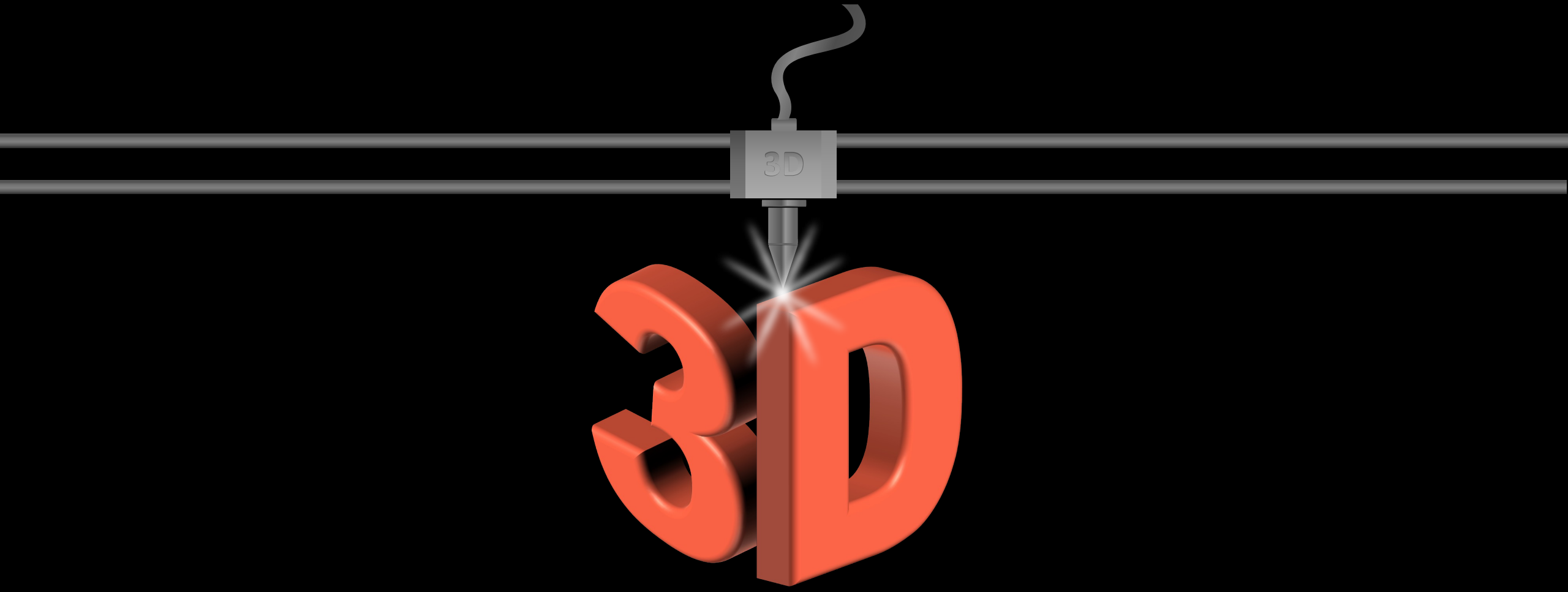
Hello,
My Name is
Mike Wilson

I am the Director of the APSU GIS Center. I am also a Maker and 3D Printing Enthusiast.



Prototype Your Life

3D Printing and the Maker Revolution

Additive vs Subtractive Manufacturing 01

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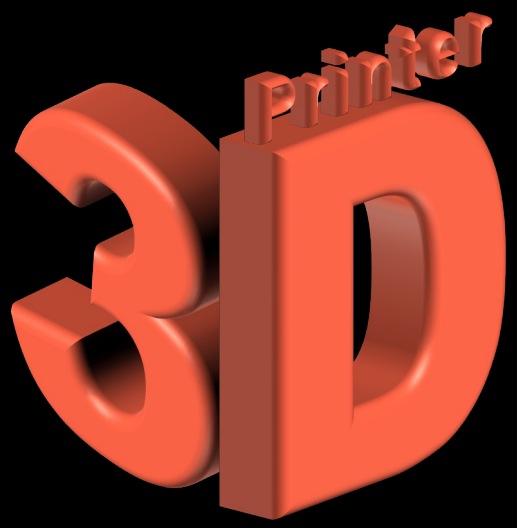
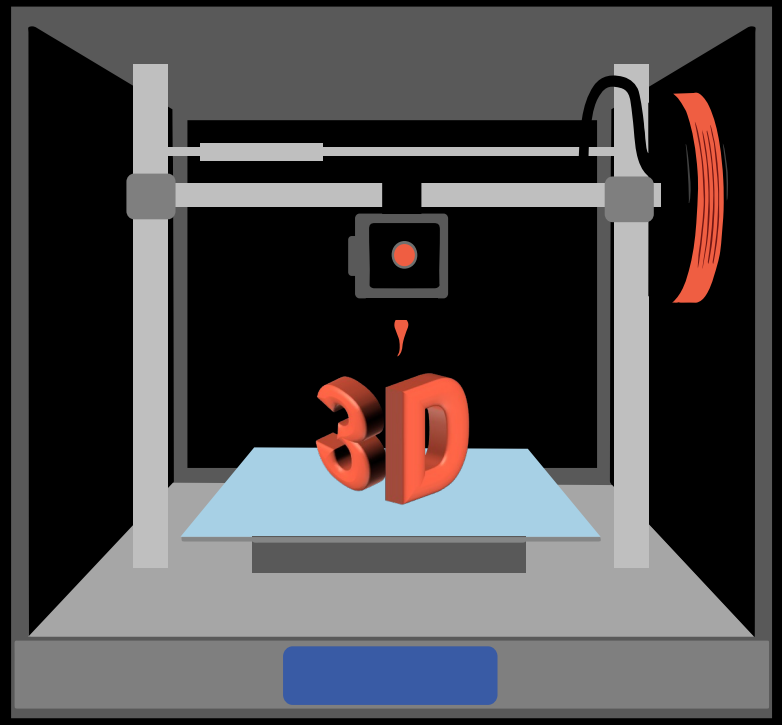




Additive vs Subtractive Manufacturing

Some Boring Definitions…..

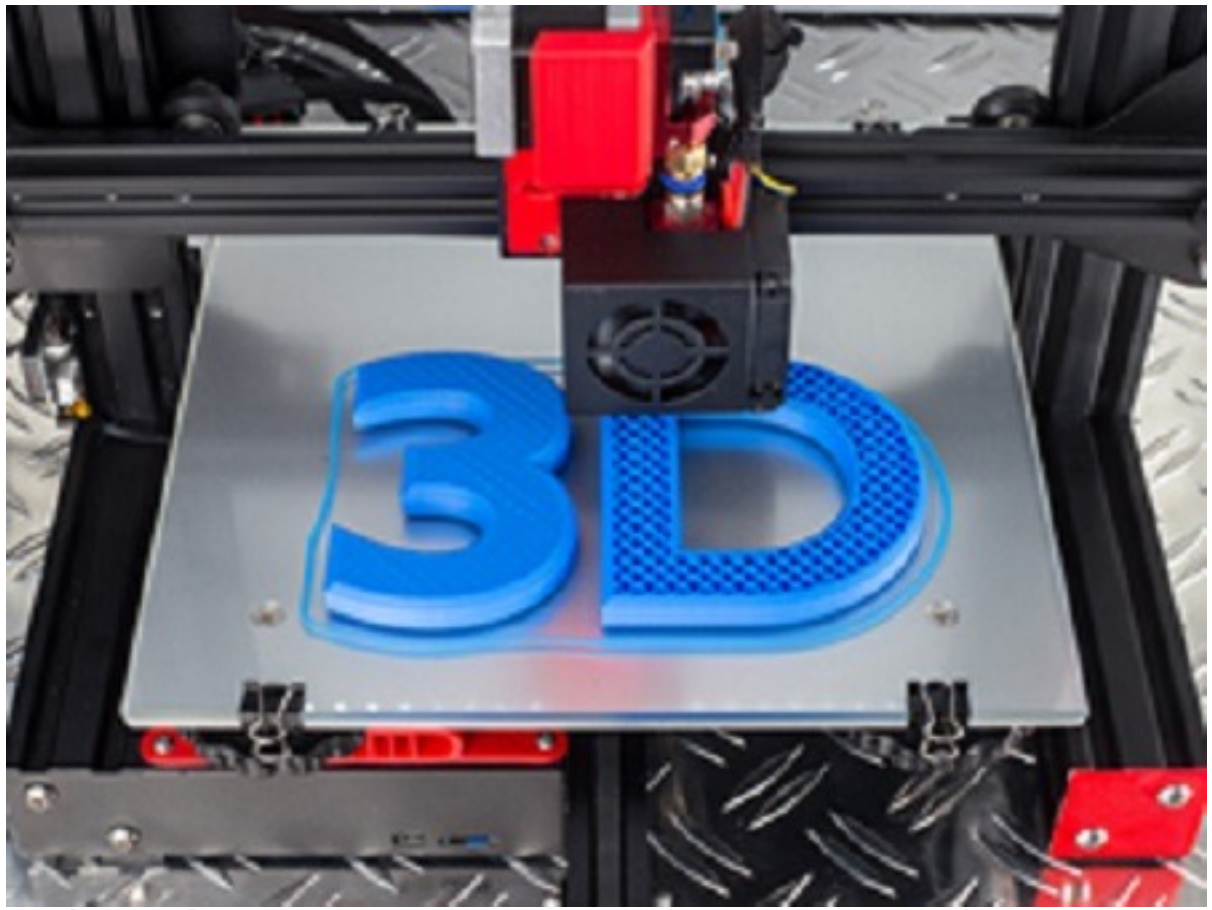
Subtractive Manufacturing

Subtractive manufacturing is a process that removes material from a solid block or sheet to create an object.

Subtractive manufacturing is often the best option for low-complexity, high-volume situations.

Ideal for applications that require tight tolerances and geometries that are difficult to mold, cast, or produce with other traditional manufacturing methods.

Additive Manufacturing



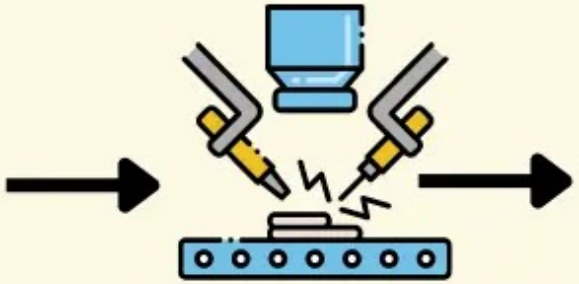
Additive manufacturing, commonly known as 3D printing, is the process of adding material to create an object.

Additive manufacturing currently considered the best option for prototyping and short production runs of complex parts.

Additive manufacturing is cheaper for plastic parts. Unfortunately, as production scales up, subtractive methods offer more cost-effectiveness, especially for larger, simpler designs.

Process of Additive vs Subtractive Manufacturing

Materials



Additive Manufacturing

Material

Subtractive Manufacturing

3D Object

Waste

VS

3D Object

Waste

Additive Manufacturing Overview

VAT Photopolymerization

Description:
3D objects are created by selectively curing liquid resin through targeted light-activation.

Strengths:
- High level of complexity
- Smooth surface finish

Typical Materials:
UV-Curable photopolymer resins

Powder Bed Fusion

Description:
3D printing methods that use a laser or electron beam to melt and fuse powder materials together.

Strengths:
- High level of accuracy and complexity
- Optimized build volume via "nesting"

Typical Materials:
Thermoplastic, metal, and ceramic powders.

Binder Jetting

Description:
a family of additive manufacturing processes in which a printhead selectively deposits a liquid binding agent onto a layer of powder. After the binding agent has been deposited to a 3D part, a post-processing step is normally used to solidify.

Strengths:
- Allows for full color printing
- High productivity

Typical Materials:
Powdered plastic, metal, ceramic, glass, or sand.

Material Jetting

Description:
3D objects are created as material is jetted onto a build surface and cured or hardened using ultraviolet (UV) light.

Strengths:
- High level of accuracy and complexity
- Multiple material parts and colors in one process

Typical Materials:
Photopolymers, waxes

Sheet Lamination

Description:
an additive manufacturing process where sheets or ribbon of material is cut out in specific shapes, placed on top of each other and bound together through welding, heat, or adhesive.

Strengths:
- Processing speed
- Allows for combinations of different materials

Typical Materials:
Paper, plastic sheet, and metal foil/tape

Directed Energy Deposition

Description:
creating 3D objects by depositing a material onto the surface of another part, where it adheres to the underlying surface by applying energy from a laser, beam, or arc.

Strengths:
- Effective for repairs and adding features

Typical Materials:
Metal powder or wire

Material Extrusion

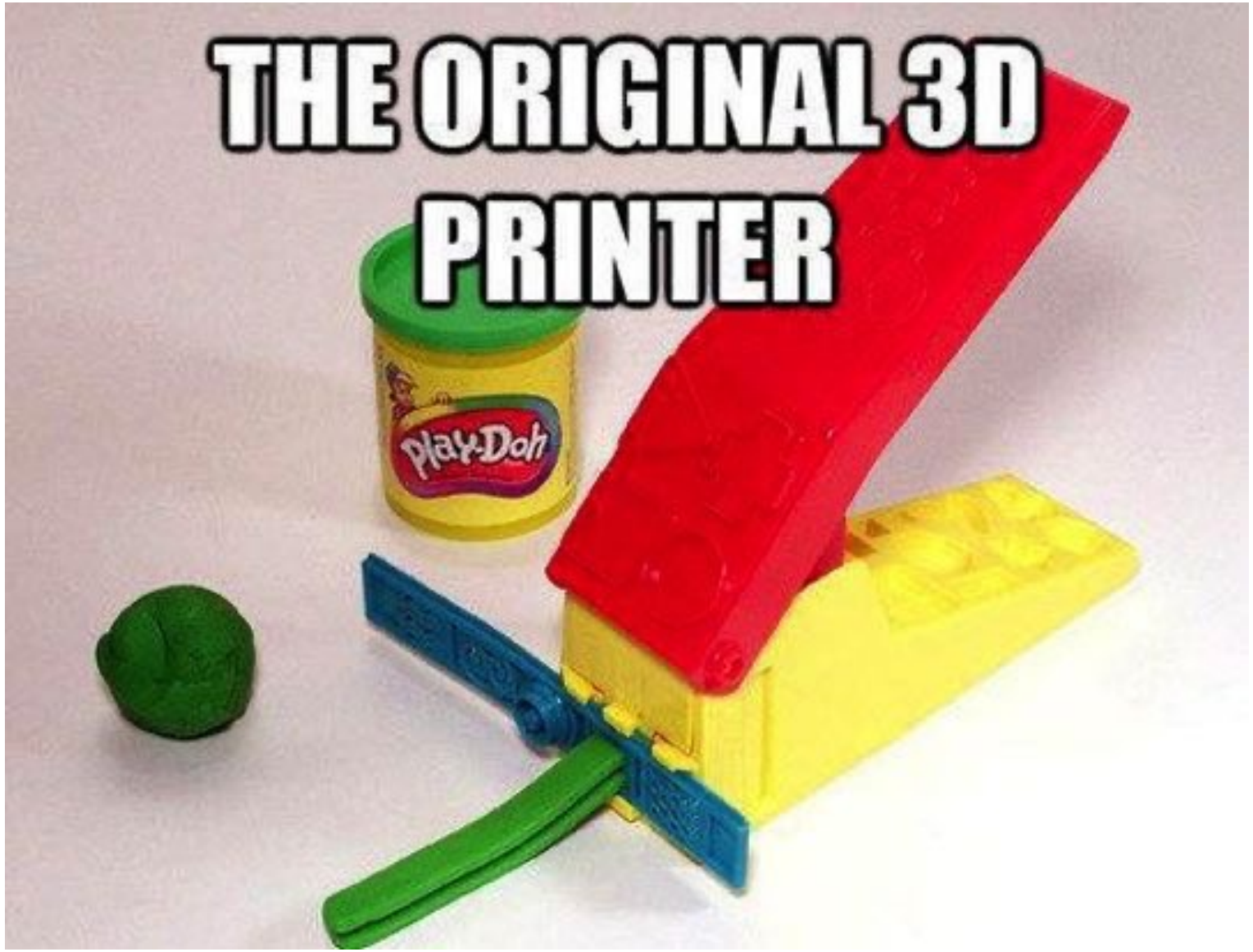
Description:
3D printing method where material is drawn through a nozzle where it is heated and then selectively deposited layer by layer.

Strengths:
- Wide range of materials with good structural properties
- Can be economical for wide range of applications

Typical Materials:
Thermoplastic filaments and pellets

JUGGERBOT3D LLC

The History of 3D Printing



1981

1st 3DP Patent

Hideo Kodama patents a rapid prototyping technique.

1984

Stereolithography

Chuck Hull pioneers SLA, solidifying resin in layers.

1988

3DP in Business

Hull founds the first 3D printing company.

1992

Selective Laser Sintering

Carl Deckard and Joseph Beaman invent SLS.

2004

Expiration of SLS Patent

Leads to increased innovation in 3DP.

2009

Desktop 3D Printing

MakerBot & Ultimaker offer desktop printers.

2011

3D Bioprinting

First artificial bladder was printed.

2015

Metal 3D Printing

DMLS and EBM transform metal manufacturing.

2016

Construction 3DP

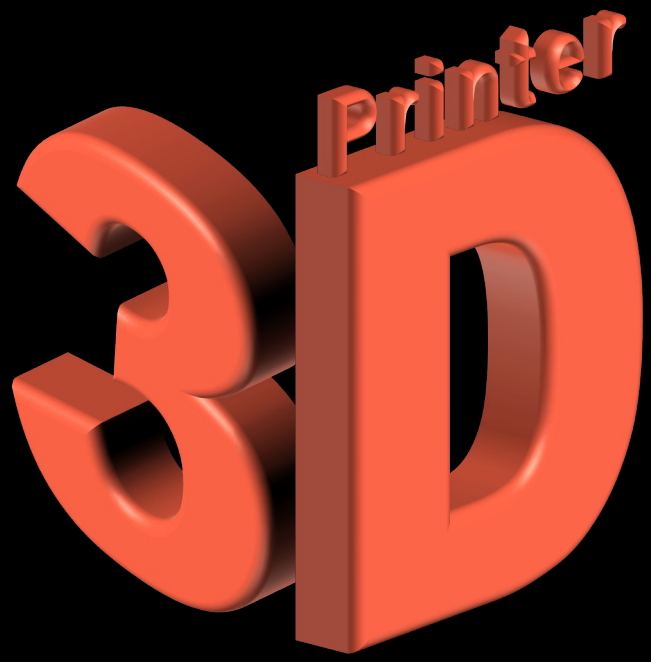
China builds the first habitable 3D printed structure.

2020

Pandemic Response

Vital in producing PPE during COVID-19.

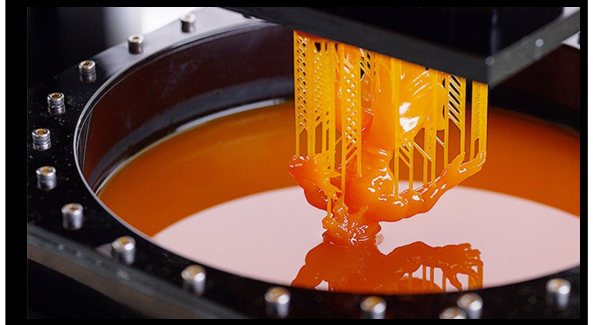
The Infancy Stage:



1981 - 1999

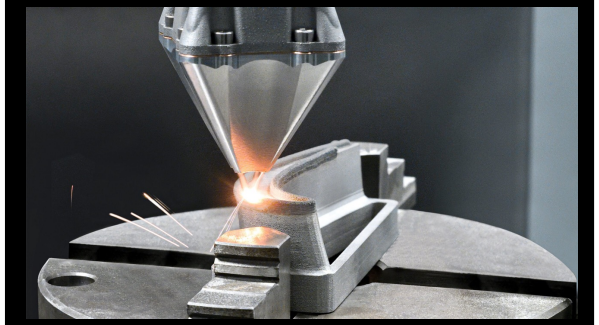
Common 3D Printers of the Era

Vat Polymerization

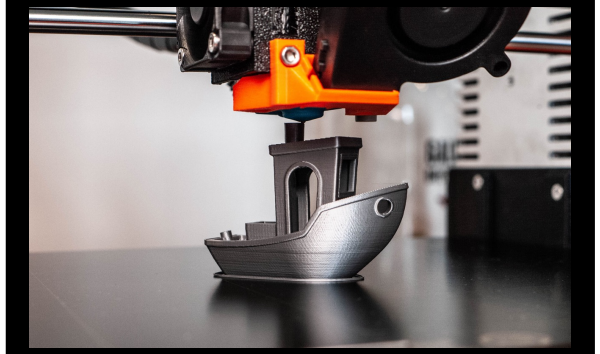


Powder Bed Fusion

Directed Energy Deposition



Material Extrusion



Inventor of SLA 3D Printing

First Successful 3D Print in 1983. Co-Creator of STL format

Rapid Prototyping Machine

Created in order to speed up the lengthy time-frame it took to have prototypes of products created. It would take approximately 6-8 weeks using one-off tooling processes back in the early ’80s, so a machine that could print a part in just hours was a major breakthrough within the manufacturing industry.

Chuck Hull’s 3D Printer

SLS Not to Be Confused with SLM Printing…

Funded via DARPA First Successful 3D Print mid 1980's a DTM.

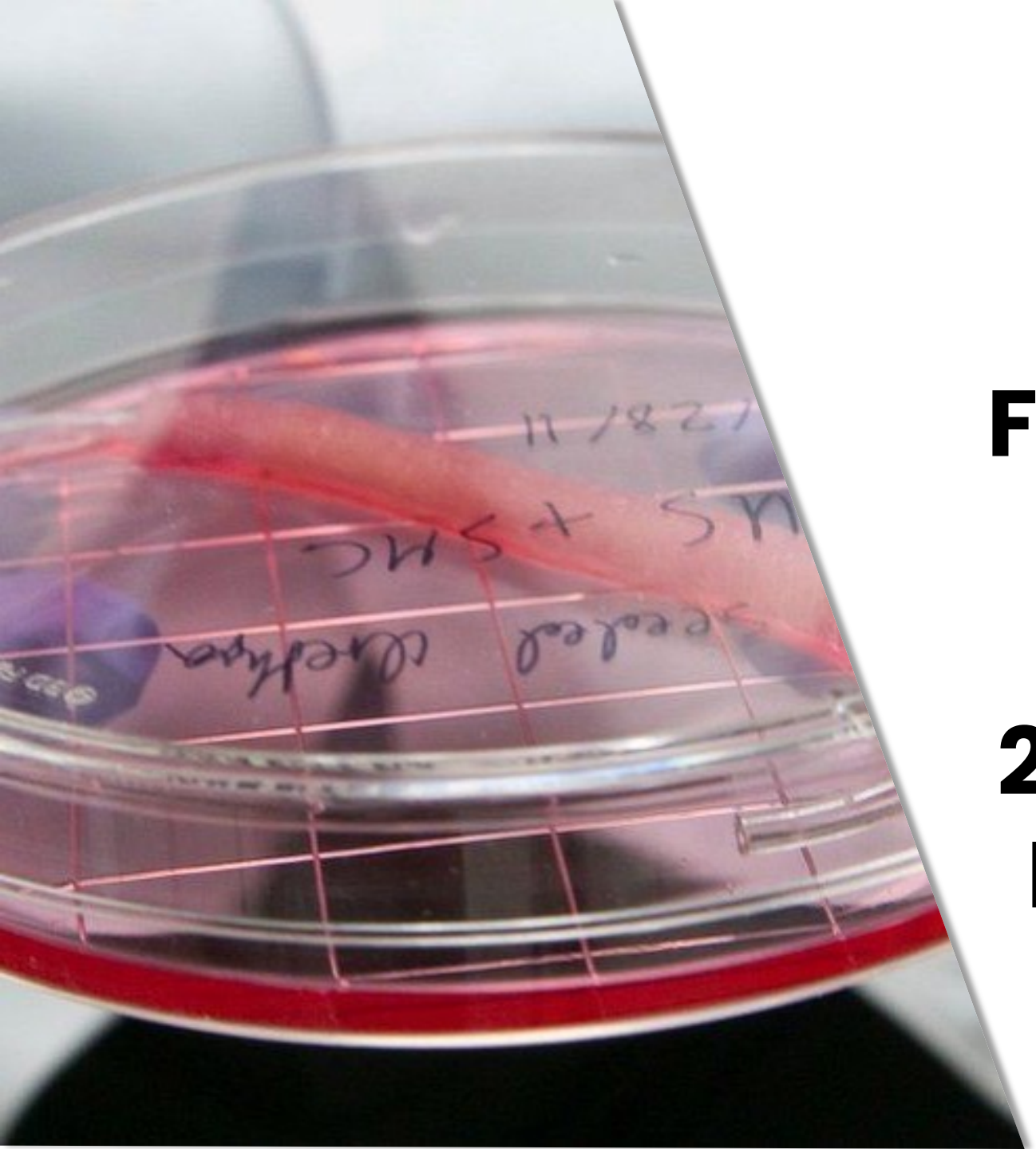
Selective Lase Sintering

Laser Sintering is the process of using a a high-powered laser to force a powdered material coalesce into a solid structure. No actual melting occurs. SLM melts the power.

Dr. Joe Beaman and Dr. Carl Deckard

The Adolescence Stage

1999 - 2010



Why 1999?

BLADDER GROWN FROM 3D BIOPRINTED TISSUE AND TRANSPLANTED IN 2004 CONTINUES TO FUNCTION AFTER 14 YEARS

Other Medical Advances

3D Printed Kidney (2002)

First Successful 3D printed kidney transplant

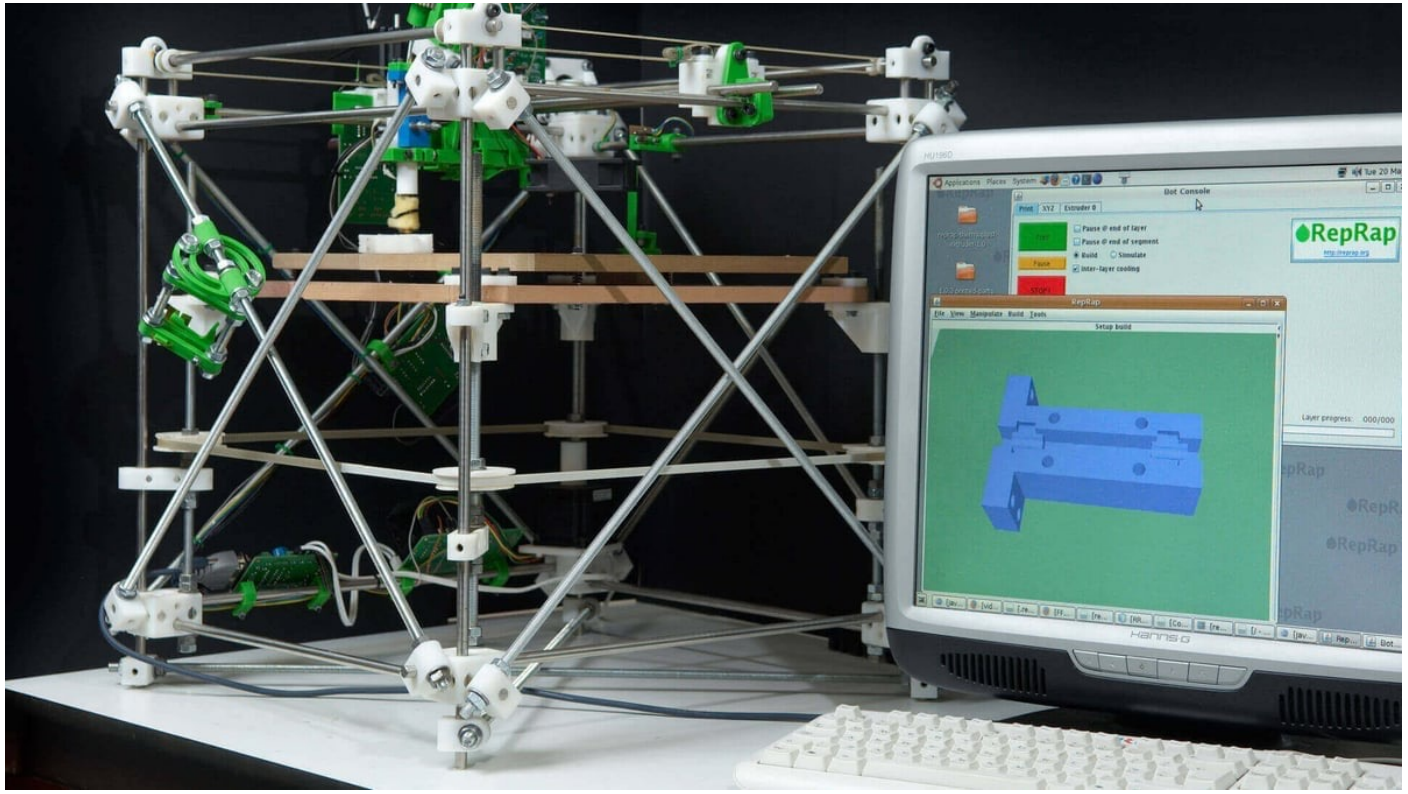
3D Printer Prosthetic Limb (2008)

Incorporated all parts of a biological limb, was printed ‘as is’, without the need for any latter assembly.

Open-Source 3D Printing

200 3D Printing Patent Expired (2002 -2014)

Affordable Consumer and Hobbyist focused 3D printers are Born

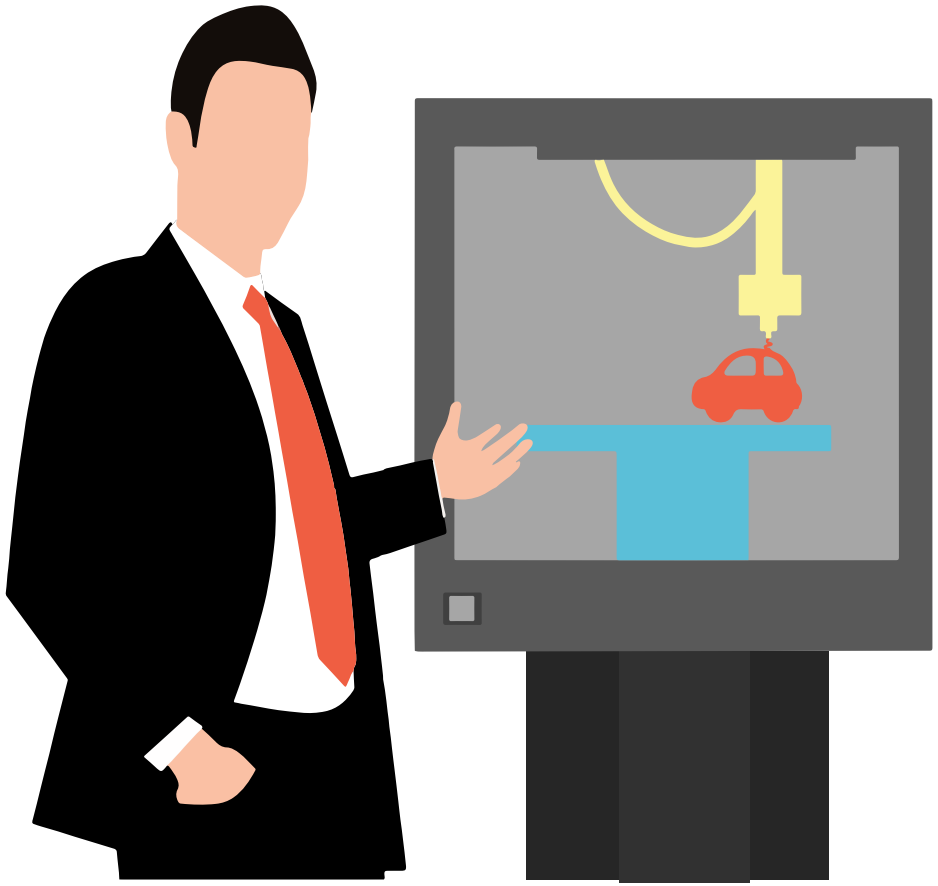


RepRap Project (2005)

The RepRap was one of these early low-cost 3D printers. It was made primarily from plastic parts and its creators envisaged that it could be used to print the parts for other printers.

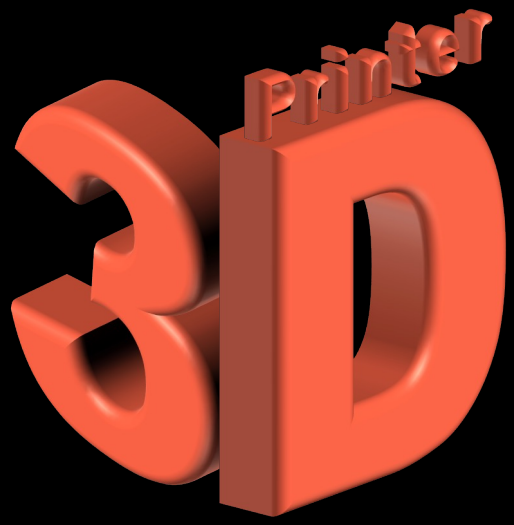
3D Printing Today

The Adult Stage:



2011 - Present

Open Source and Consumer 3D Printers

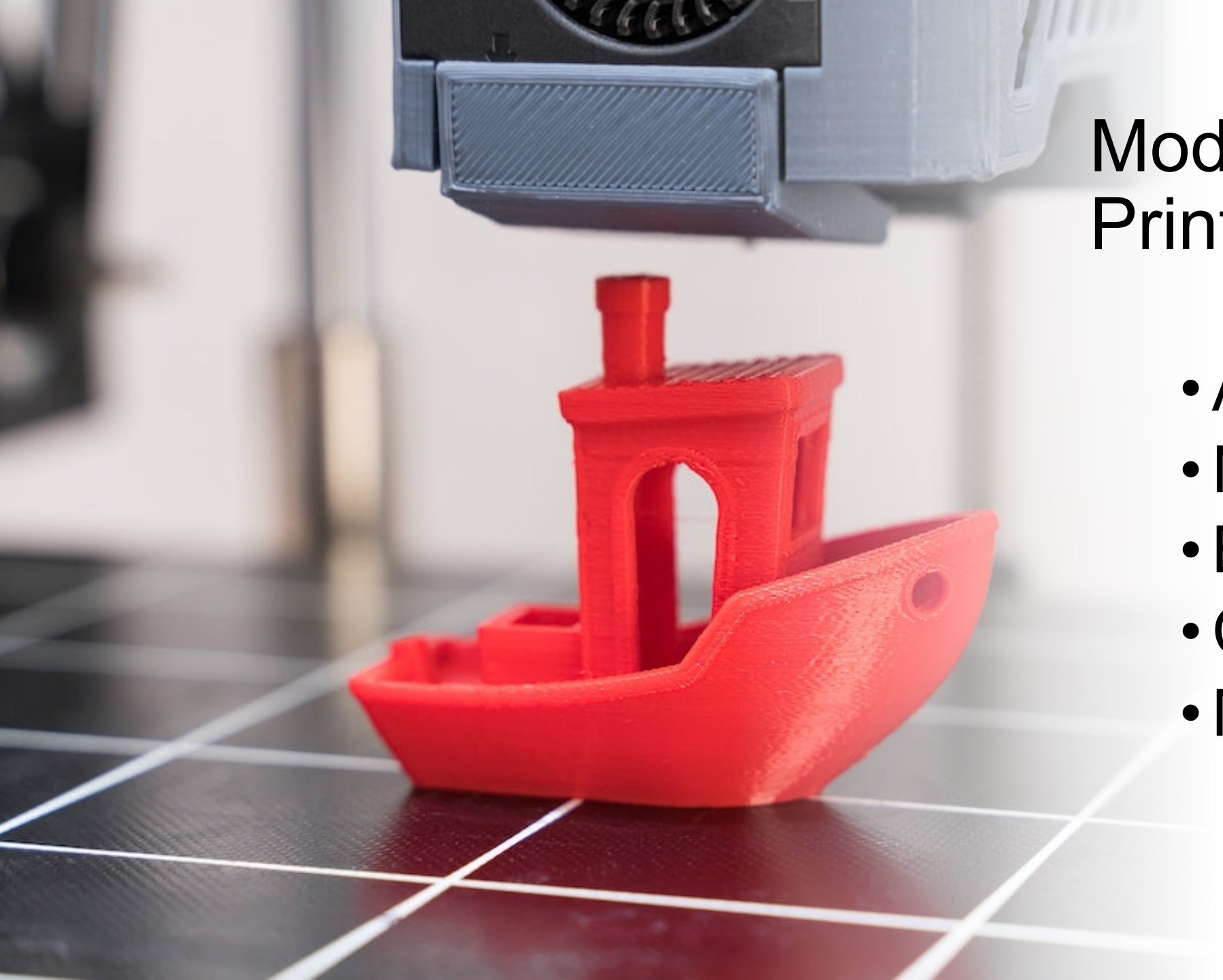


2010s

- Average Cost of $15,000 in 2012
- RepRap Kits sold for $500

Present

- Numerous 3D Printers and 3D Printer Companies derived innovation from RepRap
- Cost of FDM Printers is down to ~$200
- Metal 3D Printing still remains the domain of government and large corporations

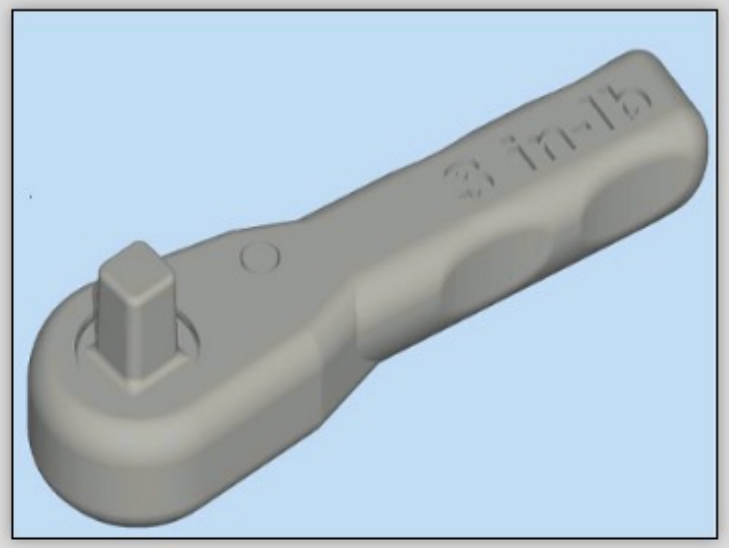


Modern 3D Printing

- Aerospace
- NASA
- Bioprinting
- Construction
- Makers

NASA

Wrench



Description

Author/Origin: Made In Space, Inc.(MIS)/NASA MSFC

Relevant Mission: Wrench

Date Added: January 14, 2015

Keywords: 3D Model, Wrench

GitHub Repository: Wrench-3D

This isn't the first 3D-printed object made in space, but it is the first created to meet the needs of an astronaut. When International Space Station Commander Barry Wilmore needed a wrench, NASA knew just what to do. They "e-mailed" him one. This is the first time an object has been designed on Earth and then transmitted to space for manufacture.

COVID-19

3D printing applications for COVID-19

3D-printed
Charlotte valve

Medical devices
- Ventilator valves
- Mask connectors for CPAP and BiPAP
- Emergency respiration device
- Non-invasive PEEP mask

3D-printed
respirator

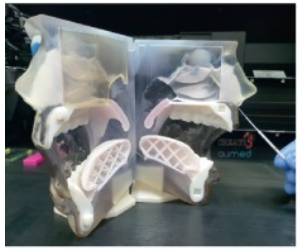
Personal protective equipment (PPE)
- Face shield
- Respirators
- Metal respirator filters

3D-printed
NP swab

Testing devices
- Nasopharyngeal (NP) swabs

3D-printed
customizable mask

Personal accessories
- Face masks
- Mask fitters
- Mask adjusters
- Door openers



3D-printed
medical manikin

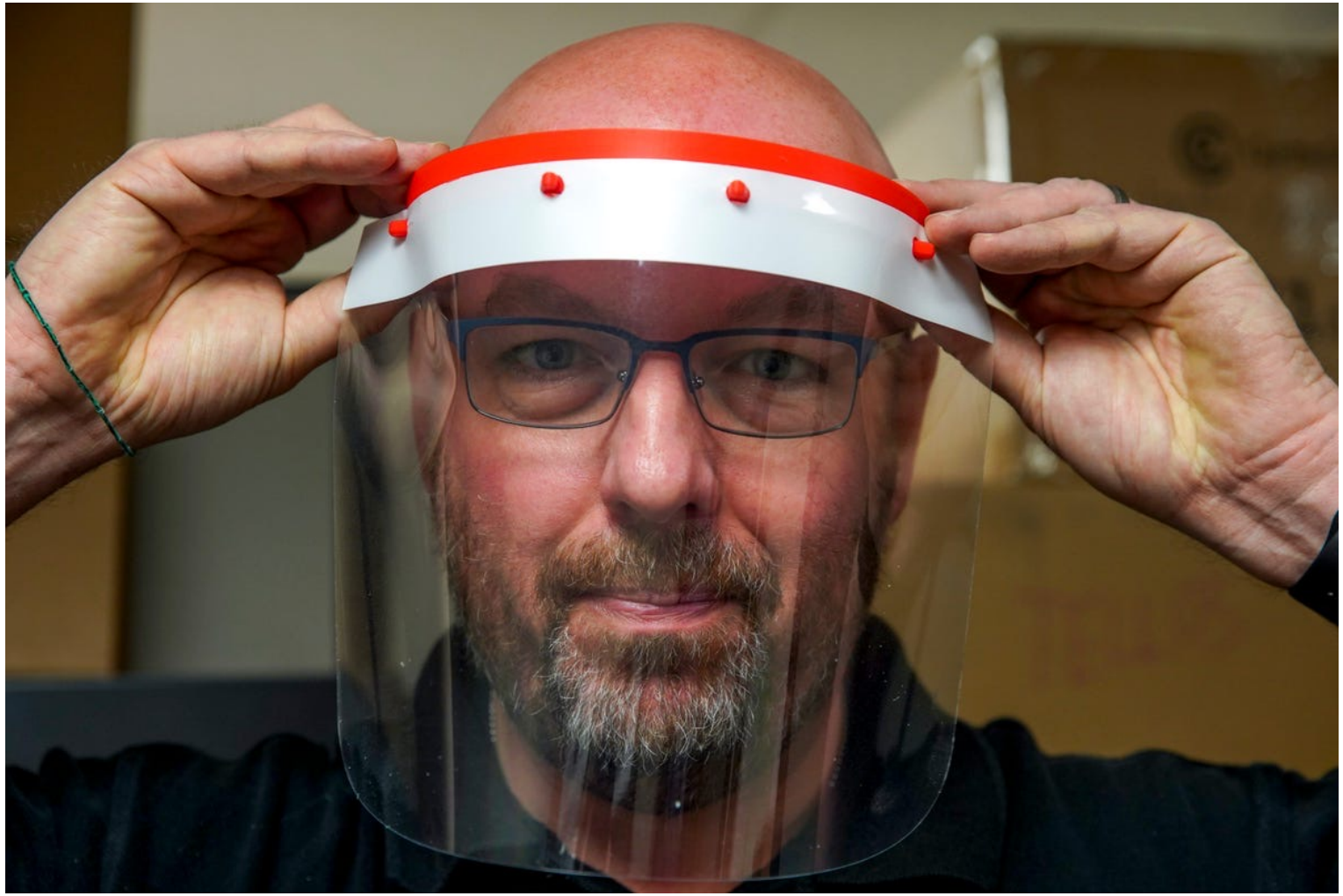
Training and visualization aids
- Medical manikins
- Bio-models

3D-printed
isolation wards

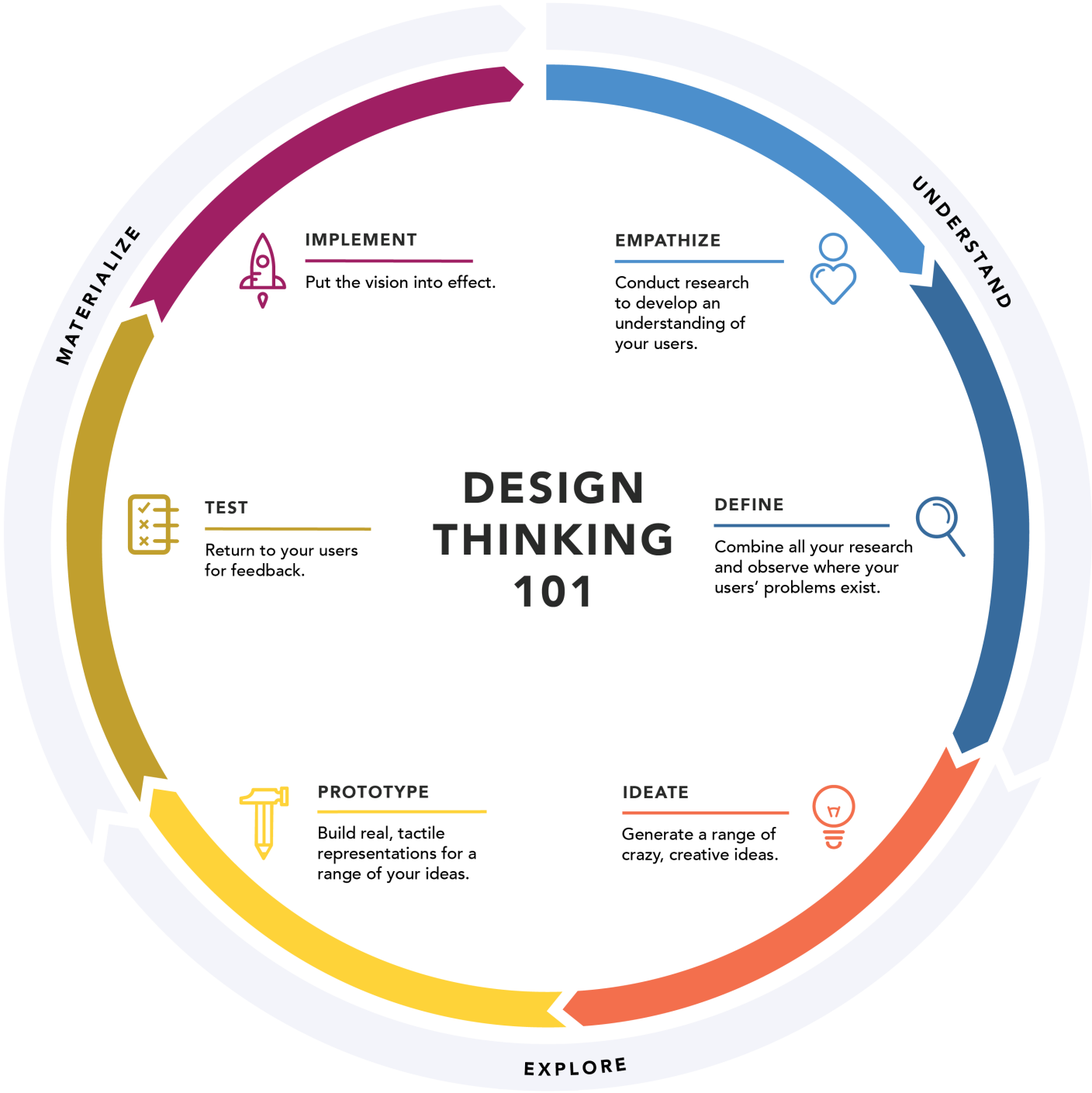
Emergency dwellings
- Isolation wards

[The global rise of 3D printing during the COVID-19 pandemic]

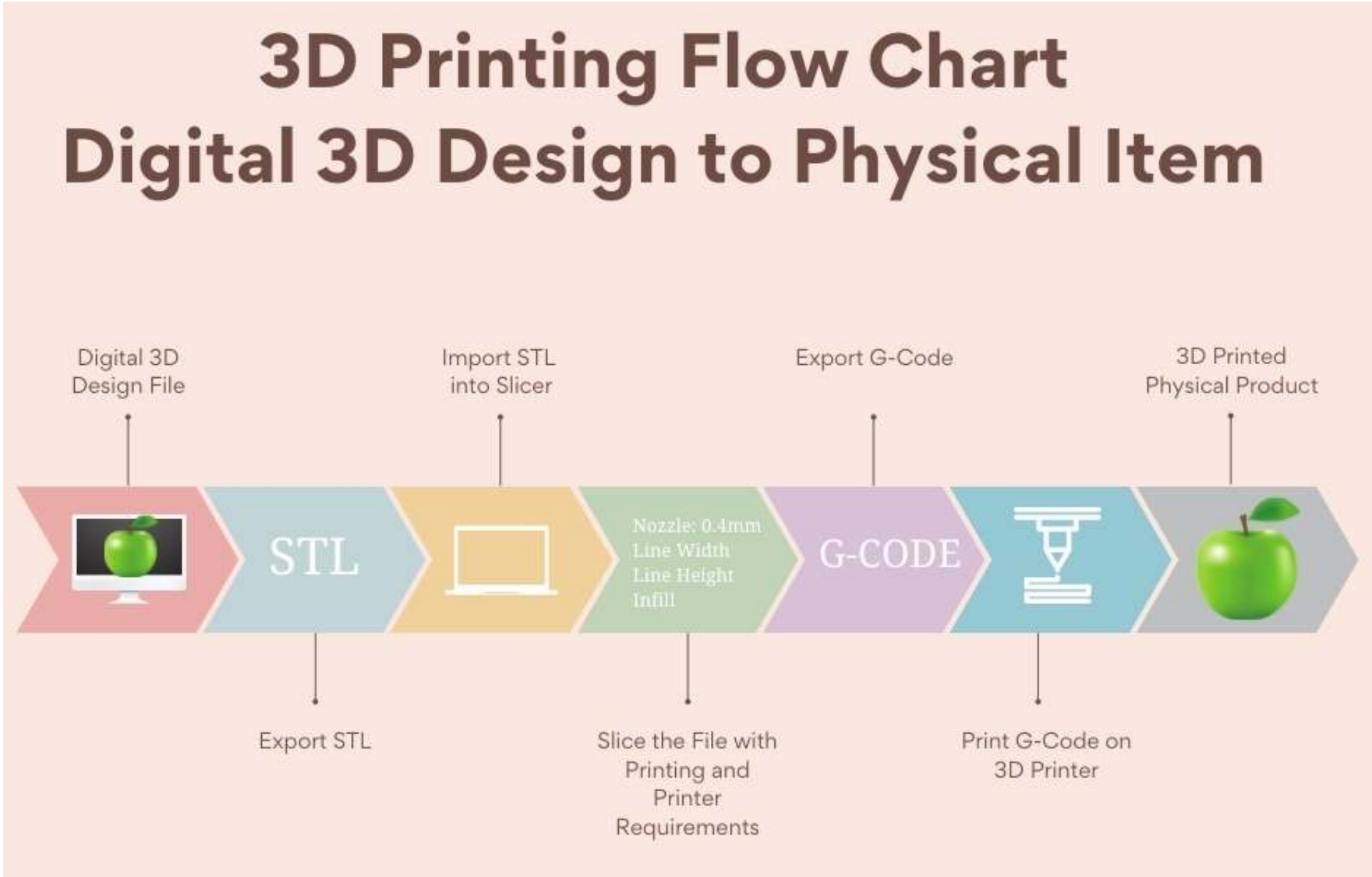
COVID-19



Prototype Your Life



Prototyping in 3D Printing



Free Models

- Thingiverse
- Printables
- Thangs
- Cults3D

3D Printing in the Future..

1. 3D printing will become a mainstream technology for serial production
2. Design software for additive will become more integrated and easier to use
3. Focusing on education will enable more 3D printing applications and adoption
4. Dental will adopt 3D printing as a dominant production technology
5. 3D printing will become smarter
6. The 3D printing service bureau market will continue to expand
7. Metal 3D printing will continue to mature
8. Composite 3D printing will offer a huge market opportunity
9. Automation will become a key focus for the industry
10. The additive manufacturing landscape will become more competitive

Autonomous Manufacturing (2019)

Getting Started with 3D Printing

Models

- Create your Own
- Online

Software

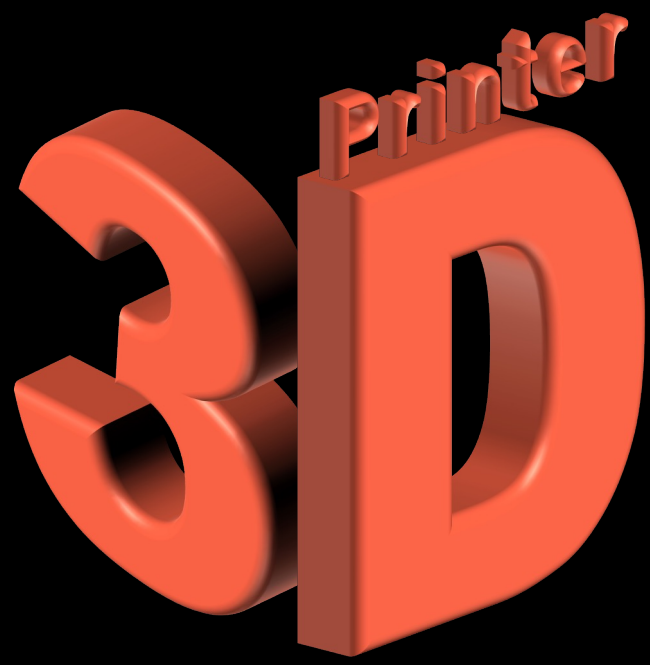
- Cura
- PrusaSlicer
- Orca Slicer

Printers

- Too Many to Name

Print....

Questions?



THANK YOU

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Status		Gadget AI
Ready		Standing By

Print Time	Time Left	Completion
-	-	-

Filament	Hotend	Bed
-	-	-

File

-

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