form an object layer by layer

3D PRINTING: MATERIALS AND TECHNOLOGY

FDM



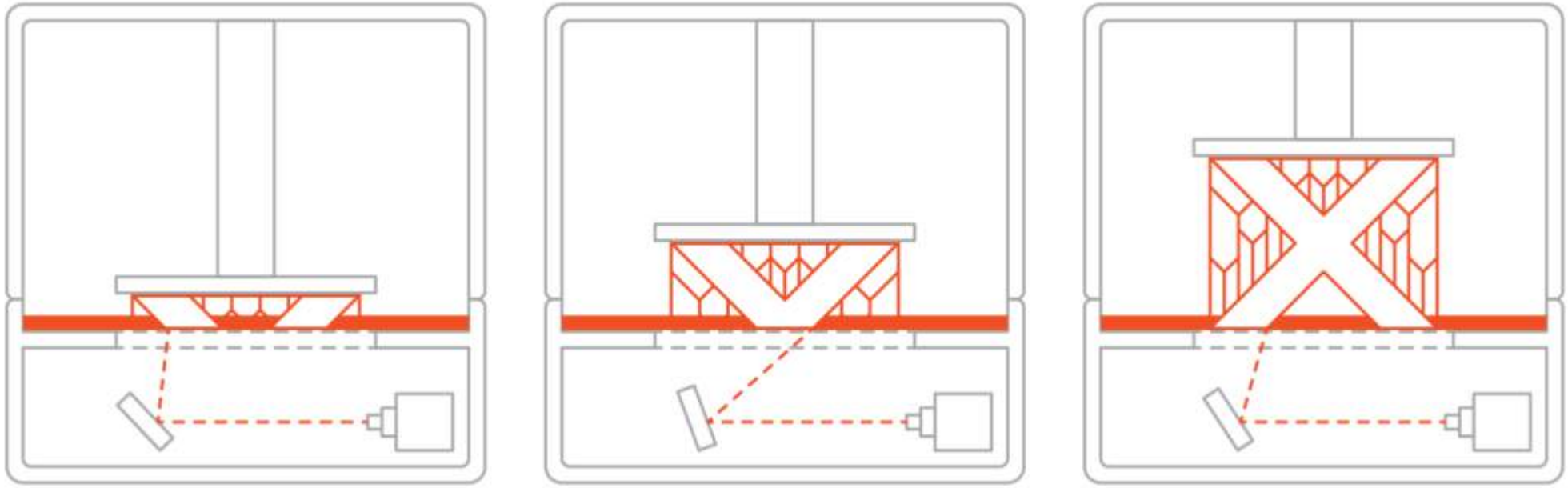
3D PRINTING: MATERIALS AND TECHNOLOGY

FDM

FDM is the most common and cheapest form of 3D printing. This method works by extruding melted filament layer by layer to form complete models. The filament solidifies a few moments after being extruded but before the plastic fuses to the layer below. FDM printing allows you to print in a wide variety of materials ranging from nylon to ABS.

3D PRINTING: MATERIALS AND TECHNOLOGY

SLA



3D PRINTING: MATERIALS AND TECHNOLOGY

SLA

Despite being the very first 3D printing technology, SLA printers are less common than FDM due to their relatively high cost and high maintenance. SLA printing works by shining a laser at precise points within a vat of resin, curing the resin in place and creating a model one pixel at a time. Although the laser moves rapidly, SLA printing is still slower than FDM printing.

3D PRINTING: MATERIALS AND TECHNOLOGY

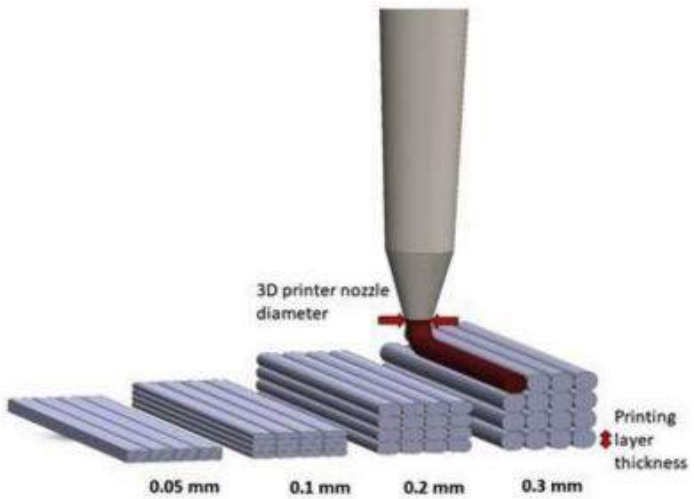
SLS

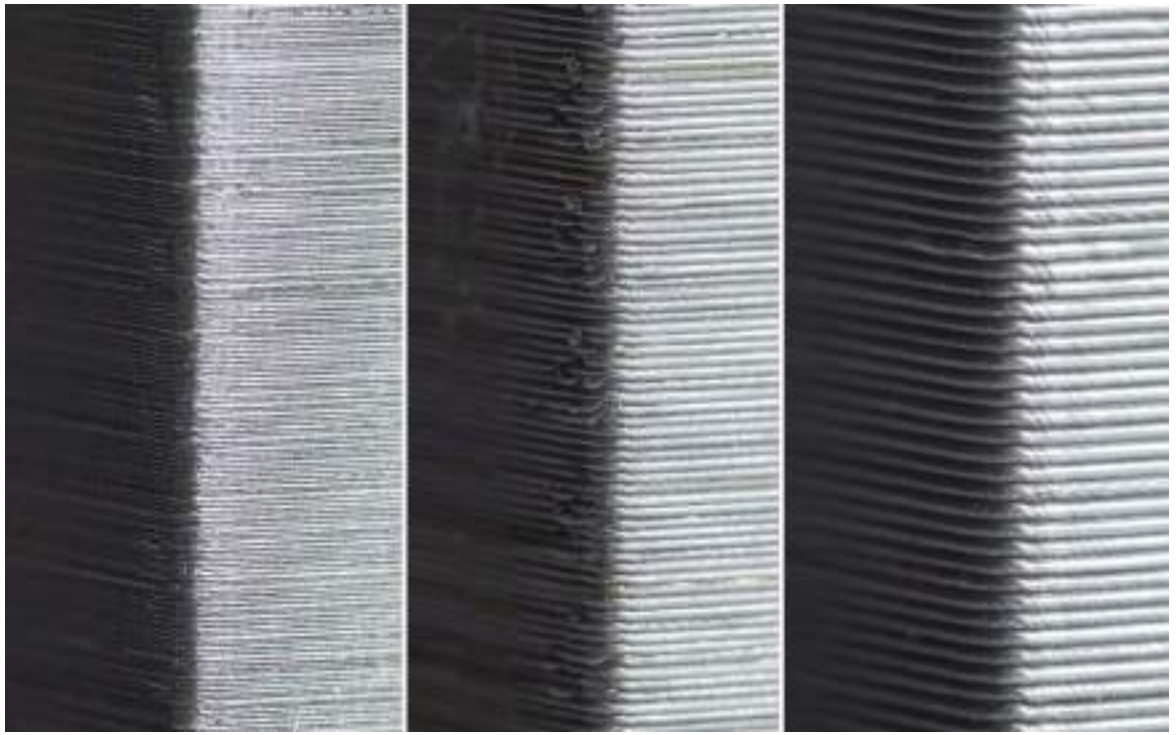
3D PRINTING: MATERIALS AND TECHNOLOGY

SLS

Selective laser sintering (SLS) 3D printing is an additive manufacturing technology. The printer uses a laser to melt polymer powder and fuse it into a solid 3D printed part. Using a CAD design model, the laser melts the plastic material precisely at the predefined points in the powder bed. The technique requires no support structures, as the unfused powder supports the part during printing. After completion of the melting process, a new layer of powder is applied. This process repeats layer by layer until the part is completed.

3D PRINT





It essentially adds hundreds or thousands of 2D prints on top of one another to make a three-dimensional object.

3D print involvement areas

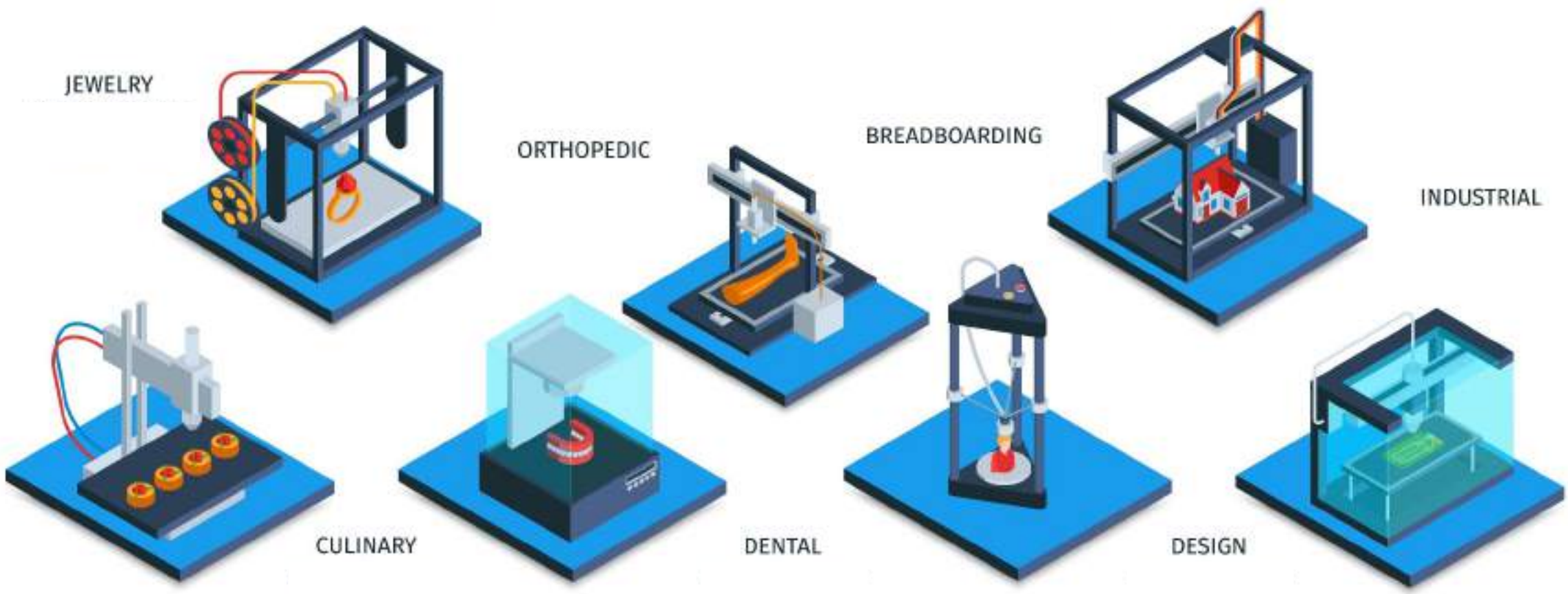
WHERE 3D PRINTING IS USED?

3D printing encompasses **many forms of technologies and materials** as it is being used in almost all. It's important to see it as a cluster of diverse industries with a myriad of different applications.

EXAMPLES OF 3D PRINTING

– consumer products (eyewear, footwear, design, furniture)
– industrial products (manufacturing tools, prototypes, functional parts)
– dental products
– prosthetics
– architectural scale models & maquettes
– reconstructing fossils
– replicating ancient artefacts
– reconstructing evidence in forensic pathology

EXAMPLES OF 3D PRINTING



As the capabilities of 3D printing continue to grow, so does its value: **By 2029, the 3D printing industry is estimated to reach a value of $84 billion.** This growth means we are bound to interact with products — and even homes and buildings — made with 3D printing.

FASHION

FASHION

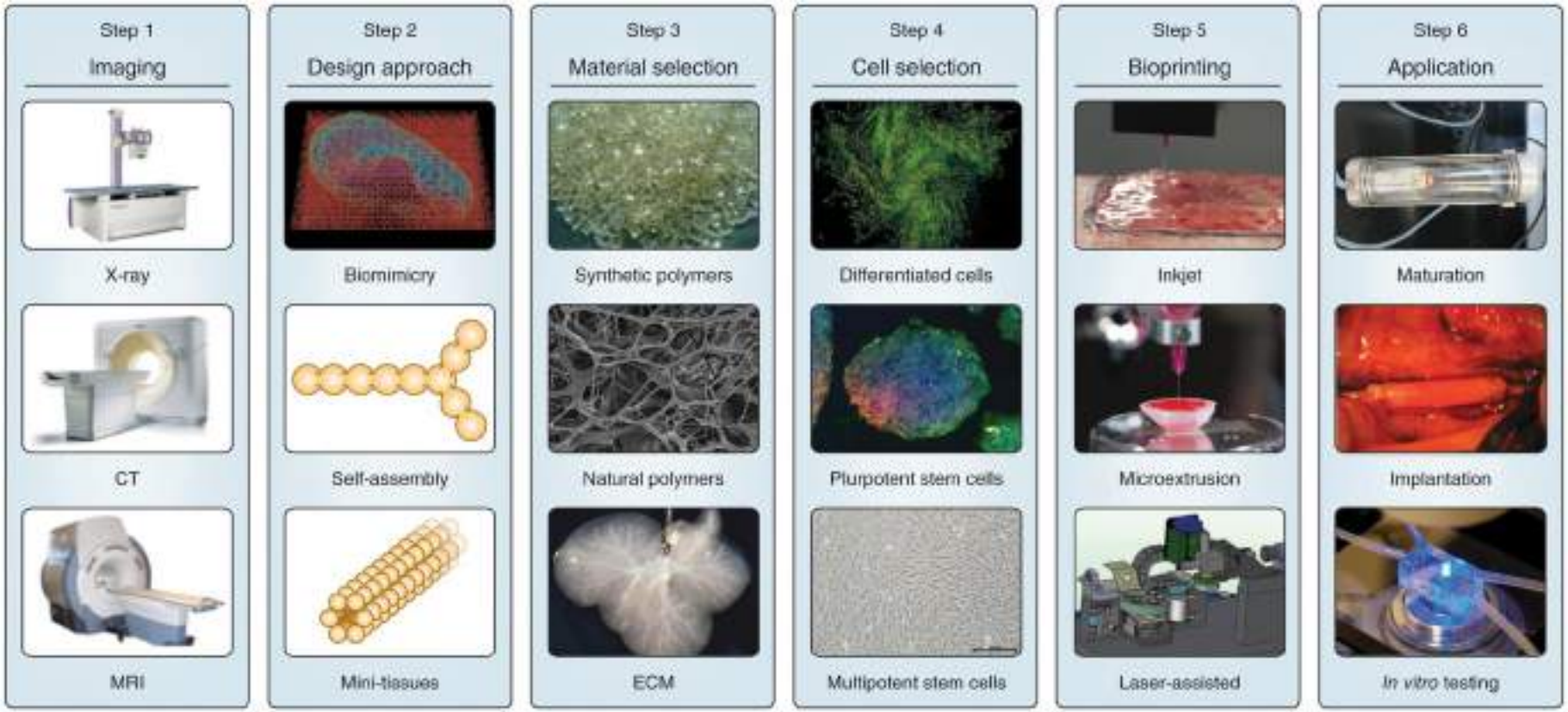
There is obviously an evolution in the way that we are thinking about fashion and clothes manufacturing. New aspects are now taken into account and now, the reasons why designers are choosing 3D printing are changing: it is becoming important to use 3D printing for **sustainable and eco-friendly** purposes.

For instance, textiles are part of the waste problem around the world, that is why a lot of elements of the manufacturing process need to be rethought in order to be more eco-friendly. **Using 3D printing allows to reduce waste**, you only need to use the amount of material that is needed to create your project.

FASHION

FASHION

MEDICINE

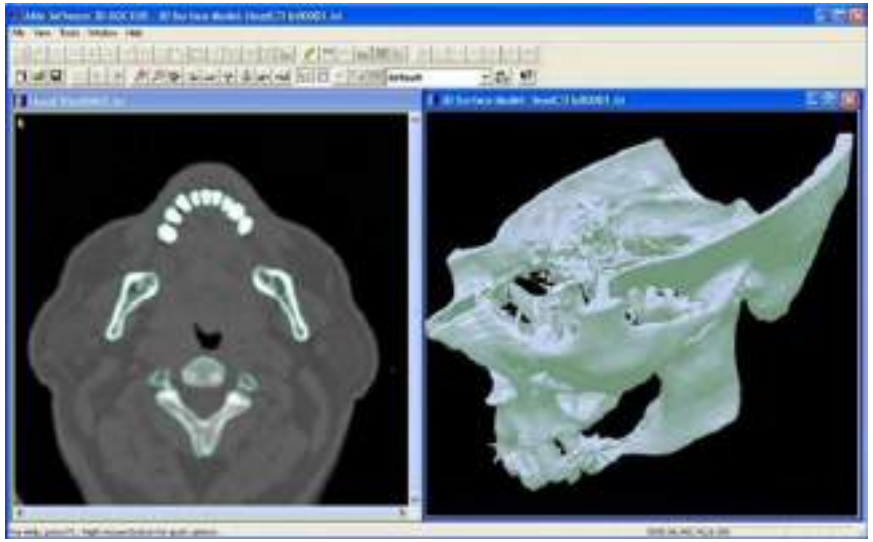

Step 1
Imaging
X-ray
CT
MRI
Step 2
Design approach
Biomimicry
Self-assembly
Mini-tissues
Step 3
Material selection
Synthetic polymers
Natural polymers
ECM
Step 4
Cell selection
Differentiated cells
Plurpotent stem cells
Multipotent stem cells
Step 5
Bioprinting
Inkjet
Microextrusion
Laser-assisted
Step 6
Application
Maturation
Implantation
In vitro testing

MEDICINE

3D bioprinting is similar to 3D printing except that it prints layers of living cells, known **as bio-ink**, rather than plastic or metal.

Bio-ink is used to create artificial skin tissue, bone, blood vessels and potentially whole organs used for transplants, grafts, training or research purposes. Bioprinting is still in its infancy due to the complexity involved in reproducing living material, particularly organs such as hearts, livers and kidneys. Advancements are happening, thanks to the pioneering work of universities. What motivates them is the prospect of **eliminating the need for donated organs and the risk of rejection by 3D printing** new organs using a patient's own cells.

MEDICINE



ARCHITECTURE

ARCHITECTURE

Three-dimensional-printed houses are life-size dwellings that use 3D printing as its primary means of construction.

Typically, **3D-printed houses** feature free-form, curvilinear shapes made out of a cement mix. Aside from time and money, many see this type of **low-waste, computerized homebuilding** delivered from an industrial-scale printer as a way to shelter unhoused communities and a gateway to sustainable, biodegradable housing solutions.

ARCHITECTURE

ENVIROMENTAL IMPACT

3D print **saves time and resources**. Rapid 3D printing prototyping can manufacture parts within hours, which speeds up the process. This allows for each stage to complete faster. 3D printing is inexpensive and quicker at creating parts allowing for each design modification to be completed at a much more efficient rate.

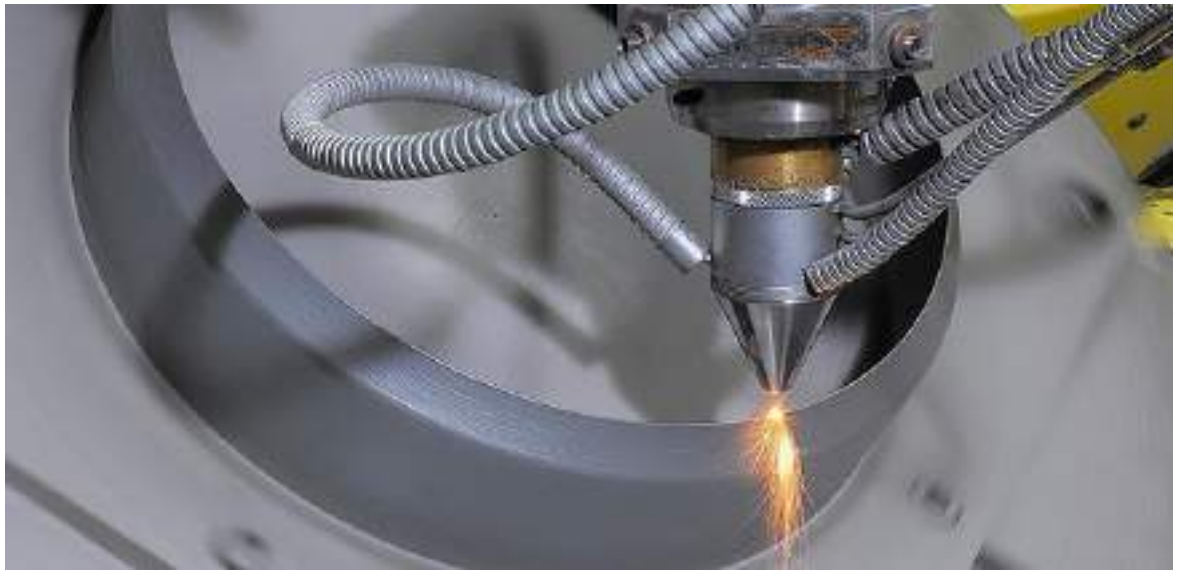
Print on demand is another advantage as it doesn’t need a lot of space to stock inventory, unlike traditional manufacturing processes. This **saves space and costs** as there is no need to print in bulk unless required.

The 3D design **files are all stored in a virtual library** as they are printed using a 3D model as either a CAD or STL file, this means they can be located and printed when needed.

Edits to designs can be made at very low costs by editing individual files **without wastage of out of date inventory and investing in tools**.

The main 3D printing material used is plastic, although some metals can also be used for 3D printing. However, **plastics offer advantages as they are lighter** than their metal equivalents. This is particularly important in industries such as automotive and aerospace where light-weighting is an issue and can deliver **greater fuel efficiency**.
Also, parts can be created from **tailored materials to provide specific properties** such as heat resistance, higher strength or water repellency.

The production of parts only requires the materials needed for the part itself, **with little or no wastage** as compared to alternative methods which are cut from large chunks of non-recyclable materials. Not only does the process **save on resources** but it also **reduces the cost of the materials being used**.



3D printing **saves costs** associated with using different machines for manufacture. 3D printers can also be set up and left to get on with the job, meaning that there is **no need for operators to be present the entire time**. While 3D printing equipment can be expensive to buy, you can even avoid this cost by outsourcing your project. Ease of access of 3D printers with more local service providers **doesn't require expensive transport costs** compared to manufacturing abroad.

3D printing is being used in the medical sector to **help save lives** by printing organs for the human body such as livers, kidneys and hearts. Further advances and uses are being developed in the healthcare sector providing some of the biggest advances from using the technology.

How does 3D printing work for the deaf people?

HOW CAN 3D HELP THE DEAF?

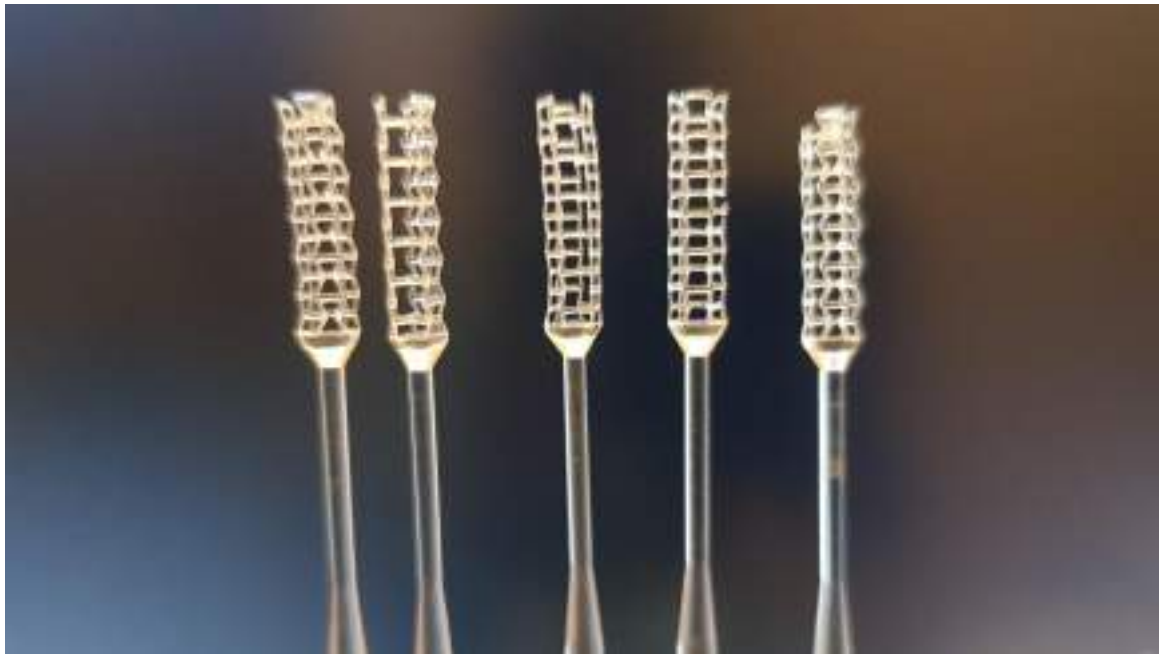
3D printing can help to cure more and more diseases, bringing adapted treatment and devices to patients.

MEDICAL DEVICES

More than 90% of the top 50 medical device companies use 3D printing to create **high-speed, low-cost prototypes** or medical devices themselves.

Beyond rapid prototyping, medical 3D printing is being used to produce components and cases for end-use medical devices and, in some cases, the entire device itself. This capability came to the fore in the wake of Covid-19 when 3D printed alternatives to traditionally sourced supplies become commonplace, nasal swabs being just one example.

3D PRINTED NASAL SWABS DURING PANDEMIC



DEAF TECHNOLOGY PRODUCTS

Deaf technology products have undoubtedly transformed the lives of individuals who are **deaf or hard of hearing**, empowering them with enhanced accessibility and communication capabilities. With advancements in technology, a wide range of innovative devices and solutions have emerged, catering to various needs and preferences.

PERFECT FIT

In short, the wearer gets a **superior fit** that's just not possible with standard one-size-fits-all devices that have been made the traditional way. With such a **high level of personalization** and the fact that the process takes a day compared with a week the traditional way, 3D printing is using custom specs taken by laser scanner, **each device is created unique to each individual.**

This is in contrast with the former way of doing things through traditional manufacturing processes. Standard templates don’t accommodate for the different sized ear canals of people with hearing impairments.

A **digital image of the ear canal**, created using a laser scanner, is taken by a skilled audiologist. After a comprehensive quality check, a model is made from the printer where a shell or mold of the hearing aid is developed out of is a material called **resin**. This material is flexible and contains all the crucial components to the device, such as acoustic vents and electronics.

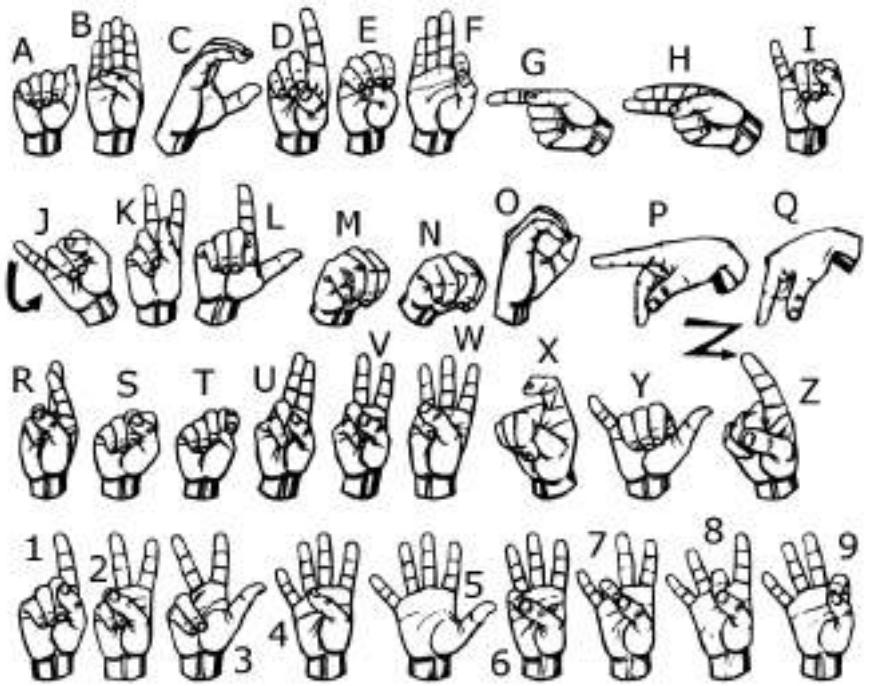
Digital cameras that assist in putting the template to the mold use 150,000 points of reference, testing various geometric patterns and combinations to get the most accurate final product. Sound, amplified through special circuitry, is the heart of the device. This revolutionary process, resulting in about 10 million 3D printed hearing devices currently used by deaf or hearing impaired individuals, has been transformed into **a completely automated process**. The shows a huge leap forward in the hearing device industry, **where 3D printing allows many people to hear better in comfort.** Born from a need to achieve a more accurate fit, additive manufacturing and 3D laser scanning are used in conjunction to achieve this method.

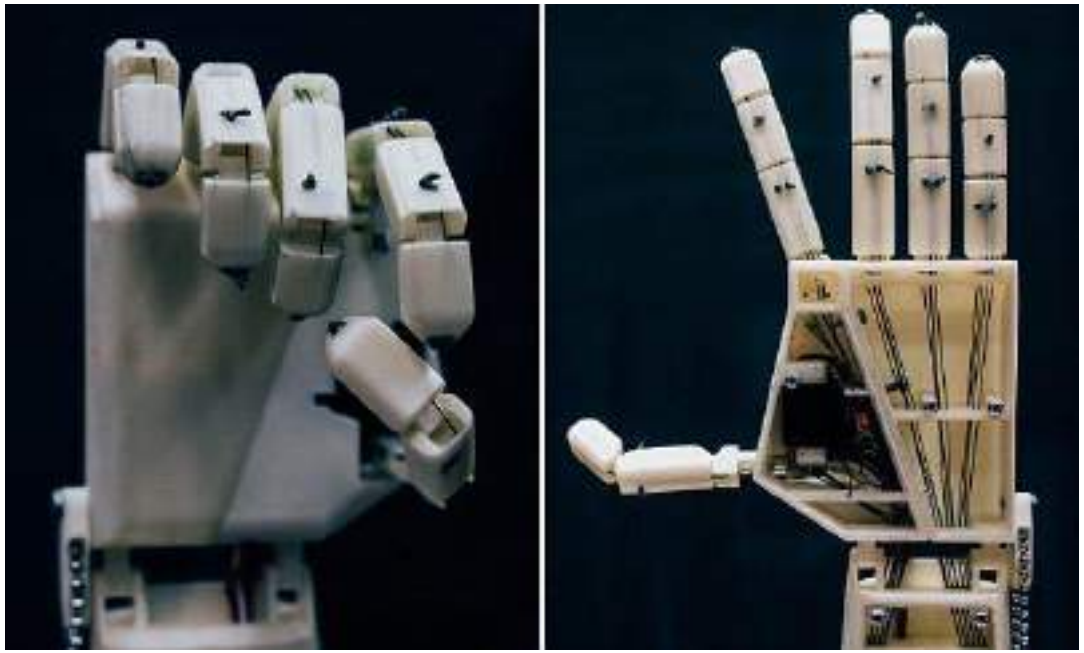
Hearing aid industry benefits from processes like 3D printing. Formerly impossible to achieve such growth, 3D printing and laser scanning work in tandem **to automate the process and create a reduction in manufacturing times and costs.**

Formerly, this used to take up to nine steps to achieve one hearing aid; now **it takes just a day thanks to the scientific application of 3D printing.** There are only three steps involved with 3D printing. They include scan, model and print. Although it still takes some intense precision to get the process exactly right, this growing technology is certainly making the medical and hearing impaired communities take notice.

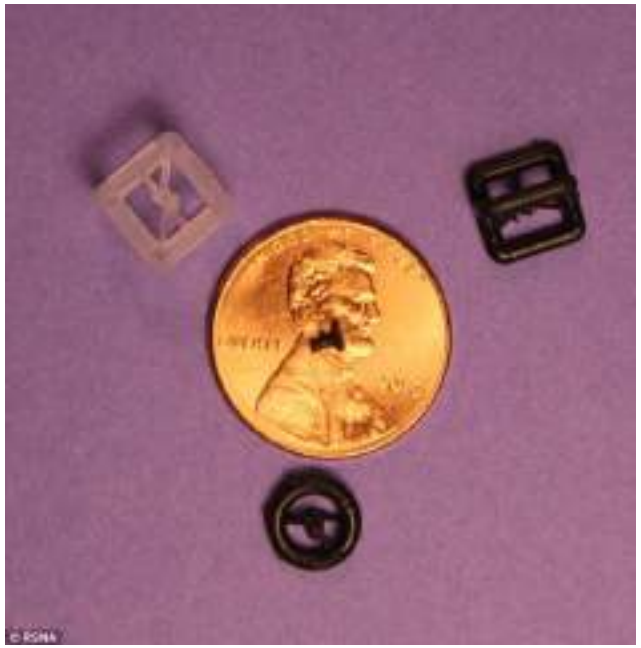
The process begins by injecting a patient's ear canal with liquid silicone to form a perfect impression of his ear canal's shape. Once solidified, the mold is removed and scanned so that it can be converted into a 3D model. Once the hearing aids have been printed, the micro-circuitry that processes and amplifies sound is packed into the custom shell and, well, there you have it – the world's most accurately produced, customized hearing aid.

Guy Fierens, Stijn Huys, and **Jasper Slaets**, three engineers from the University of Antwerp implement a 3D printed humanoid robot capable of translating speech into language (ASLAN).





The robotic arm can articulate fingers while remaining controlled by a specific software. Thereafter, once the user writes a text in the software, the robotic arm translates it into sign language.



The world's first transplant of middle-ear bones using **3D printed components** has restored the hearing of a 40-year-old man with conductive hearing loss in 2020. The groundbreaking surgical procedure was pioneered by Mashudu Tshifularo, MD, Head of the Department of Otorhinolaryngology at the University of Pretoria's (UP) Faculty of Health Sciences, and his medical team at Steve Biko Academic Hospital, in South Africa.

Revolutionary 3D printing technology may offer the key to helping deaf people to hear, without the need for hearing aids. Experts can now craft **replacement parts for fragile bones, known as ossicles,** which transmit external soundwaves towards the cochlear nerve.

The ability to personalise the plastic devices to create intricate prostheses, based on an individual's physiology, could make hearing aids a thing of the past. **The new implant is smaller than a US penny and is inexpensive to make.**

Japanese Ontenna is a hairpin printed in 3D that uses vibration to relay sounds to the wearer. The white compact device looks just like a hairpin but with integrated sensors that register noise in the surrounding environment.

ACCESSIBILITY

While museums are largely thought of as a visual encounter, there are also still some issues that deaf and hard of hearing (HoH) visitors may face, such as hurtful sound acoustics or inaccessibility to sign language.

https://youtu.be/dEvjjhM2UU8

Summary

The World Health Organization estimates that 1.5 billion people live with some degree of hearing loss of which 430 million people require habilitation services.

The future of additive manufacturing in the **medical sector** is really promising. It offers accuracy, to print really small parts, but also to create custom-made parts with a biocompatible material. This technology can be perfectly adapted to the needs of any patients.

Light and vibrations in 3D printed devices designed to be discrete – all of these elements can influence and inspire communication for deaf and hard of hearing people.

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