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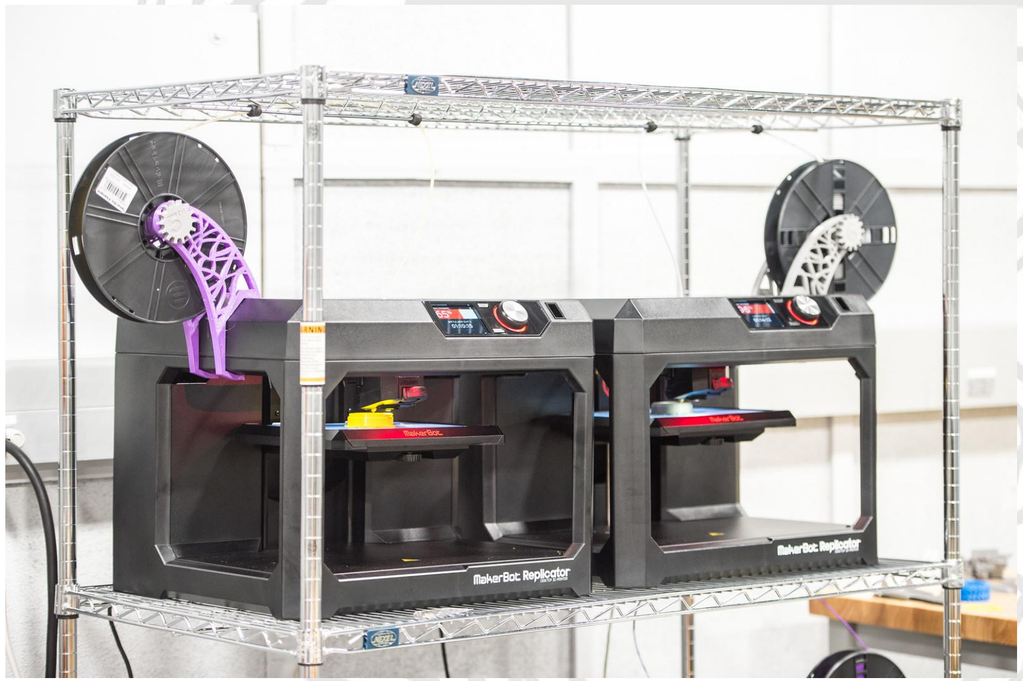
The Digital Manufacturing Laboratory (DML)

- A Shared Instrumentation Laboratory (SIL)

"The Essentials - What I need to know to submit a Work Order in the Digital Manufacturing Laboratory"



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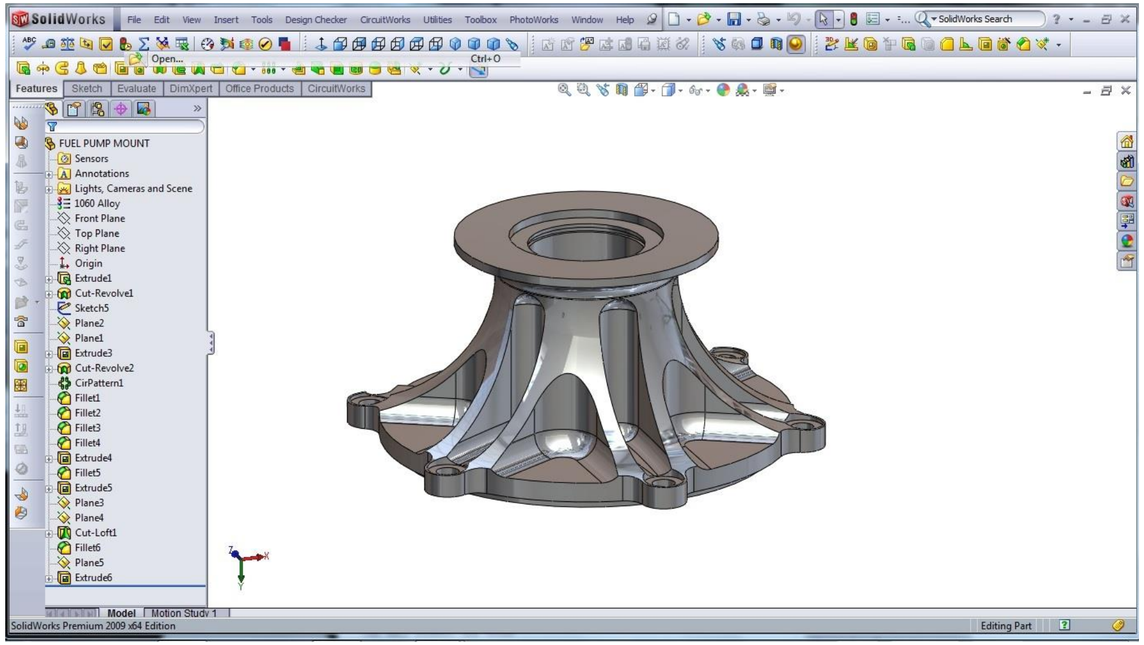
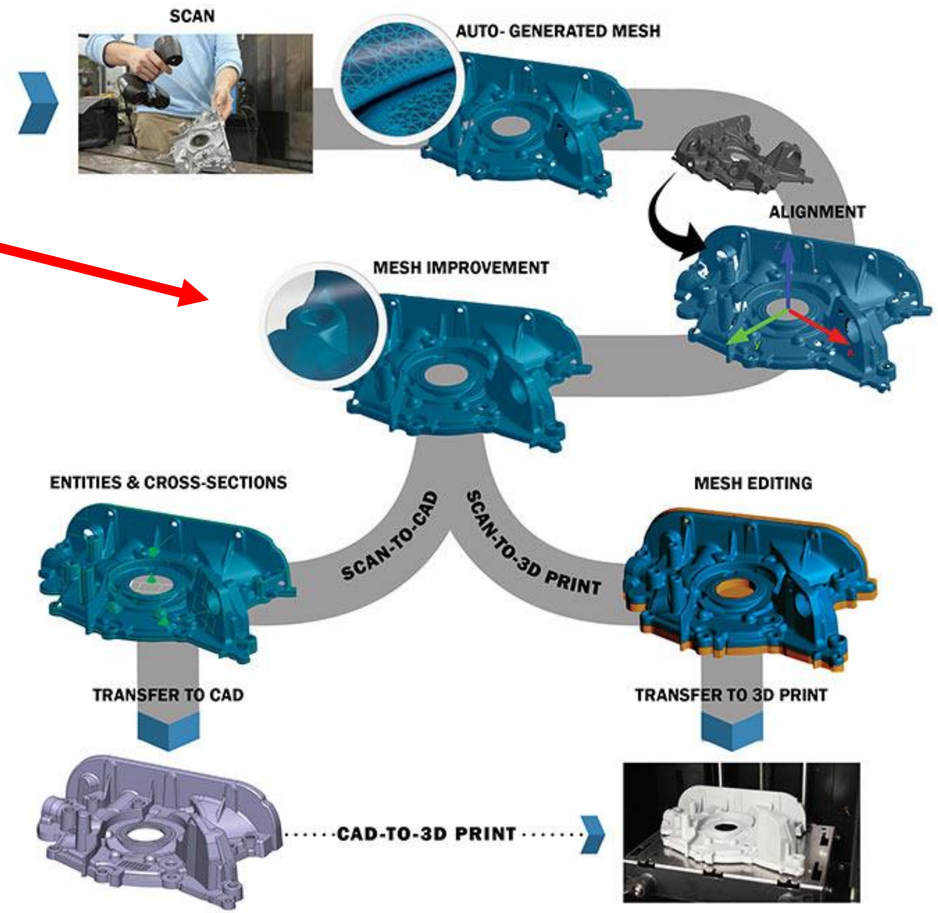
Getting Started: "How do I print a 3-D component?"

FIRST -- Digitally Construct a 3-D CAD Model

1. The DML is modeling software "agnostic"
2. Use Creo, Solidworks, or ANY modeling package!
3. For simple parts, 3-D scanning *may* be an option



CAD (e.g., SolidWorks, Creo, AutoDesk)



3-D scanning (steps, scan-to-print)

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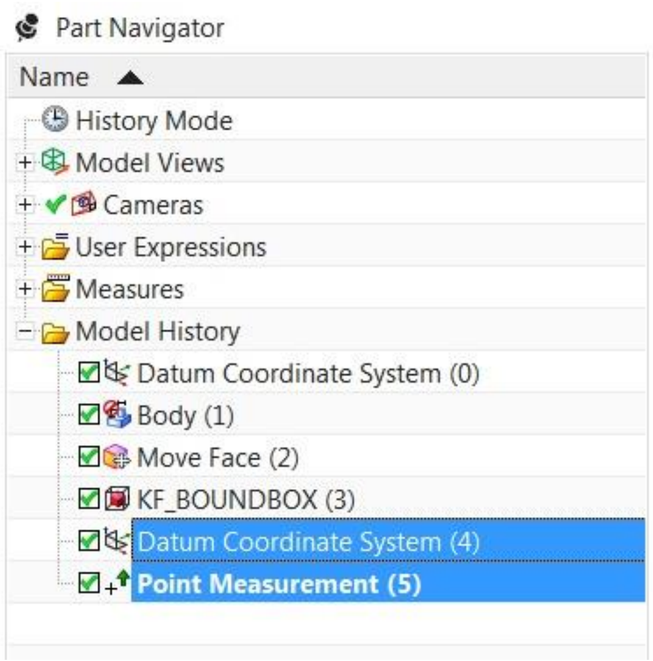
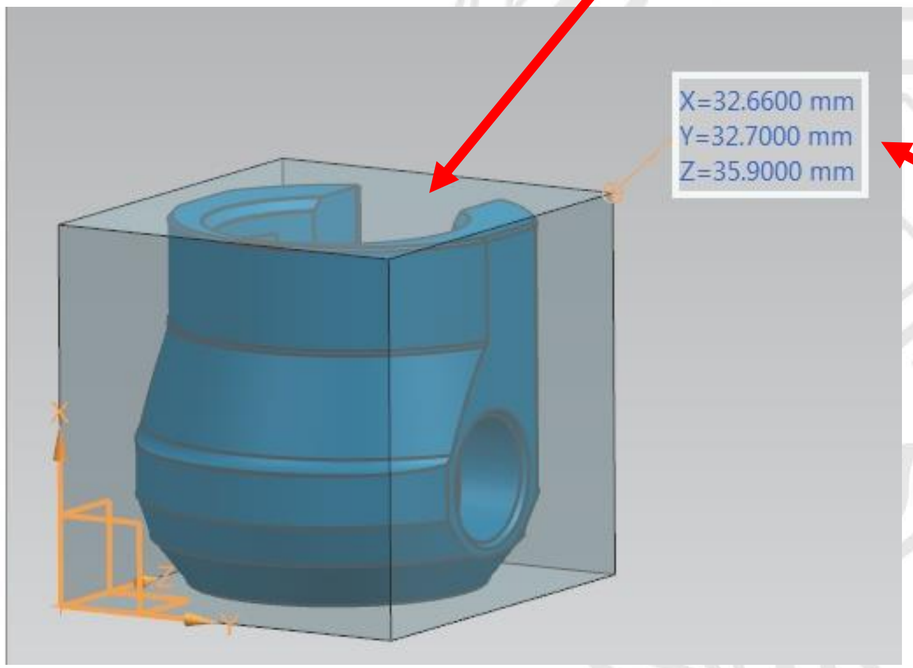
“What are the UNITS of my CAD Model (bounding box)?”

As the modeler of your part, YOU must understand the size of your “bounding box”

- **Units should be in either inches or millimeters for part export**
- **These key dimensions will be requested on your Work Order**





Length, width, height

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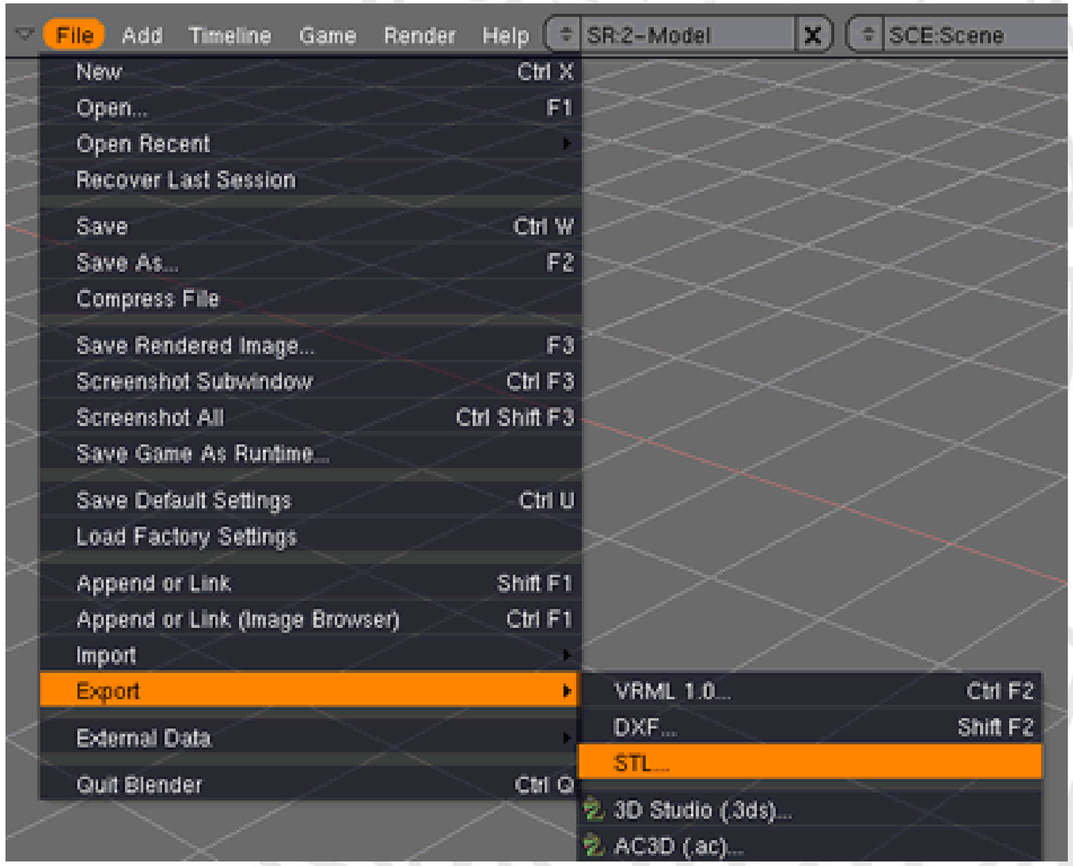
“What file format do I export my models to for 3-D Printing?”

Once you have FINALIZED your 3-D CAD Model:

Step 1. Export finalized model(s) to .stl file format (Most Common export format for 3-D printing)

** Note: each part needs to be exported as a separate .stl file*

** Note: 3-D printing may require other file formats, e.g., .OBJ files, for 3-D prints with colors/materials. Unless otherwise instructed,* ***please export your files into .stl format***



STL file format: https://en.wikipedia.org/wiki/STL_(file_format)

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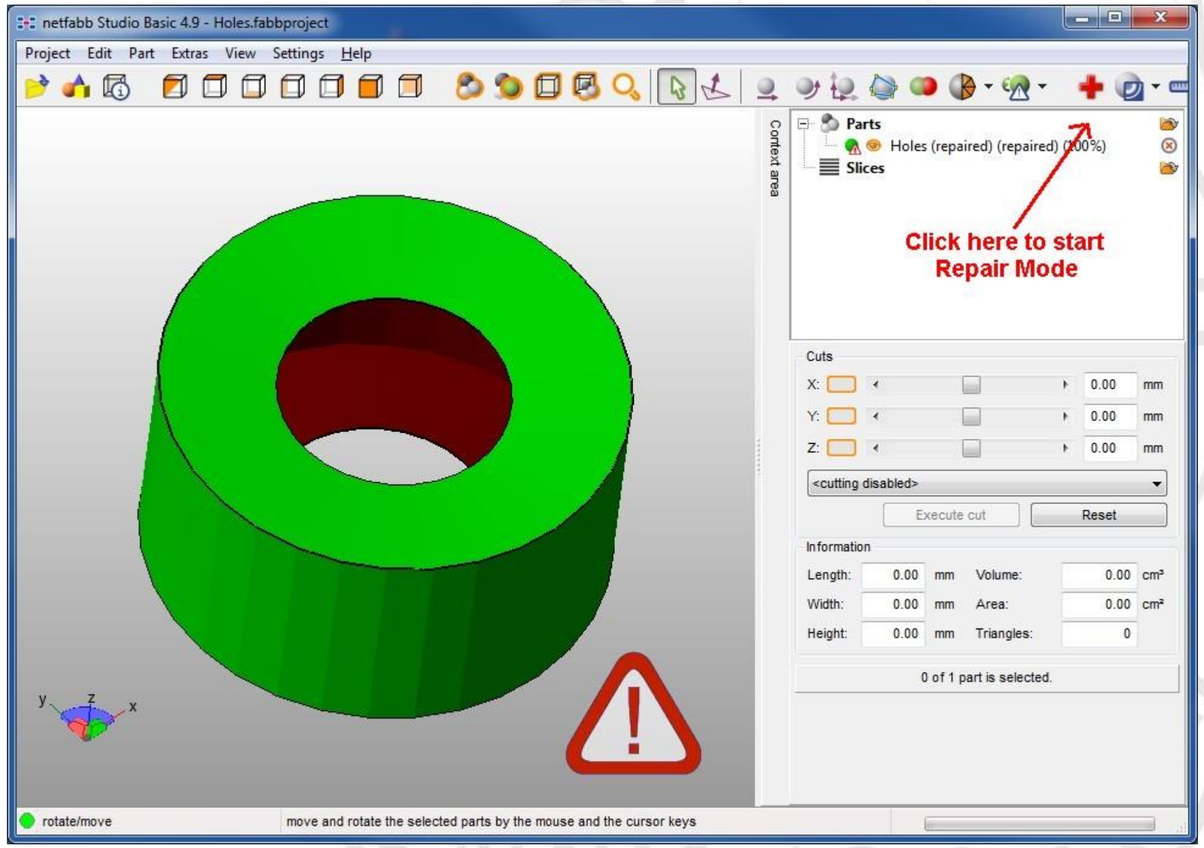
“Is my CAD model ready to be 3-D printed?”

As modeler, it is your responsibility to ensure that your CAD model, and your exported .stl parts, are free of any defects



<u>CAD model repair tools:</u>

- **netFabb (free trial):** https://www.autodesk.com/products/netfabb
- **Meshmixer:** http://www.meshmixer.com/download.html

<u>Step 2</u>. Compress (VERIFIED) .stl file(s) into a single .zip archive

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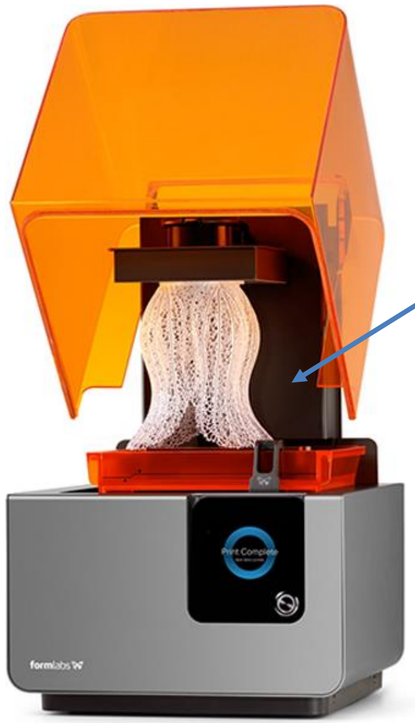
“How large can my model be for a 3-D Print?”

A: It depends on the size of the Build Plate, per printer

- And each printer (typically) has a designated material type
- For printers in the DML, build volumes range from: (5”x5”x5”) to (12”x5”x6”)



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1. PLA plastic

“What are my Printer/Material options?”

MakerBot Replicator (5th Generation) printers

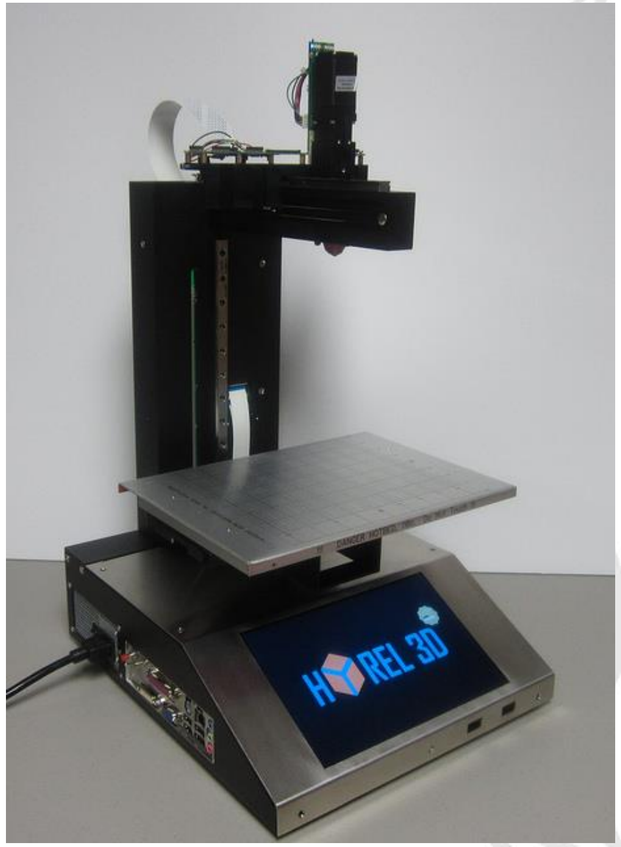
- Uses *PLA plastic* for filament

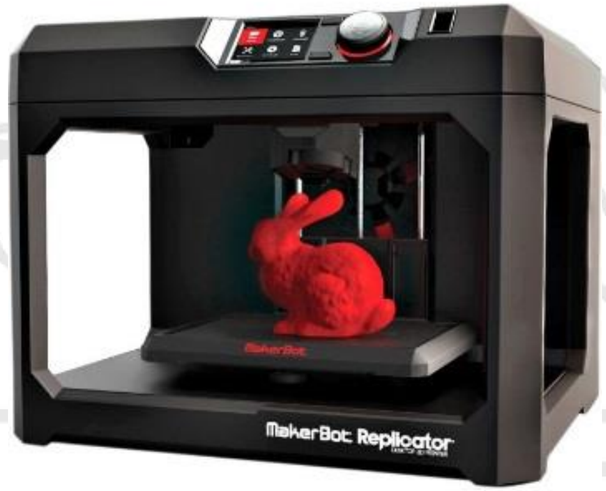
MakerBot Replicator 2X printer

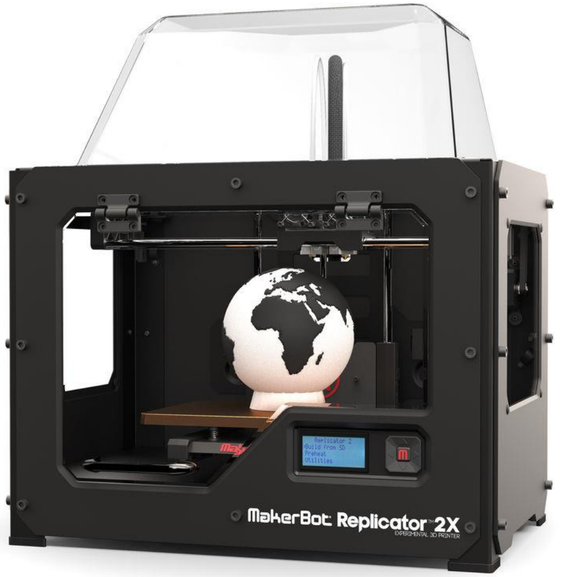
- Has **2 extruders** for multi-colored prints
- Uses *ABS plastic* filament

Hyrel 3-D Engine E3 Printer

- Can print in PLA, nylon, flexible materials
- More for *experimental applications*







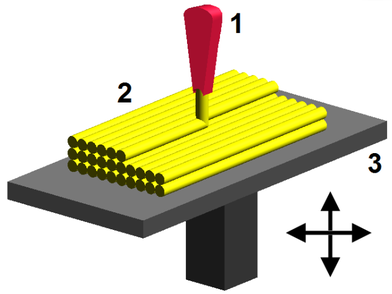
2. SLA resin

“What are my Printer/Material options?”

FormLabs 1+ Printers

- Use a liquid resin (SLA) as the product build material
- Options for different colors, material types and constituencies

“What are my Printer/Material options?”



mojo

- Uses ABS-plus plastic (Ivory)
- Fused Deposition Modeling (FDM) Technology
- Efficient post-processing bath (no trimming/cutting required)

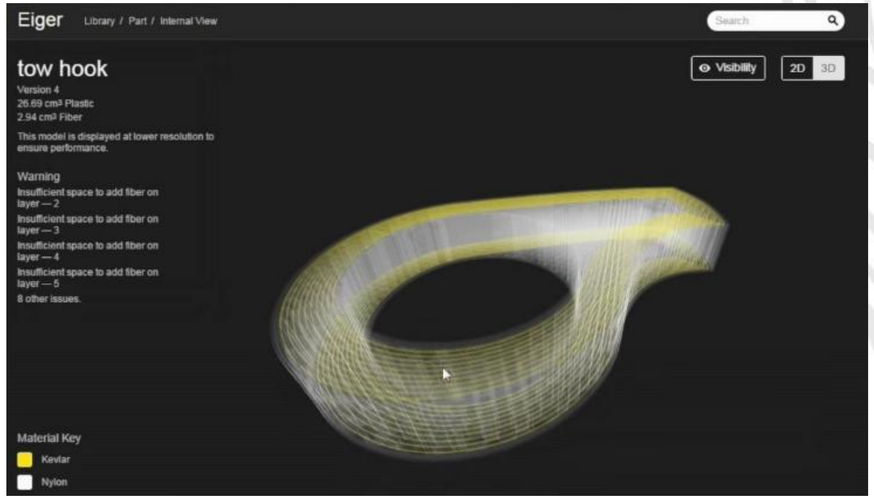
uPrint SE printer

- Higher quality builds than standard ABS/PLA
- **Uses a water soluble support material**
- Efficient post-processing bath (no trimming/cutting required)

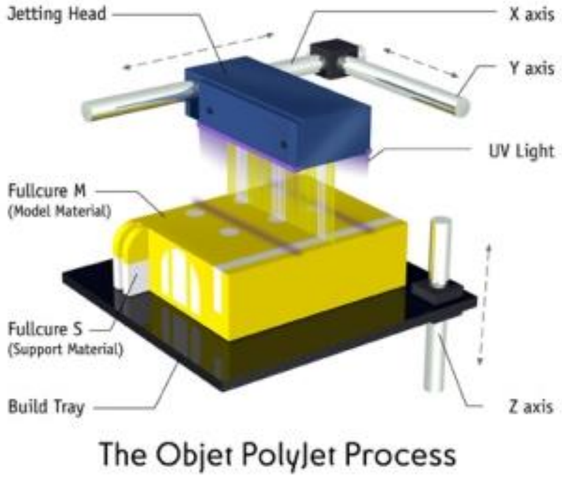
“What are my Printer/Material options?”

MarkForged MarkTwo printer

- A composite material printer (stronger, durable parts)
- Uses nylon base, with carbon/kevlar/fiberglass embedded
- “Onyx” material embeds carbon fibers within the nylon matrix material



“What are my Printer/Material options?”



The Objet PolyJet Process

obJet 30 printer

- “PolyJet” 3D printer is analogous to inkjet 2-D printing
- Can produce complex parts using a wide range of (pre-loaded) materials
- Power-wash station enables support material to be easily removed

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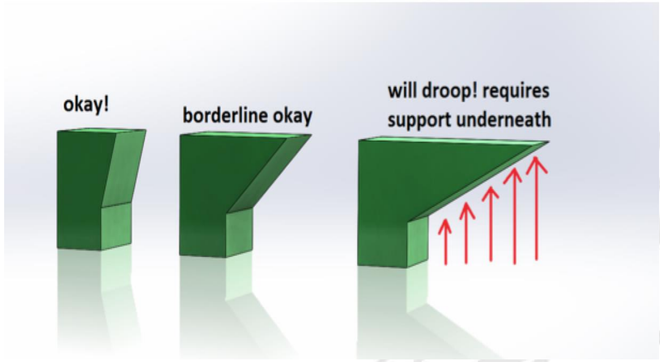
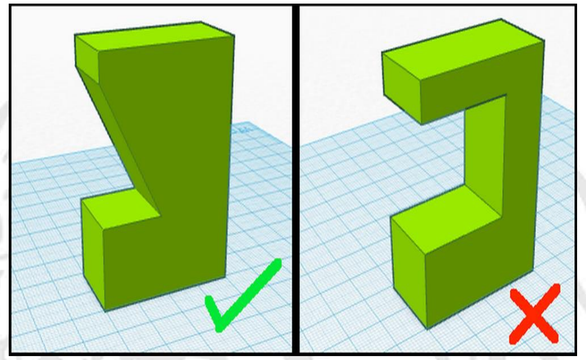
"What are structural considerations in 3-D Printing?"

What are "overhangs"?

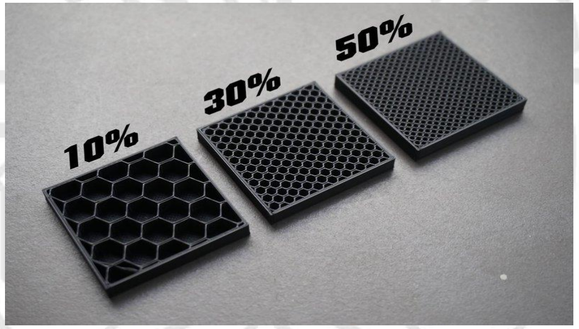
- **3-D Prints take place in a vertical manner**, and each layer needs to be supported from below
  - If so, you will require a ***support structure*** during the 3-D build
  - Temporary **material must be removed** during post-processing





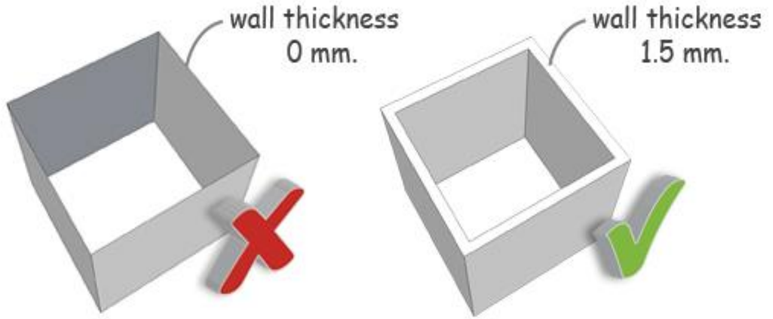
Model Infill Percentage

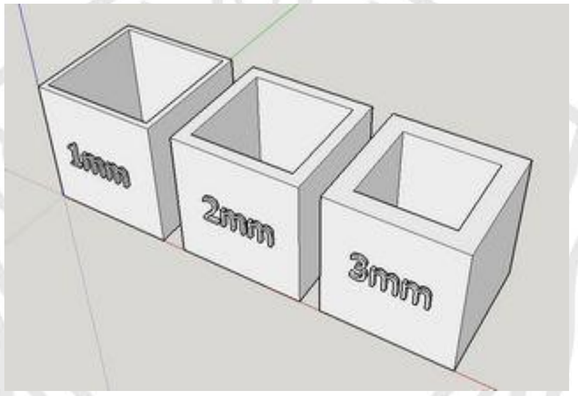
- How "solid" does your model need to be?
  - Assigned during (printer) software setup
  - Should be dictated by the CAD modeler
  - 10% is default



Wall Thickness Limitations

- Make sure the printed wall has integrity
  - **Can't print** a thin "foil" (i.e., NO thickness)
  - Most printers can handle 1 mm
  - To be safe, go as large as is feasible





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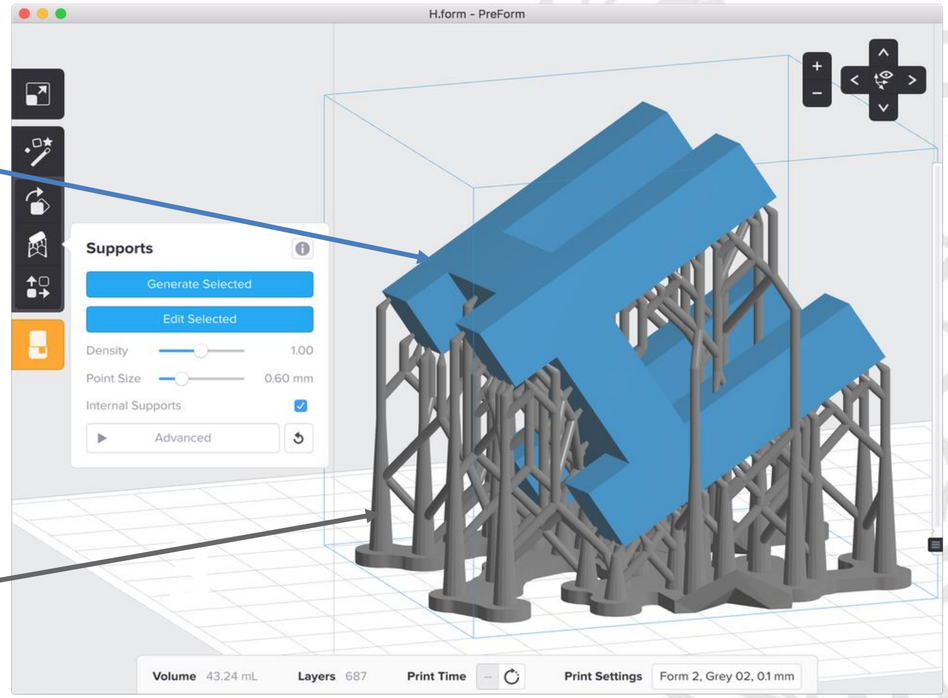
“What are SUPPORTS in 3-D Printing?”

In order to print your part, a temporary “support structure” will be required

- Supports are **generated by the 3-D printer software – NOT by the CAD modeler**
- Supports will be removed after the print is complete
- Supports will add to your overall print volume (e.g., in^3 of total material consumed) **and costs**

3-D Printed Model (permanent)

Supports (temporary)



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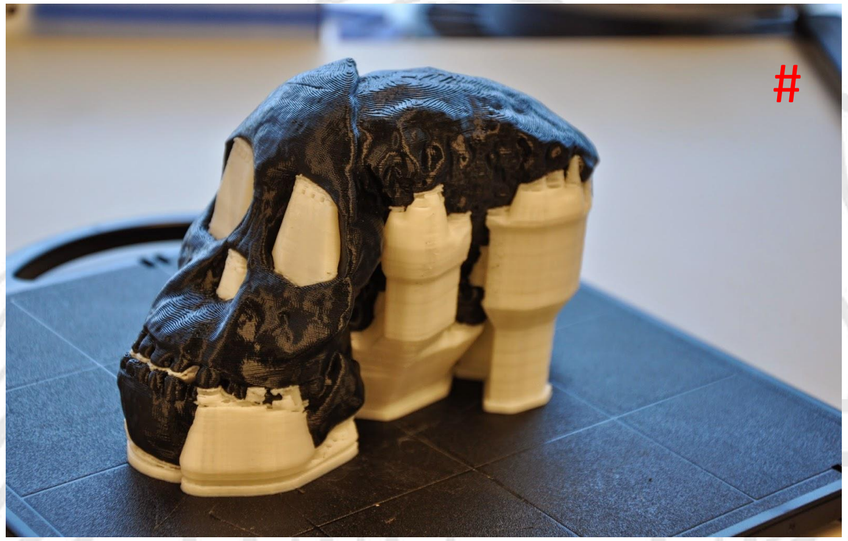
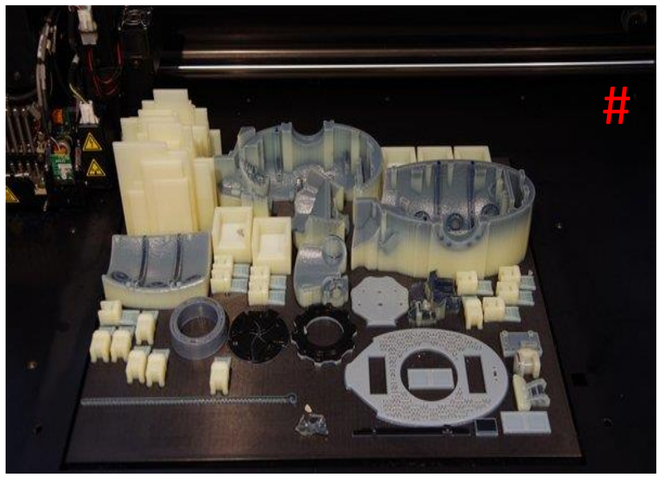
“What is post-processing in 3-D Printing?”



Remove support structure from completed part

- Manual removal may be required to finish part
  - ✓ Responsibility of the customer (**not the DML staff**)*
- Washing/rinsing may be required to finish part
  - ✓ Responsibility of the DML staff (**not the customer**)#



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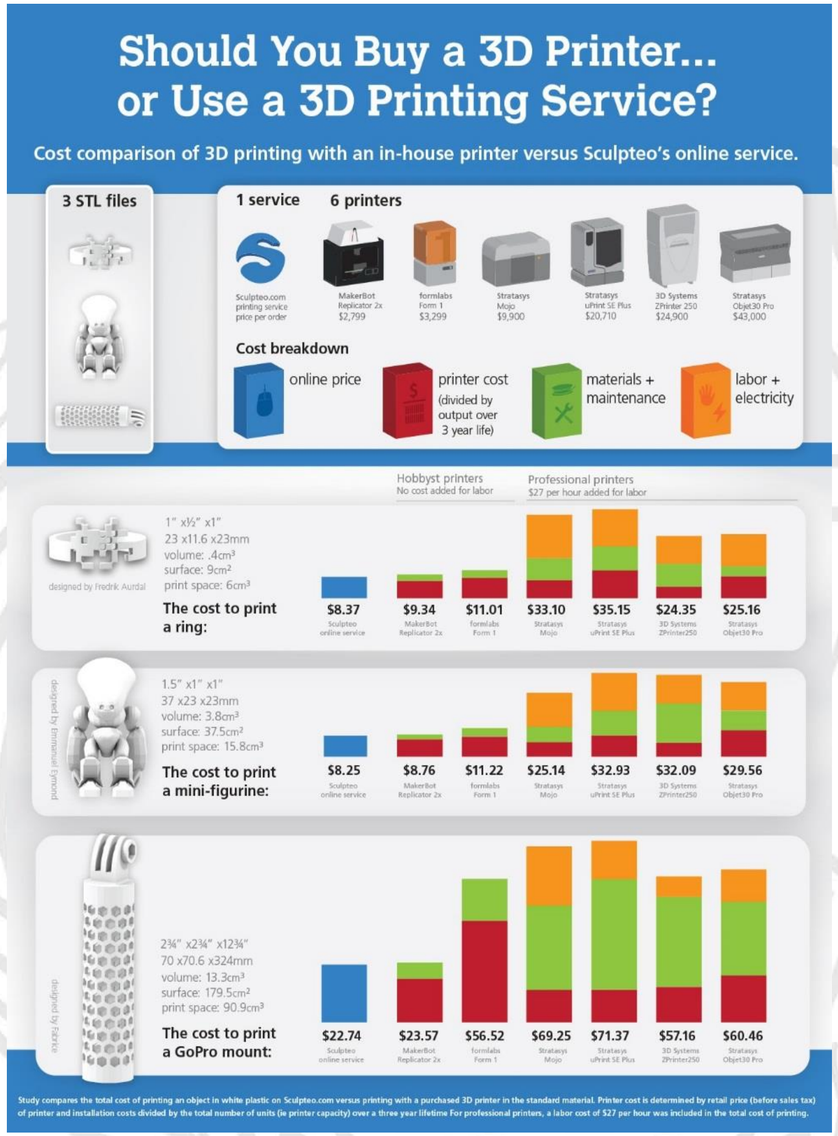
“How much will it cost to print my part?”

- The DML is an established UB Service Center
  - —Rate structure established to recover costs
- Rates are based per printer, per material
- **Rates are based on total print volume** (in^3), **model & supports**

- We have 3 tiers of rates, and payment:
  1. Student Educational projects (***pay by epay***)
  2. UB Sponsored Research/Internal (***pay by IDI***)*
  3. Industry/External (***pay by credit card or Invoice***)*

**: invoiced monthly*



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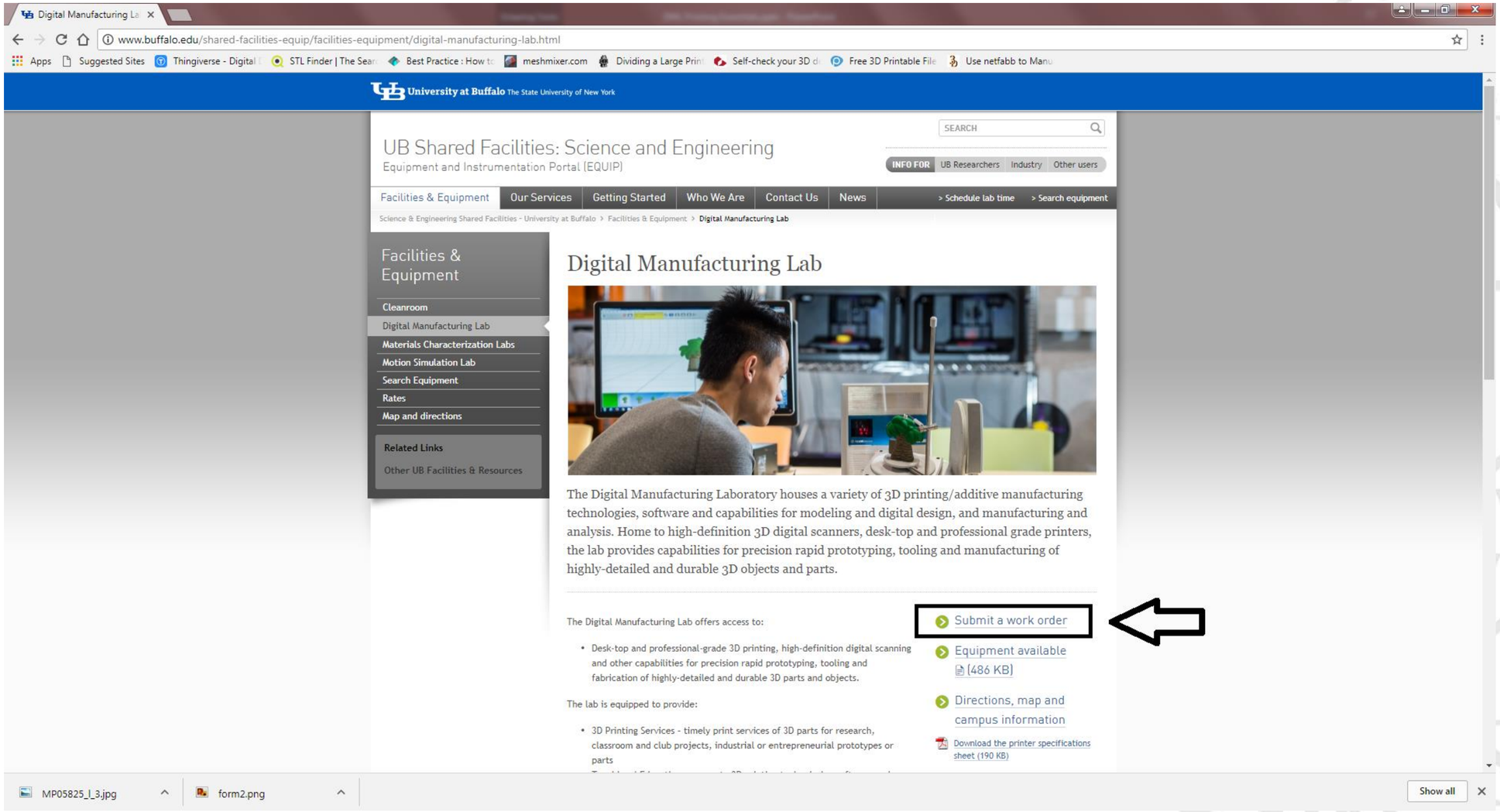
"When I am ready to Print, where do I submit my Work Order?"

http://www.buffalo.edu/shared-facilities-equip/facilities-equipment/digital-manufacturing-lab.html



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“What happens after I submit my Work Order?”

1. You will be contacted (e-mail) by a qualified DML staff member
2. We will schedule a consultation to discuss project requirements
3. You will be provided a cost estimate for your prototype
4. You will pay for your part using an approved payment mechanism
5. We will then perform your print, and contact you with any questions/concerns
6. When the part is complete, **we will contact you to arrange for pickup**

Note: Normal turnaround time can be expected to be **3-5 business days**

- During peak periods, **this may increase to 5-7 business days**
- **Our print submission queue is FIRST COME, FIRST SERVED. NO EXCEPTIONS**

“Where are you Located?”

Digital Manufacturing Laboratory (DML)
School of Engineering and Applied Sciences
118 Bonner Hall
University at Buffalo
Buffalo, NY 14260