# Gladys Marcus Library




Welcome!

# 3D PRINTING WITH THE FABLAB

## Workshop for FIT Students

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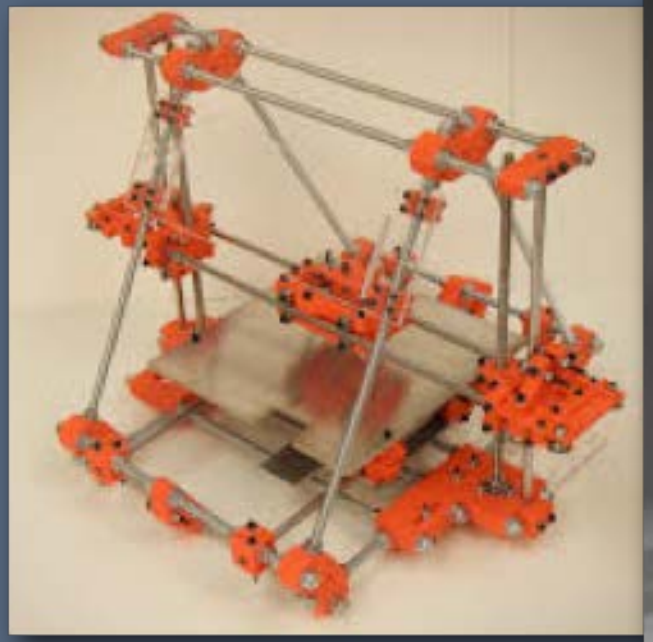
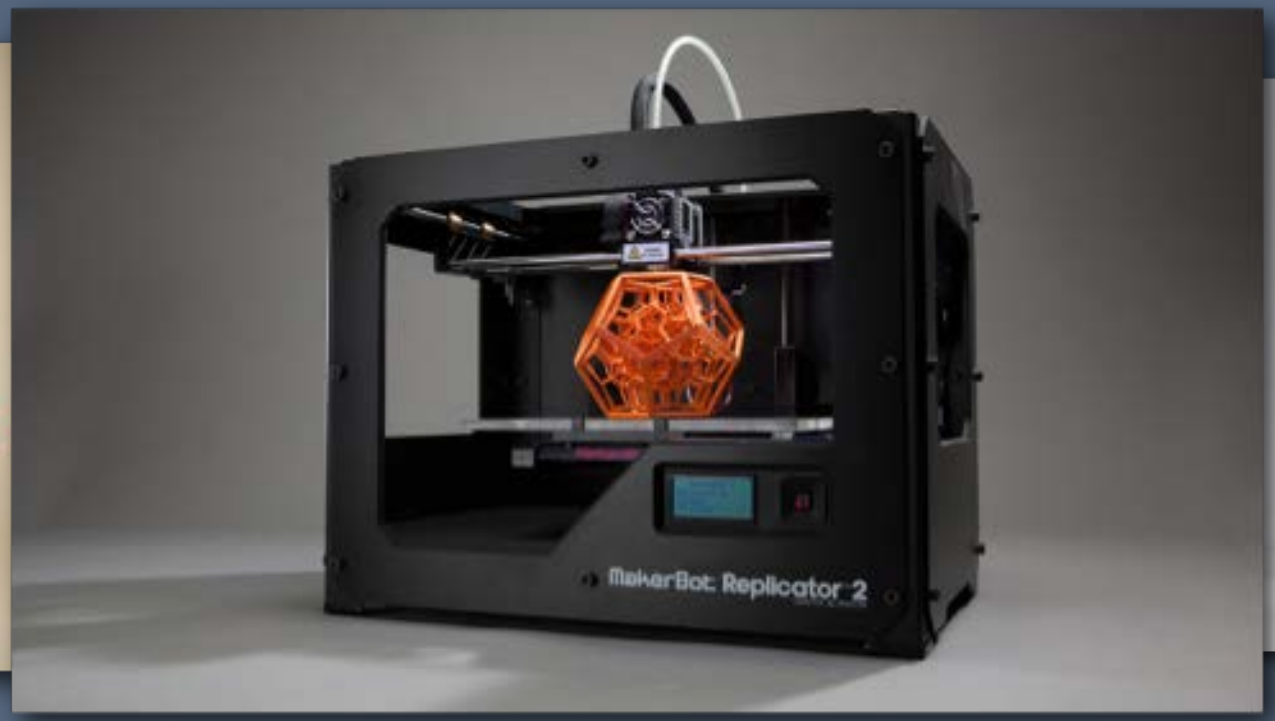
JASPER LIN
MO SHAHADAT

# TOPICS WE WILL BE COVERING TODAY

- THE FIT FABLAB'S 3D PRINTING SERVICES
- 3D PRINTING POLICIES AND PROCEDURES AT THE FABLAB
- COMMON 3D MODELING PITFALLS

# What is 3D Printing?






# What is 3D Printing?

Some of the different types of rapid prototyping processes:

- FDM (Fused Deposition Modeling)
- SLS (Selective Laser Sintering)
- Powder/Binder-based Printing
- SLA (Stereolithography)


Fused Deposition Modeling

# FIT FABLAB – 3D Printing at the FabLab

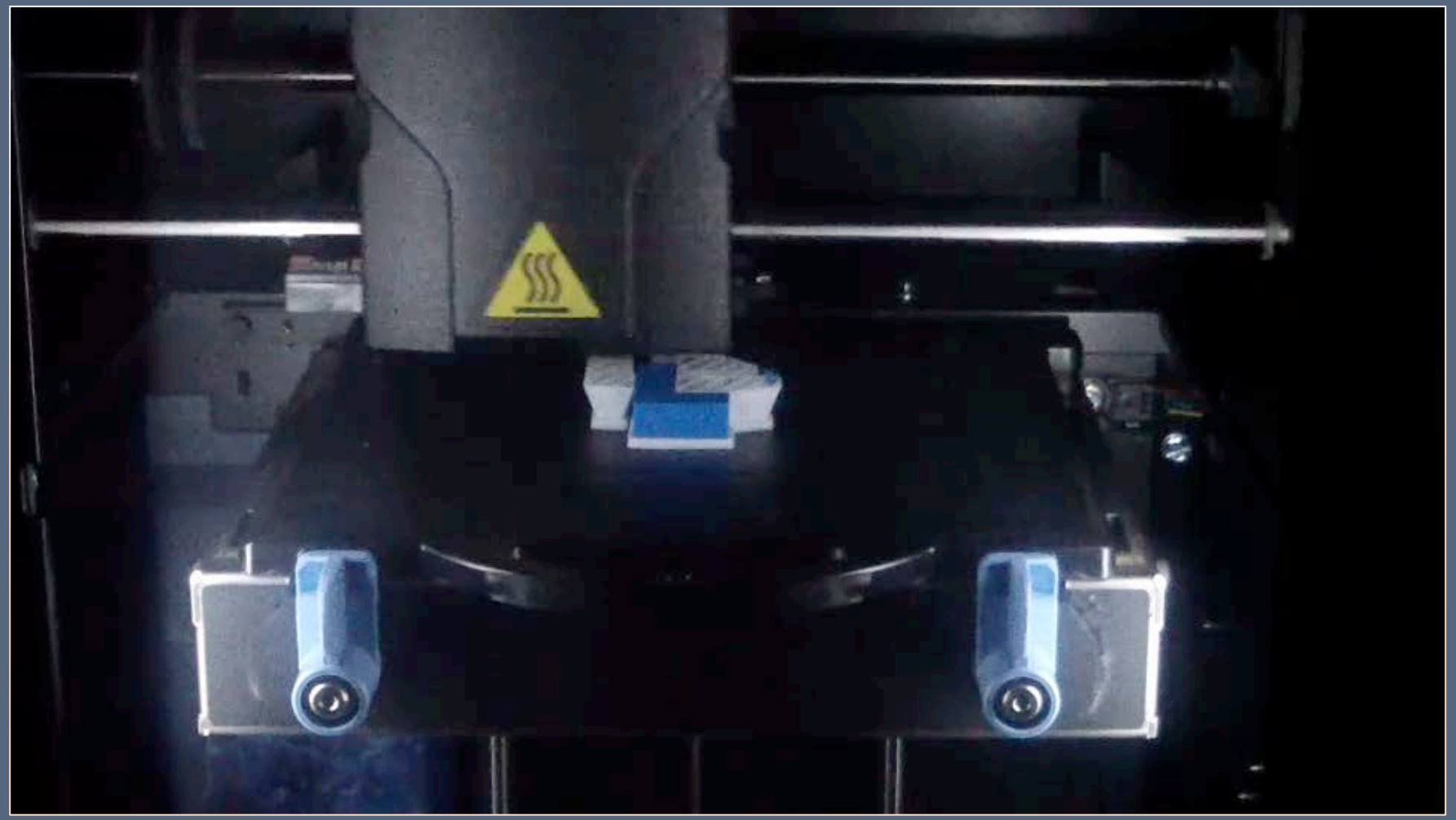
- Full-service 3D Printing
- ONE WEEK turnaround time for all jobs (NO RUSH SERVICE)
- PRICE: $7 per Cubic Inch
- Special considerations for projects and exhibitions

# FIT FABLAB – Our 3D Printer

## Stratasys uPrint SE Plus

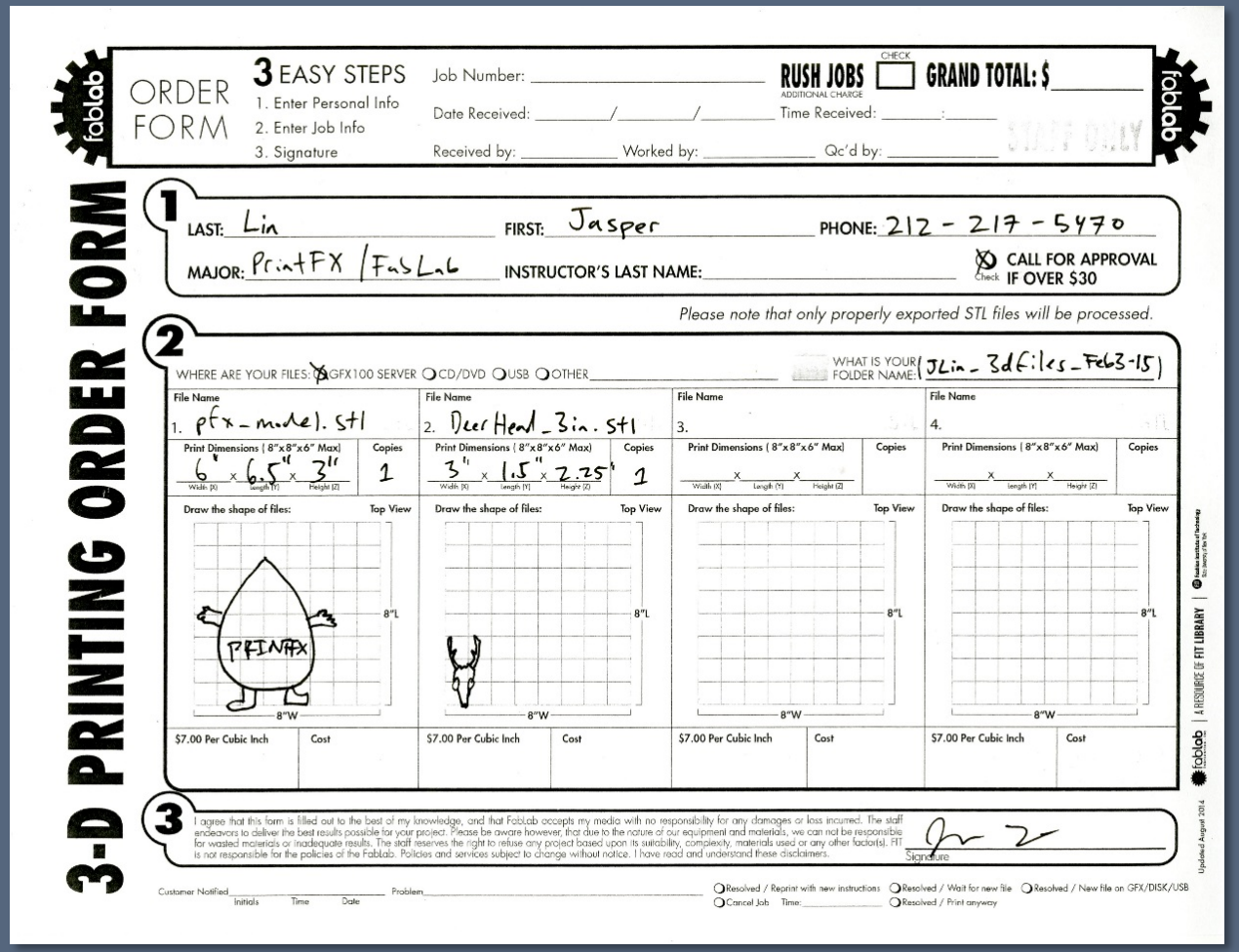
- Offers reliable FDM printing
- 8” x 8” x 6” Bed Size
- .254mm/.010” Layer Thickness
- Build Material: ABS Plastic
- Colors (monochromatic): White, Black, Blue, Red
- Generates its own soluble support material

# FIT FABLAB – Our 3D Printer



# FIT FABLAB – Policies and Procedures

- One week turnaround time is dependent on a properly filled out order form and an error-free file
- Order forms missing required information will be put on HOLD while we try to contact you
- Delays on orders that have been placed on HOLD will effect overall turnaround time



3-D PRINTING ORDER FORM

fablab ORDER FORM

3 EASY STEPS
1. Enter Personal Info
2. Enter Job Info
3. Signature

Job Number: _____ RUSH JOBS ADDITIONAL CHARGE CHECK ☐ GRAND TOTAL: $_____

Date Received: ___/___/___ Time Received: ___:___

Received by: _____ Worked by: _____ Qc'd by: _____

1

LAST: Lin FIRST: Jasper PHONE: 212 - 217 - 5470

MAJOR: PrintFX / FabLab INSTRUCTOR'S LAST NAME: _____ ☒ Check CALL FOR APPROVAL IF OVER $30

*Please note that only properly exported STL files will be processed.*

2

WHERE ARE YOUR FILES: ☒ GFX100 SERVER ○ CD/DVD ○ USB ○ OTHER _____ WHAT IS YOUR FOLDER NAME: (JLin_3dFiles_Feb3-15)

| File Name | Print Dimensions (8"x8"x6" Max) | Copies | Draw the shape of files: Top View |
|---|---|---|---|
| 1. pfx_model.stl | 6" x 6.5" x 3" (Width [X] x Length [Y] x Height [Z]) | 1 |  |
| 2. DeerHead_3in.stl | 3" x 1.5" x 2.25" | 1 |  |
| 3. | | | |
| 4. | | | |

8"L / 8"W

$7.00 Per Cubic Inch | Cost

3

I agree that this form is filled out to the best of my knowledge, and that FabLab accepts my media with no responsibility for any damages or loss incurred. The staff endeavors to deliver the best results possible for your project. Please be aware however, that due to the nature of our equipment and materials, we can not be responsible for wasted materials or inadequate results. The staff reserves the right to refuse any project based upon its suitability, complexity, materials used or any other factor(s). FIT is not responsible for the policies of the FabLab. Policies and services subject to change without notice. I have read and understand these disclaimers.

Signature _____

Customer Notified _____ Initials Time Date Problem _____

○ Resolved / Reprint with new instructions ○ Resolved / Wait for new file ○ Resolved / New file on GFX/DISK/USB
○ Cancel Job Time: _____ ○ Resolved / Print anyway

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Contact Info

File Name

Size of Part

Sketch of Part

Estimate Notification

File Location

Quantity

# 3-D PRINTING ORDER FORM

ORDER FORM

**3 EASY STEPS**
1. Enter Personal Info
2. Enter Job Info
3. Signature

Job Number: _____

Date Received: ____/____/____ Time Received: ____:____

Received by: _____ Worked by: _____ Qc'd by: _____

**RUSH JOBS** ADDITIONAL CHARGE CHECK ☐ **GRAND TOTAL: $** _____

STAFF ONLY

## 1

LAST: Lin FIRST: Jasper PHONE: 212 - 217 - 5470

MAJOR: PrintFX / FabLab INSTRUCTOR'S LAST NAME: _____

☒ Check **CALL FOR APPROVAL IF OVER $30**

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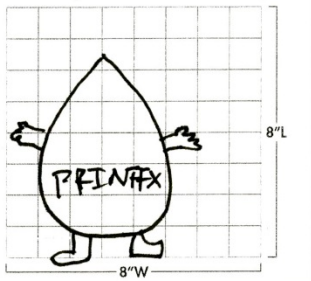
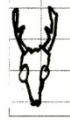
| 1. pfx_model.stl | 6" x 6.5" x 3" (Width (X) / Length (Y) / Height (Z)) | 1 |   | | |
| 2. DeerHead_3in.stl | 3" x 1.5" x 2.25" (Width (X) / Length (Y) / Height (Z)) | 1 |  | | |
| 3. | | | | | |
| 4. | | | | | |

8"L / 8"W

## 3

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○ Cancel Job Time: _____ ○ Resolved / Print anyway

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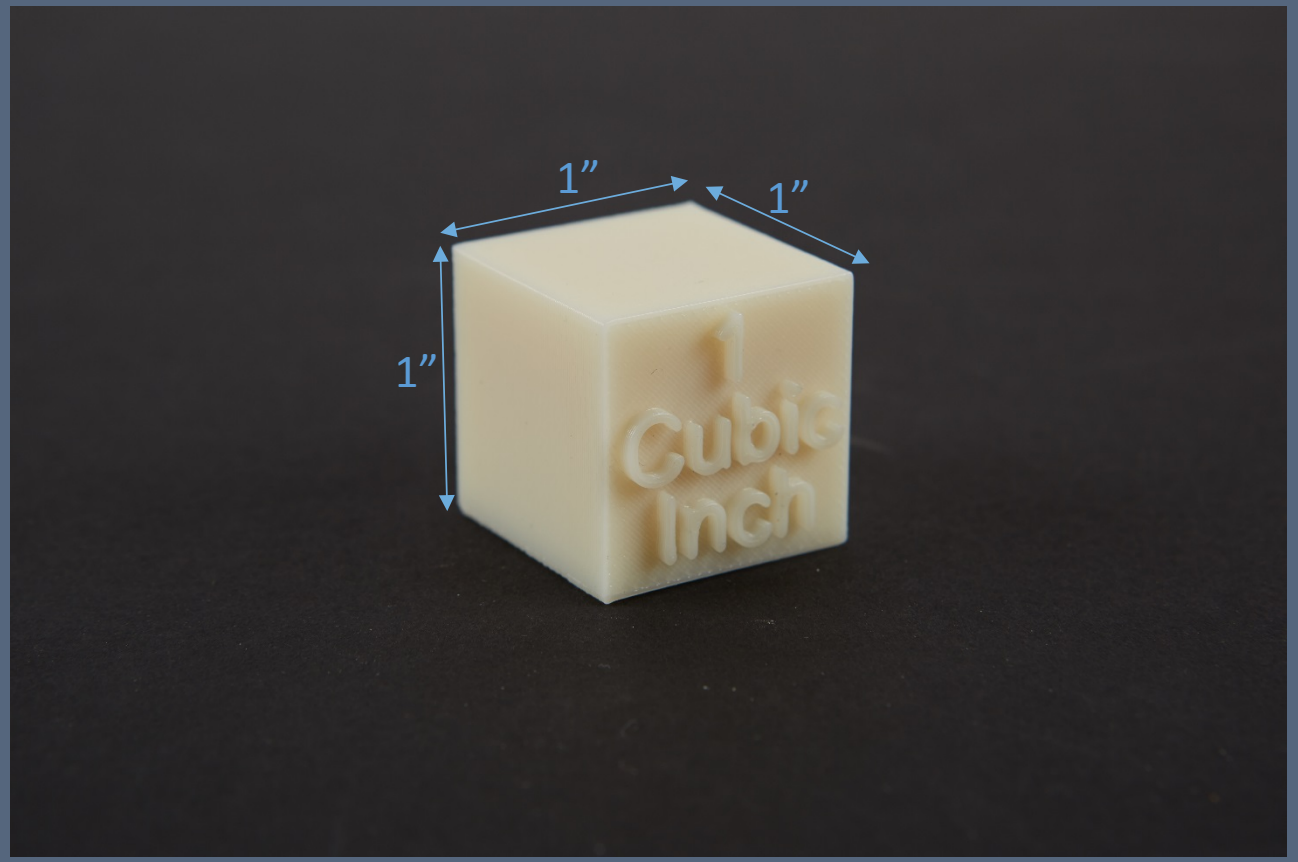
Updated August 2014

# FIT FABLAB – Cost of a 3D Print

- $7 PER CUBIC INCH OF MODEL AND SUPPORT MATERIAL



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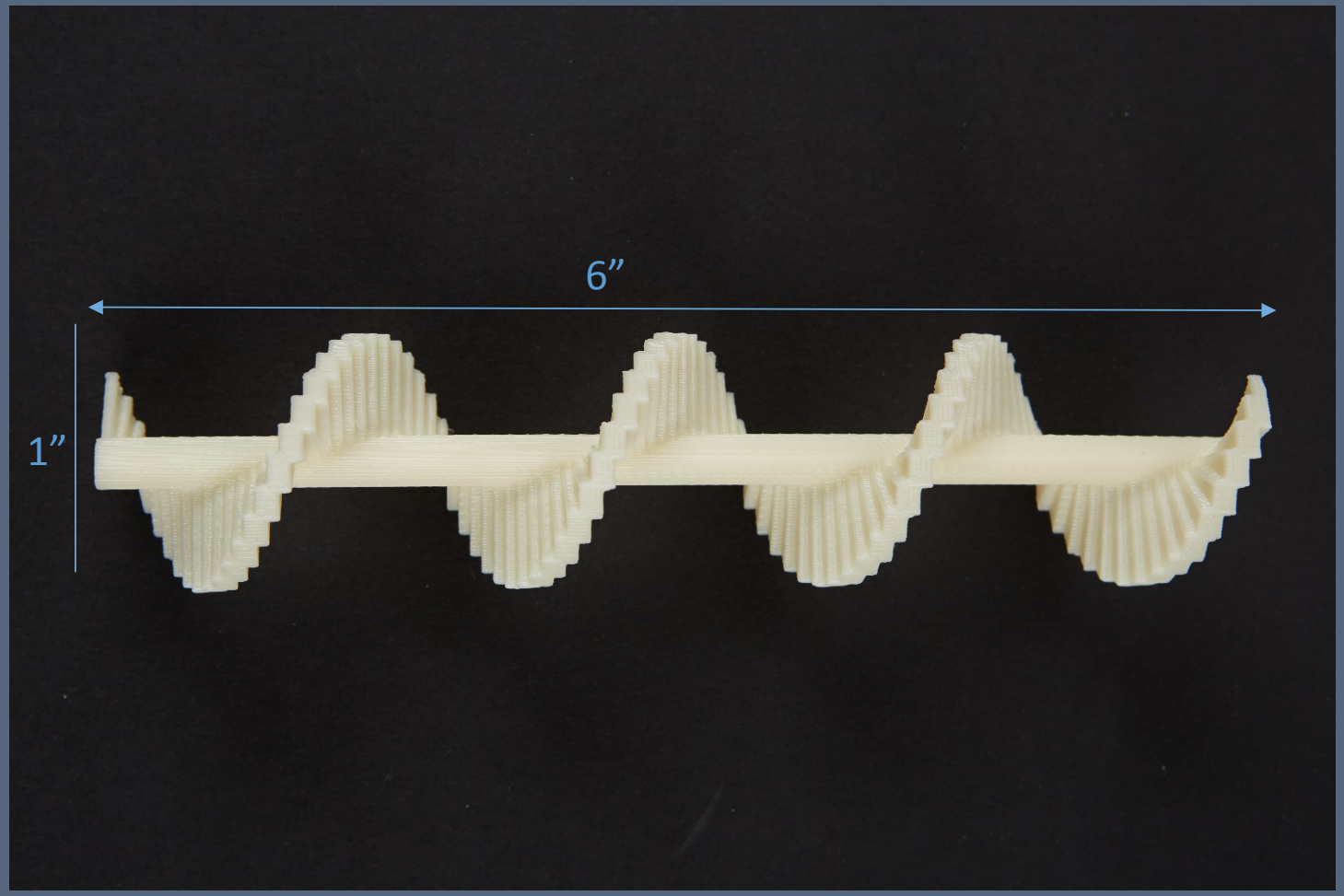

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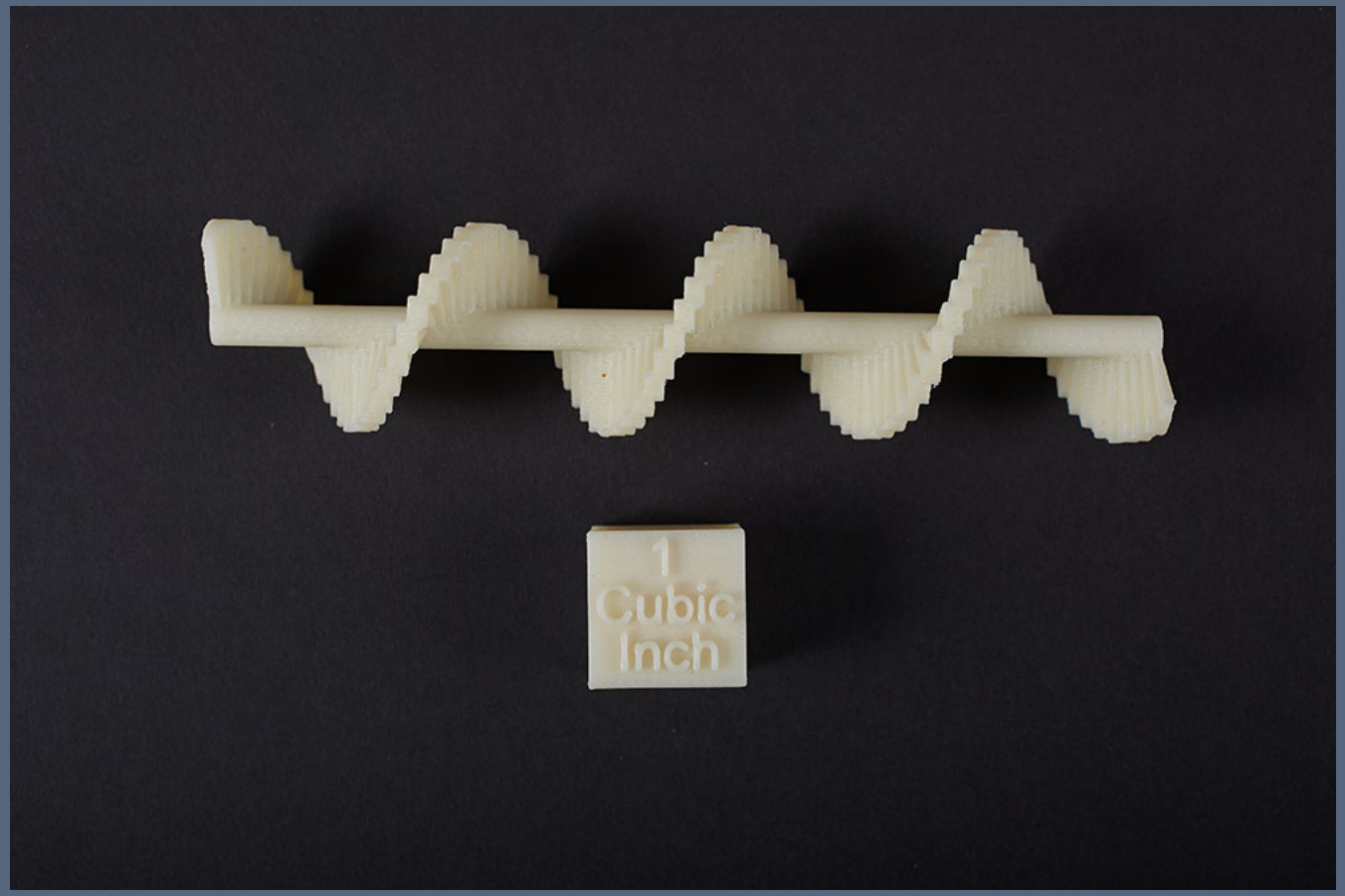

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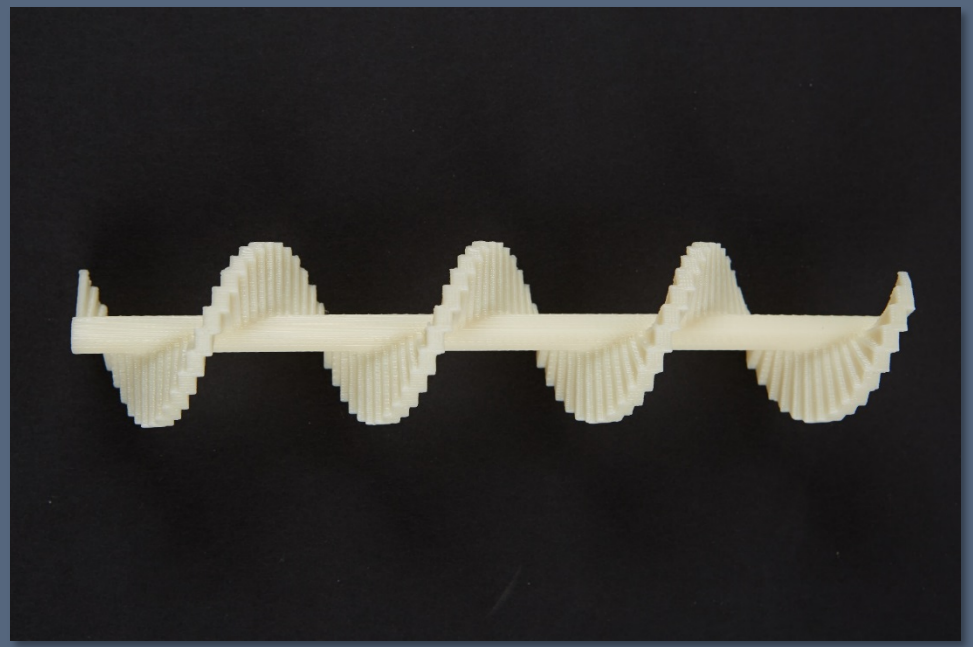
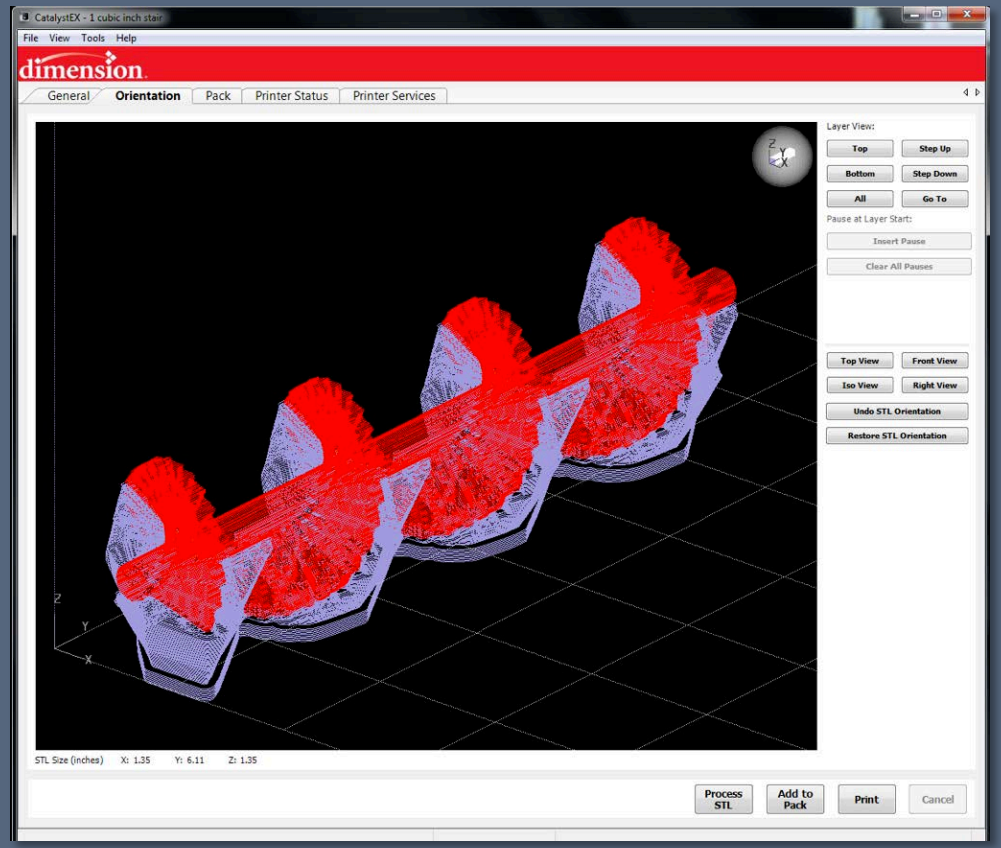
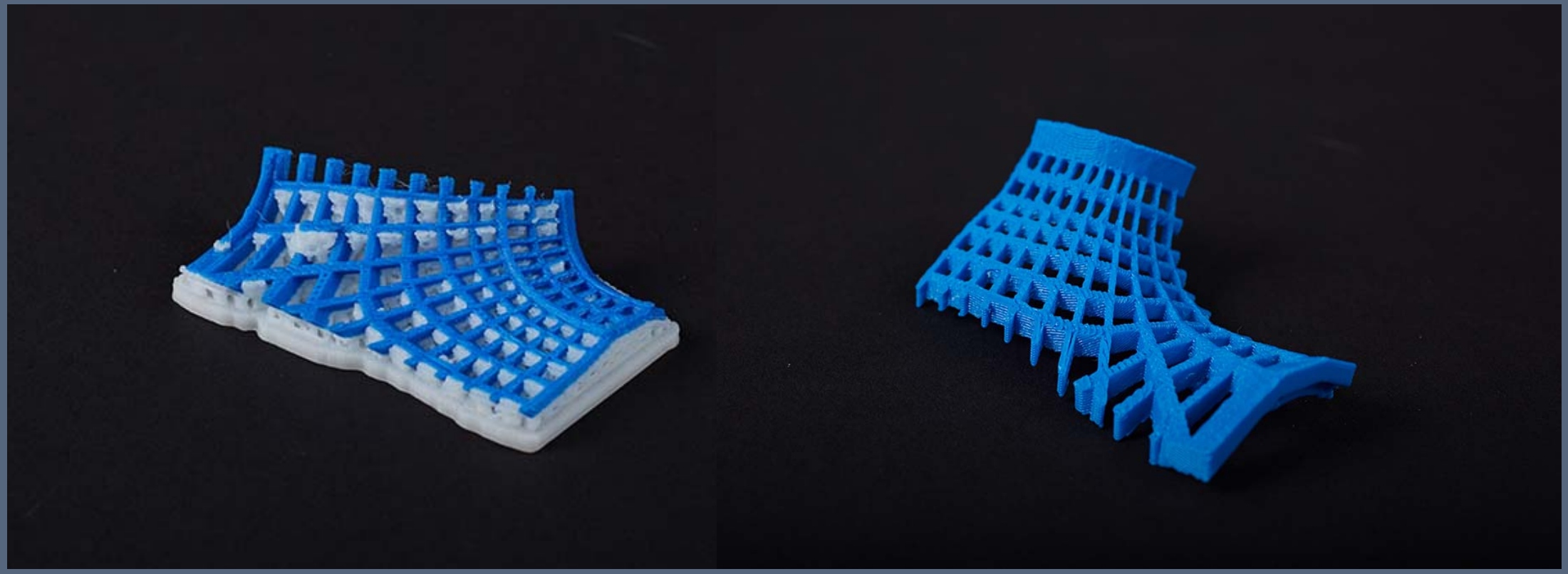


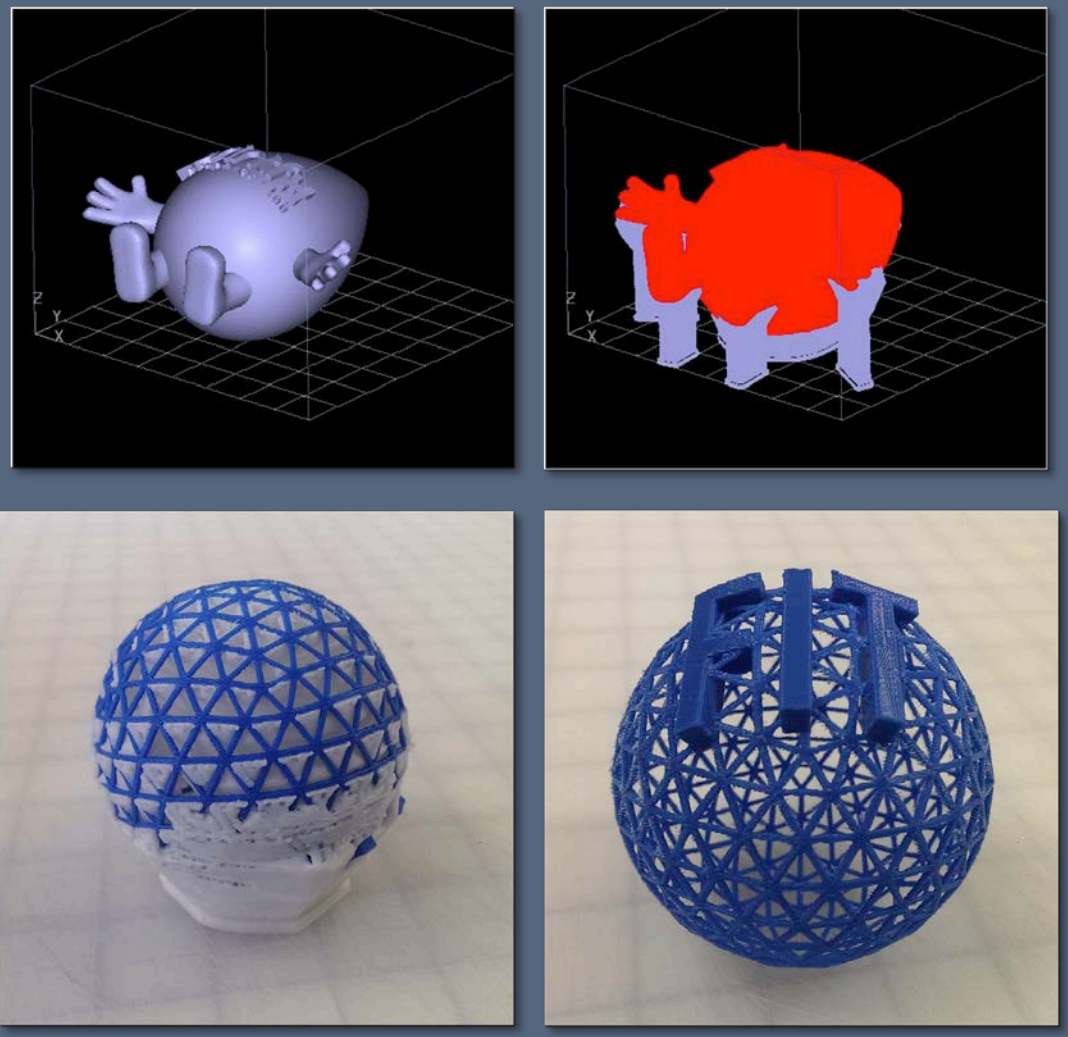


# FIT FABLAB – Automatic Support Generation



# FIT FABLAB – Automatic Support Generation

- The uPrint's automatic support generation allows for stable 3D printing of models with complex geometric designs, such as:
  - Overhangs
  - Intricate holes and cutouts
  - Interlocking and/or moving parts



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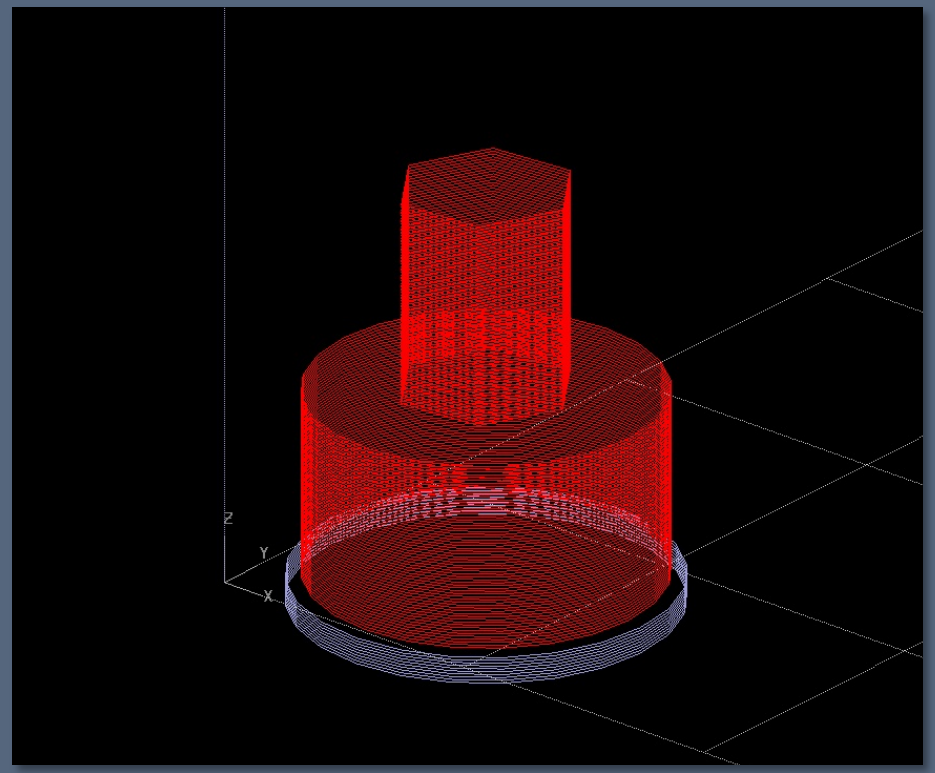
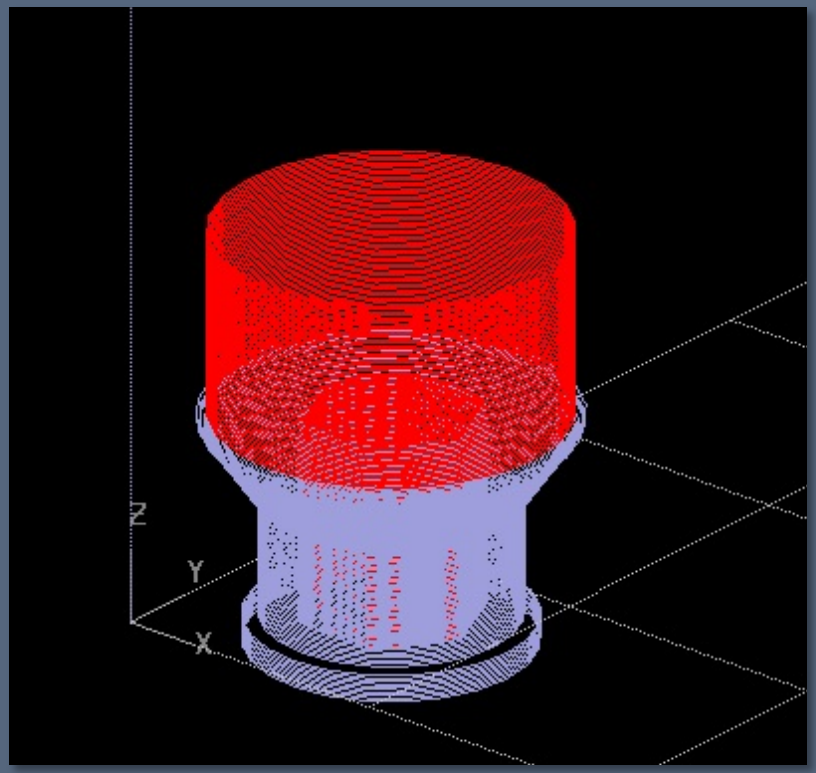
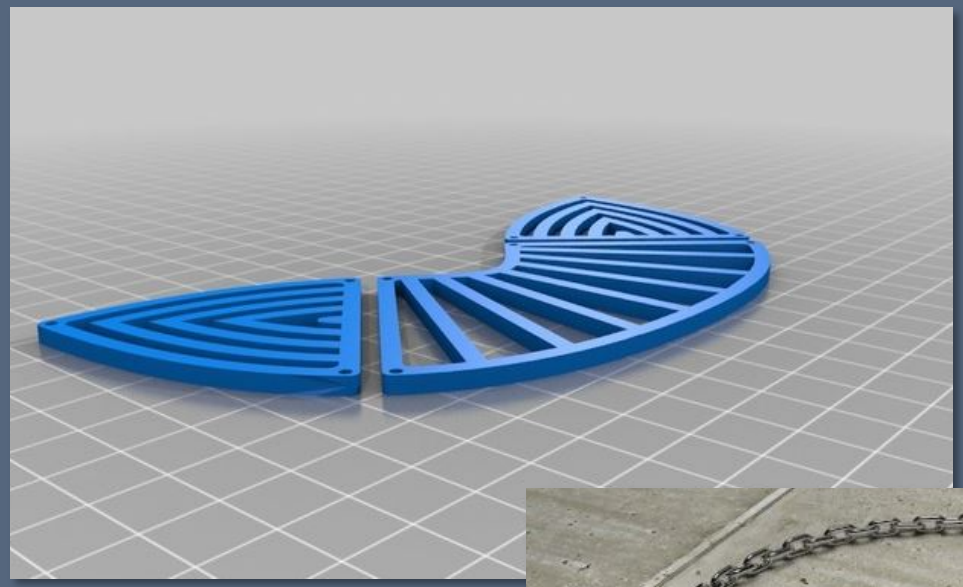


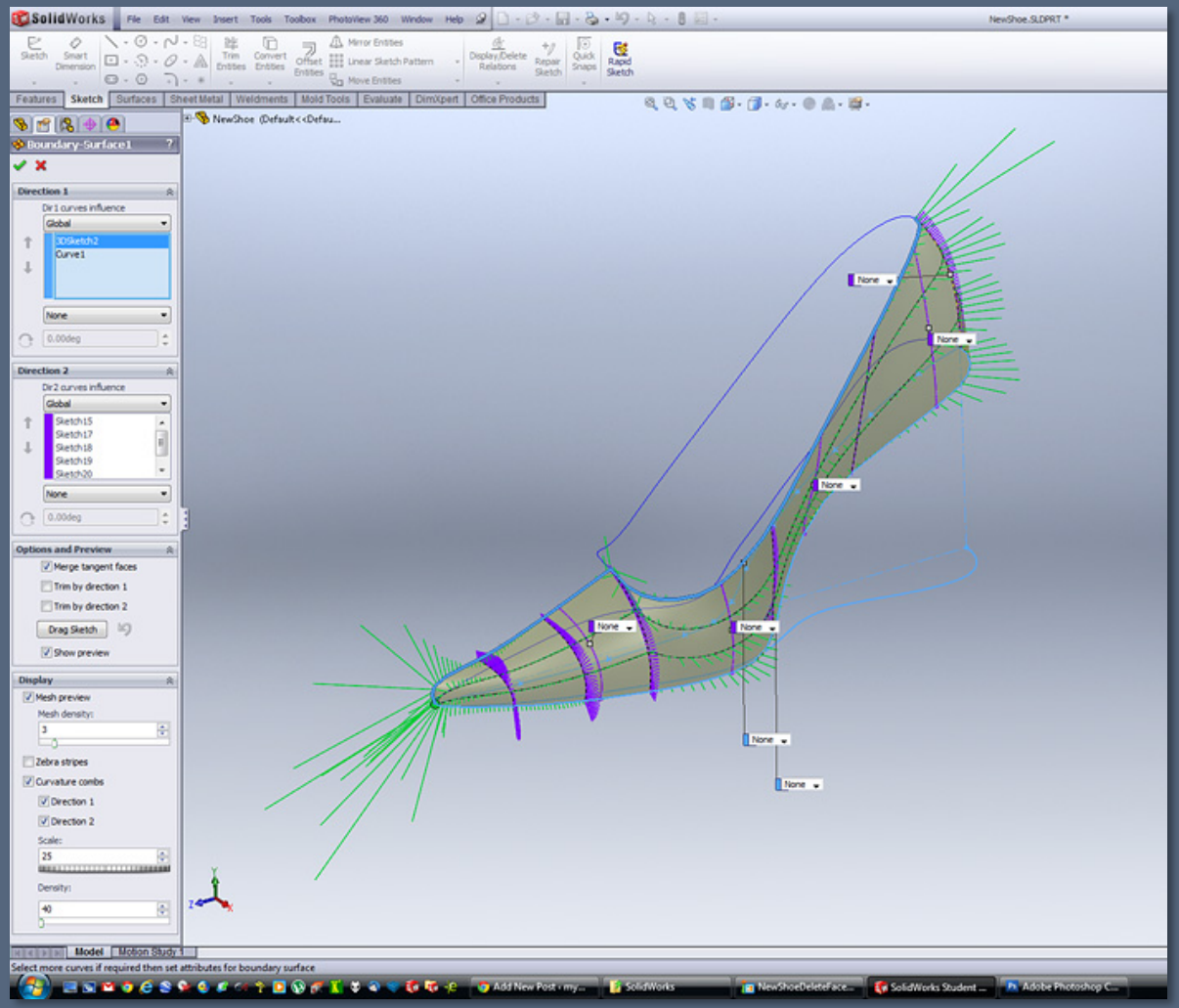
# FIT FABLAB – Getting Started with 3D Printing

- Types of design software
- 3D classes at FIT
- Online 3D repositories
- Web-based apps
- Acceptable file formats

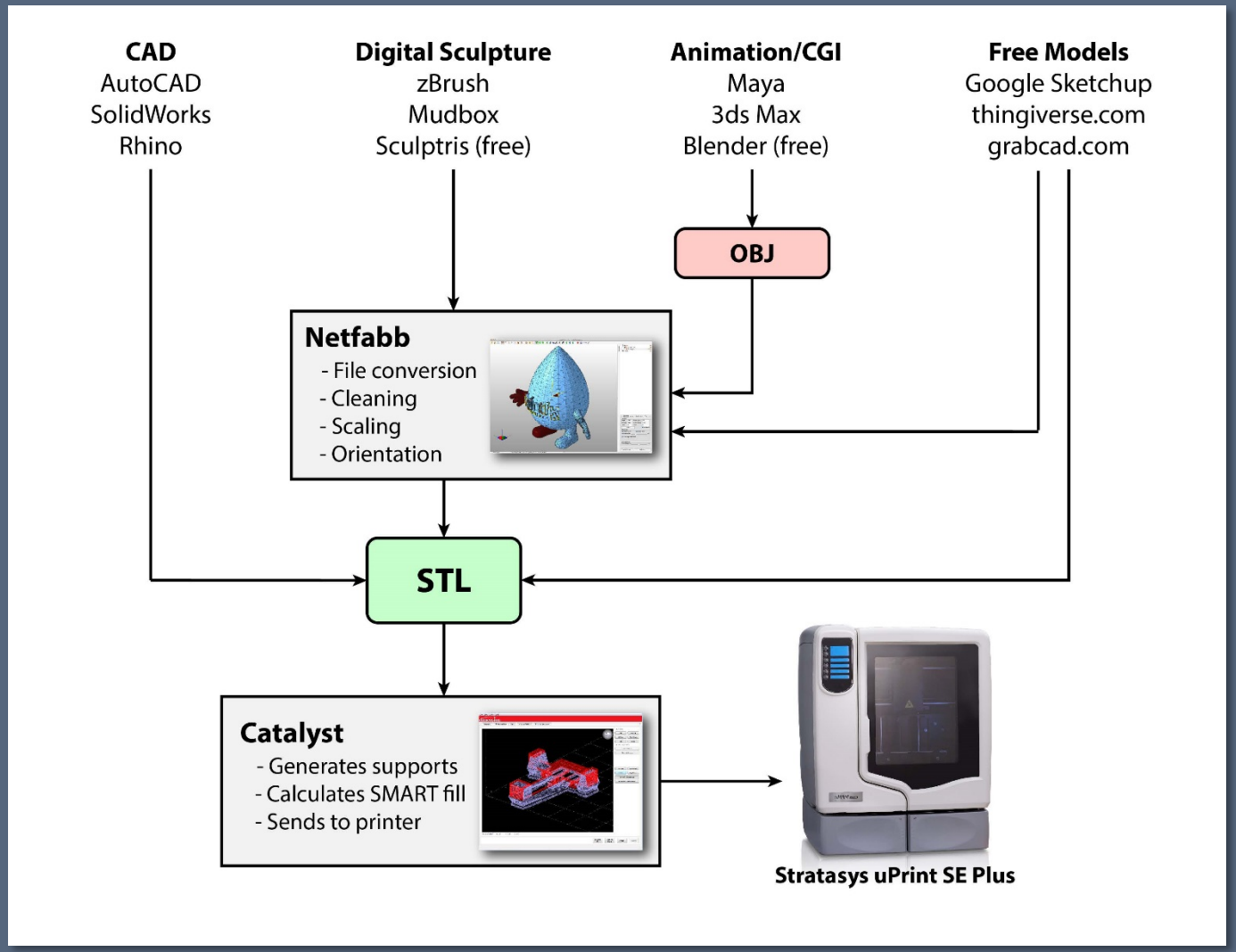


# FIT FABLAB – Differences in 3D Software

- History Based Software
- Non-History Based Software
- Digital Sculpting Software
- Parametric Software
- Non-Parametric Software
- NURBS Modeling
- Polygon Modeling



# FIT FABLAB – Suggested 3D Software Workflow



**CAD**
AutoCAD
SolidWorks
Rhino

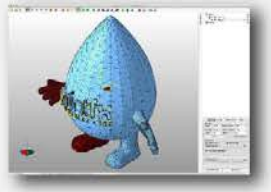
**Digital Sculpture**
zBrush
Mudbox
Sculptris (free)

**Animation/CGI**
Maya
3ds Max
Blender (free)

**Free Models**
Google Sketchup
thingiverse.com
grabcad.com

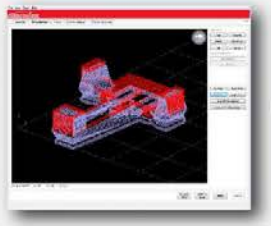
**OBJ**

**Netfabb**
- File conversion
- Cleaning
- Scaling
- Orientation



**STL**

**Catalyst**
- Generates supports
- Calculates SMART fill
- Sends to printer



**Stratasys uPrint SE Plus**

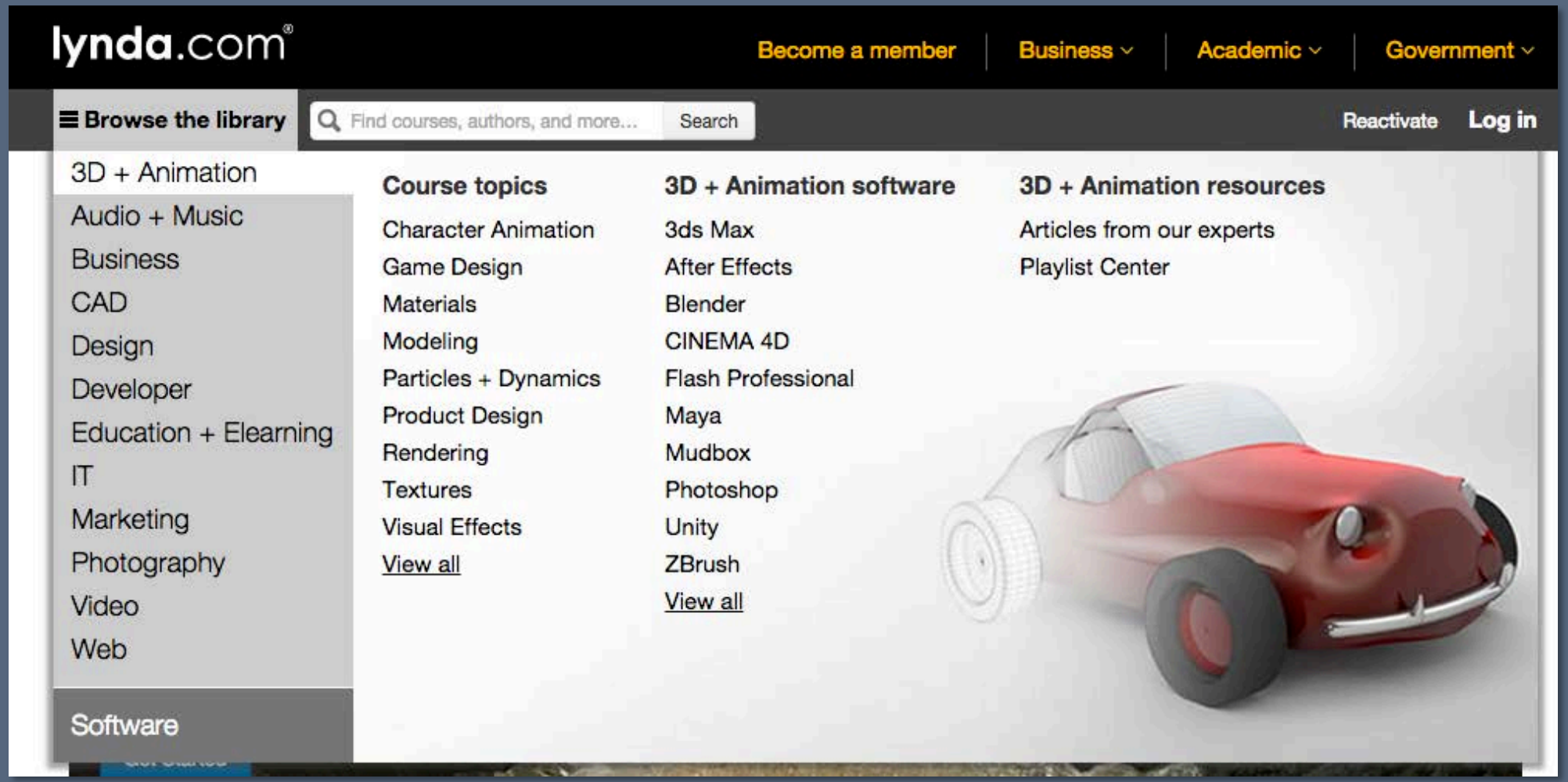
# FIT FABLAB – Software in PrintFX/Library Labs

- Solidworks
- Google SketchUp
- Adobe CC Suite
- Autodesk AutoCAD
- Autodesk 3ds Max
- Netfabb Basic (PrintFX only)

# FIT FABLAB – 3D/CAD Classes at FIT

- CG 212 - Introduction to 3D Computer Modeling
- JD 138 - Introduction to CAD for Jewelry Design
- CTD 429 - Introduction to Rhino for the CAD Novice
- CTD 371 - SketchUp Pro
- CTD 375 - SketchUp for 3D Printing
- CTD 225 - Photoshop for 3D Printing

# FIT FABLAB – 3D/CAD Tutorials on Lynda.com



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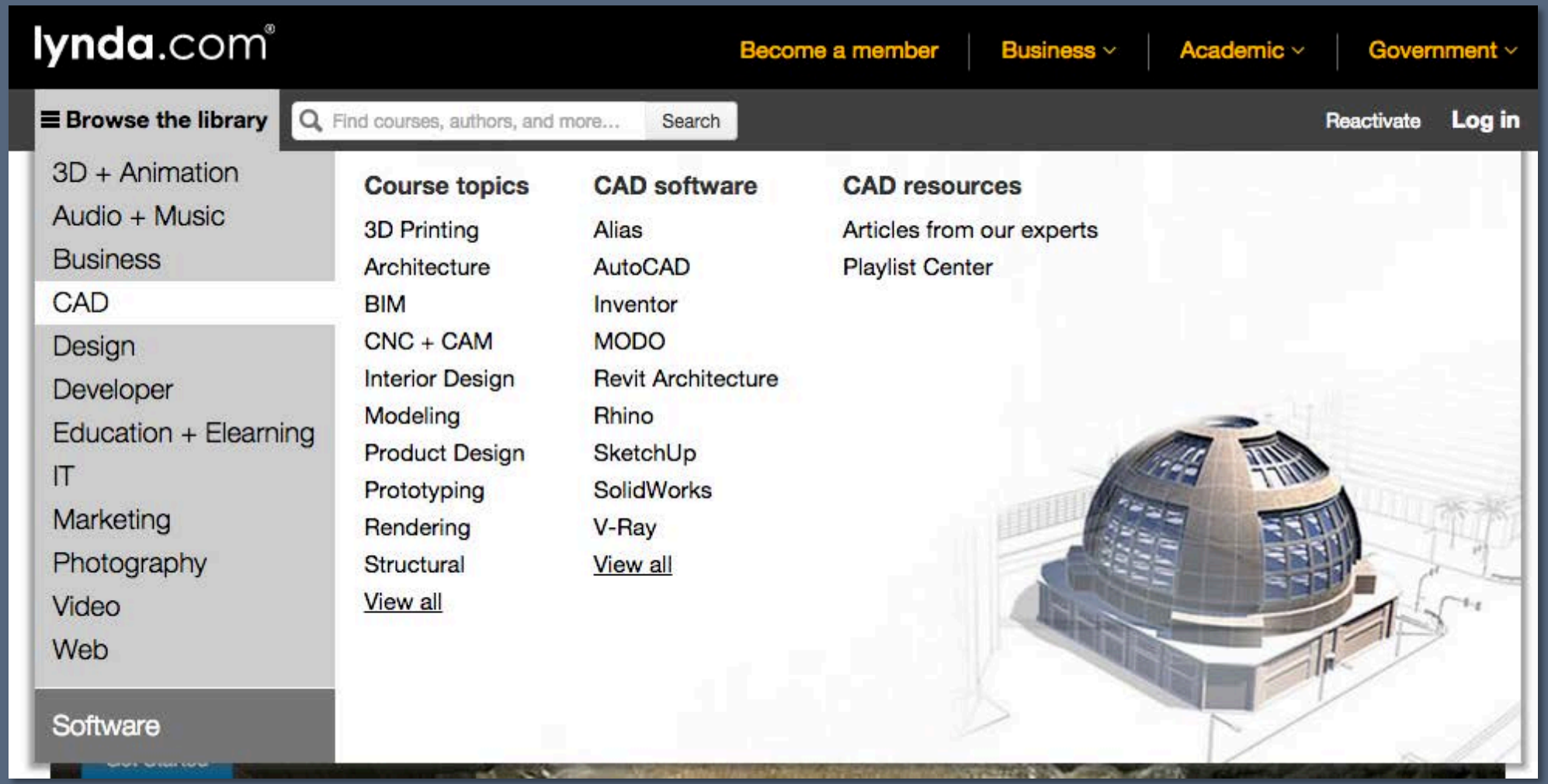

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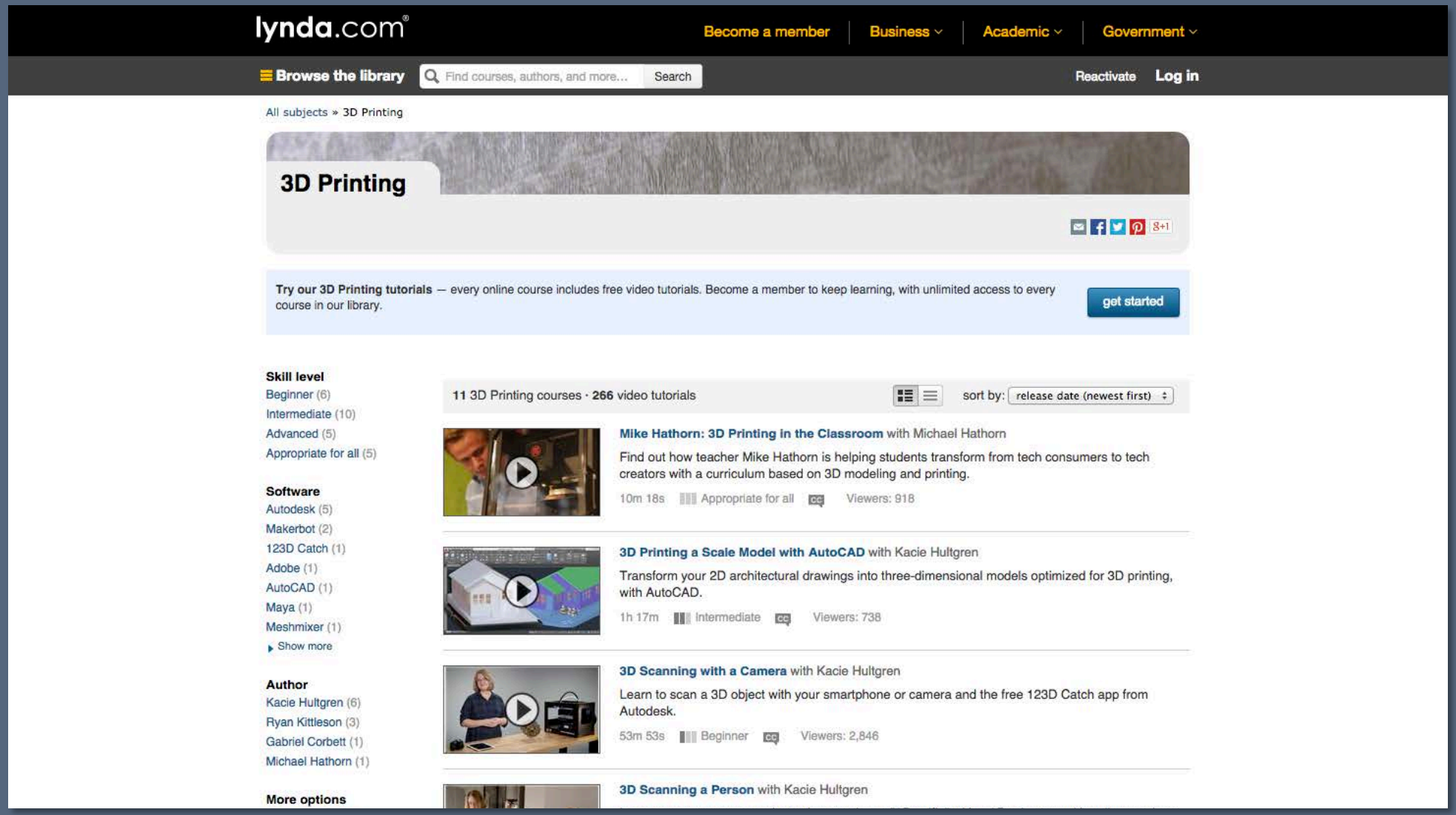
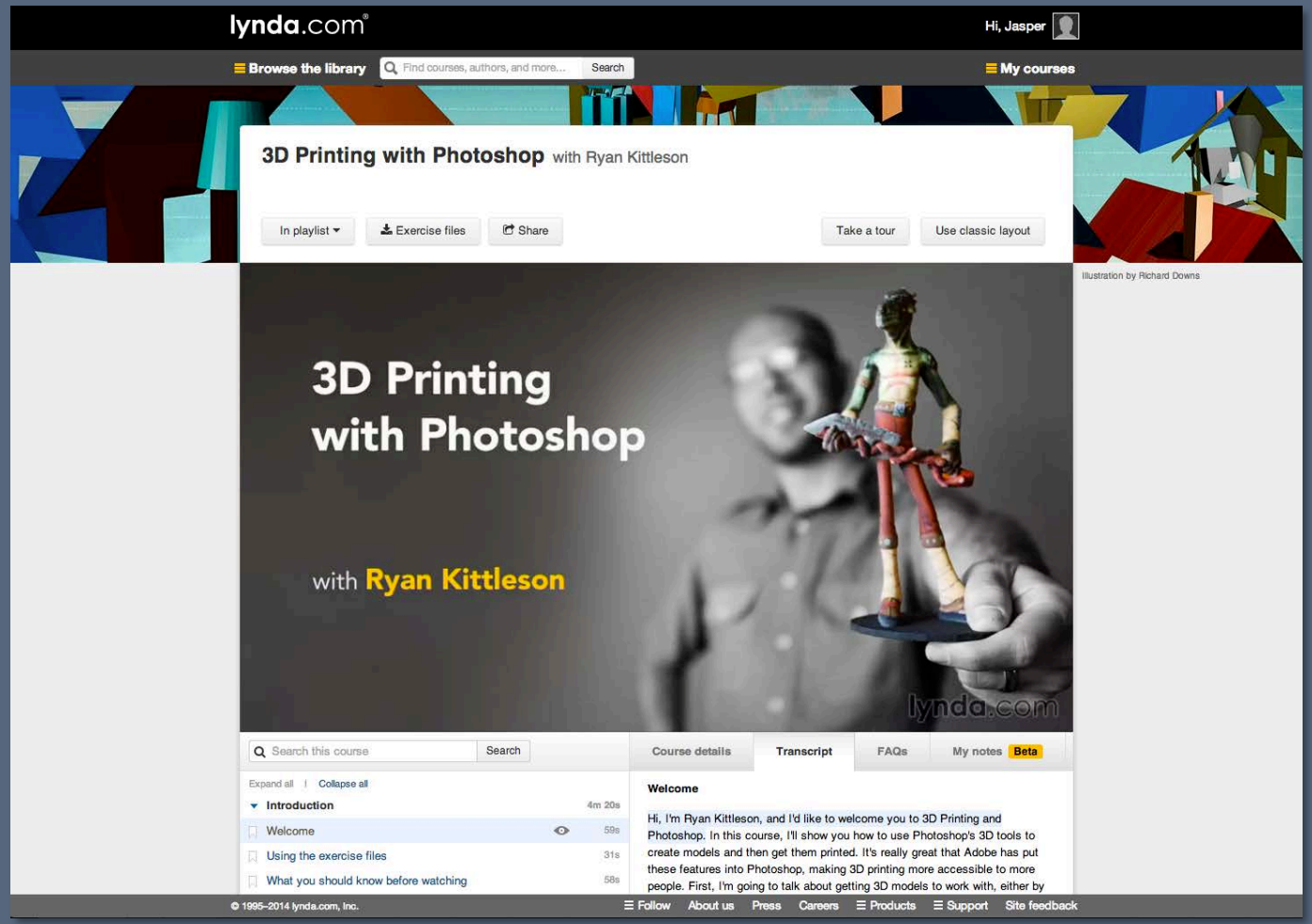


# FIT FABLAB – Adobe Software for 3D Printing



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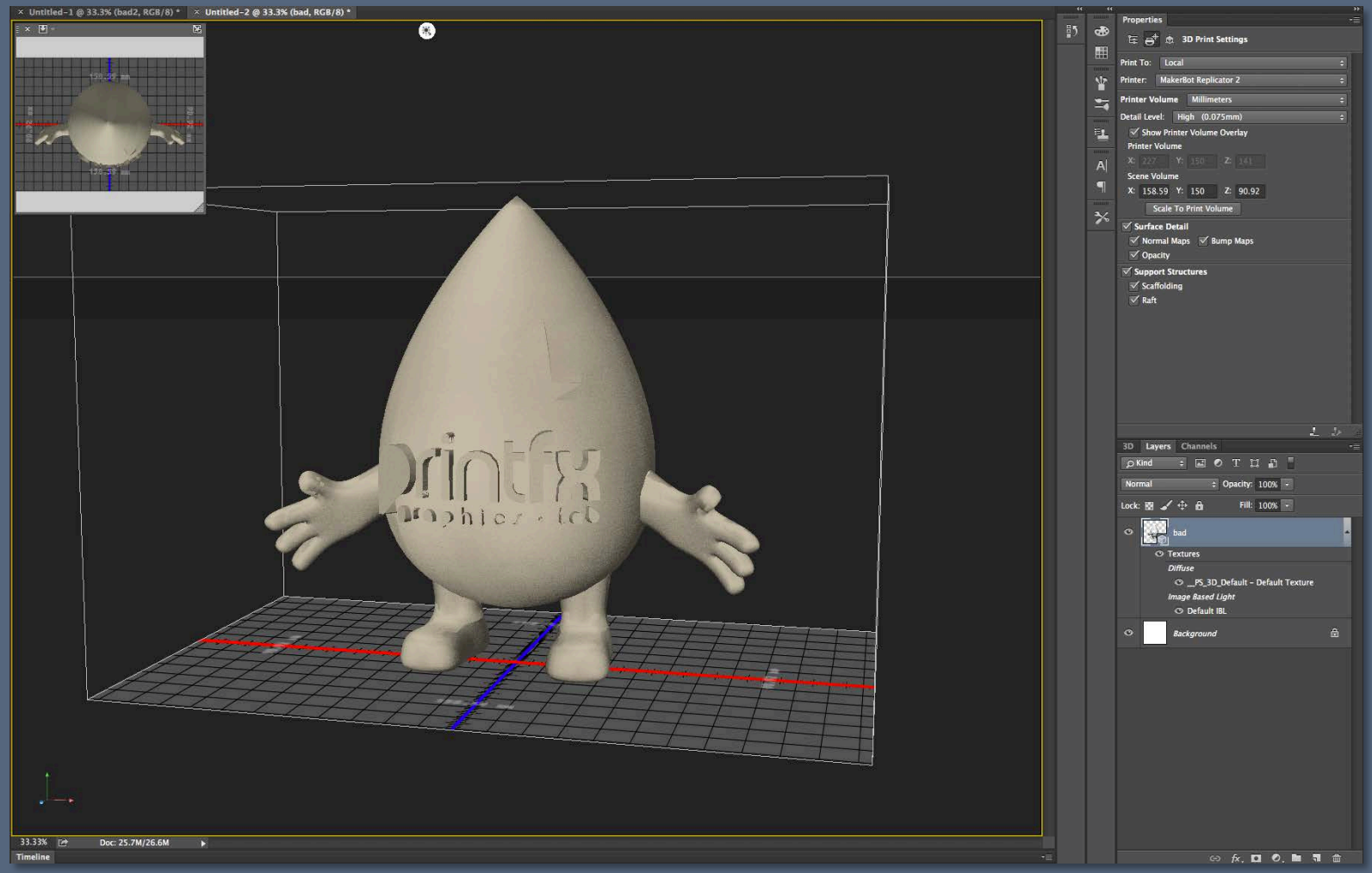

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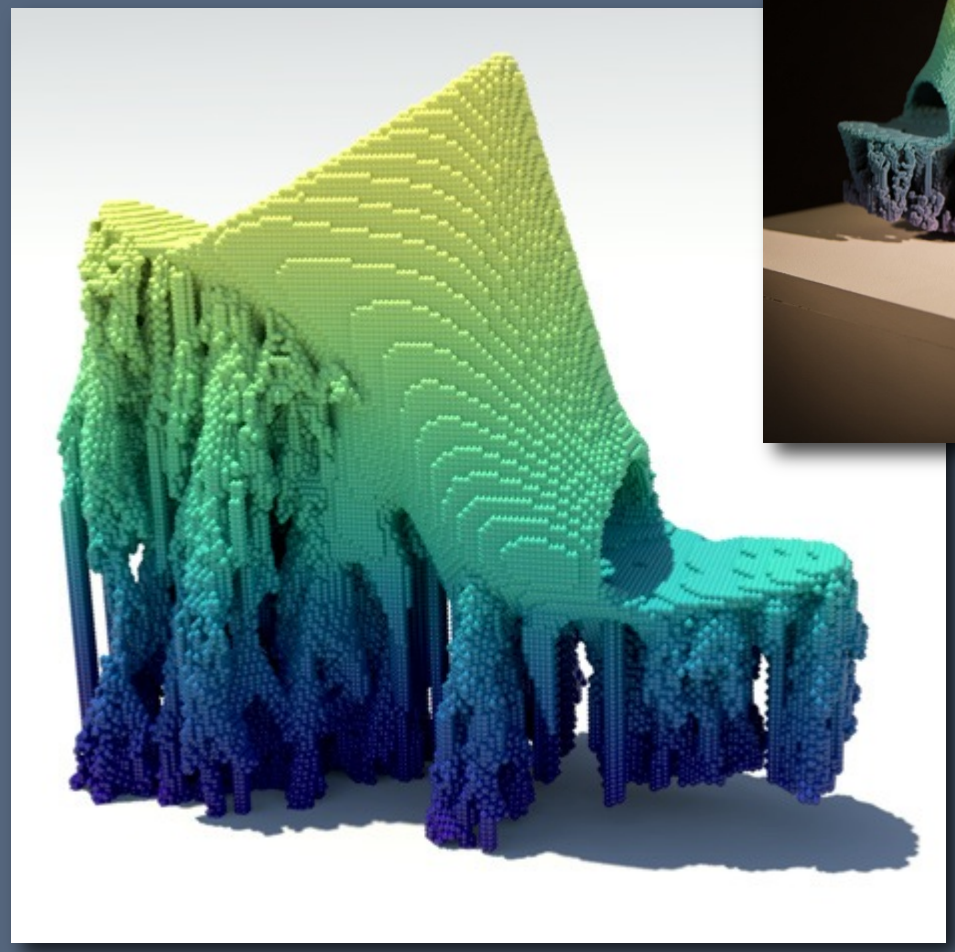
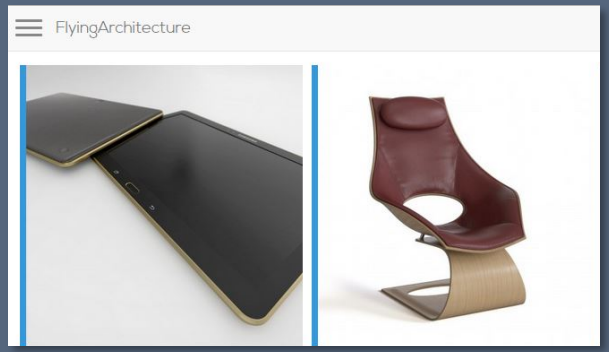
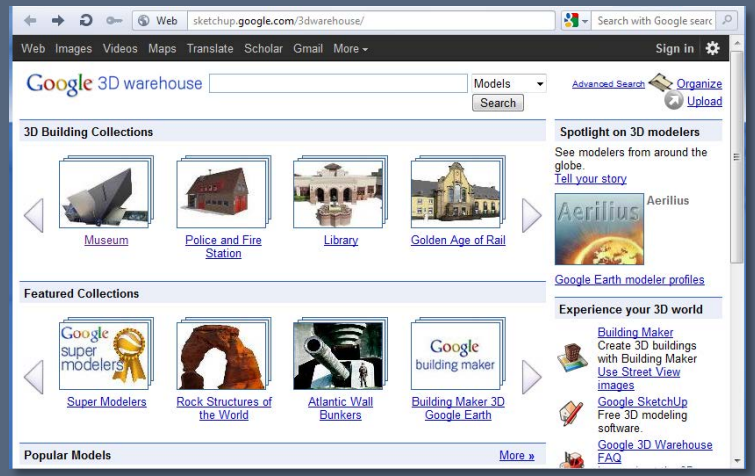


# FIT FABLAB – 3D Repositories

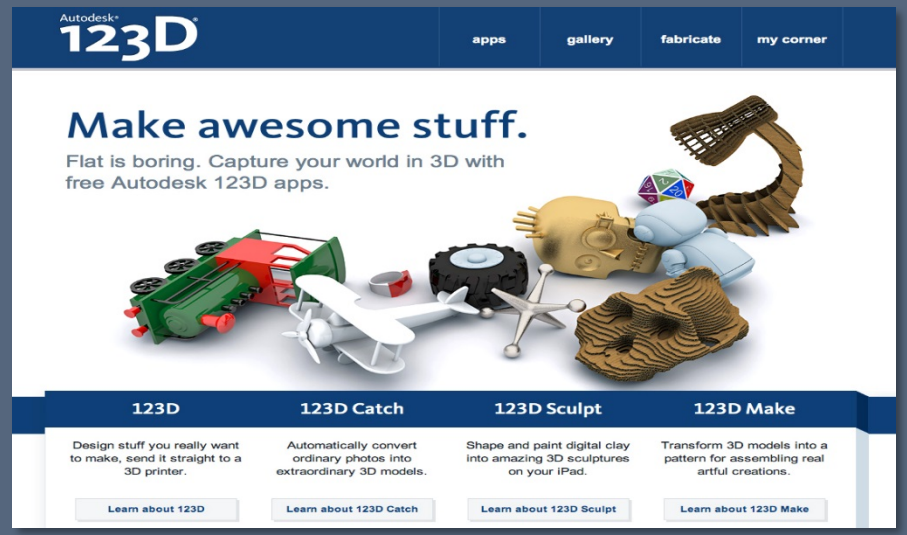
- Google Warehouse
- GrabCAD.com
- FlyingArchitecture.com
- Thingiverse.com

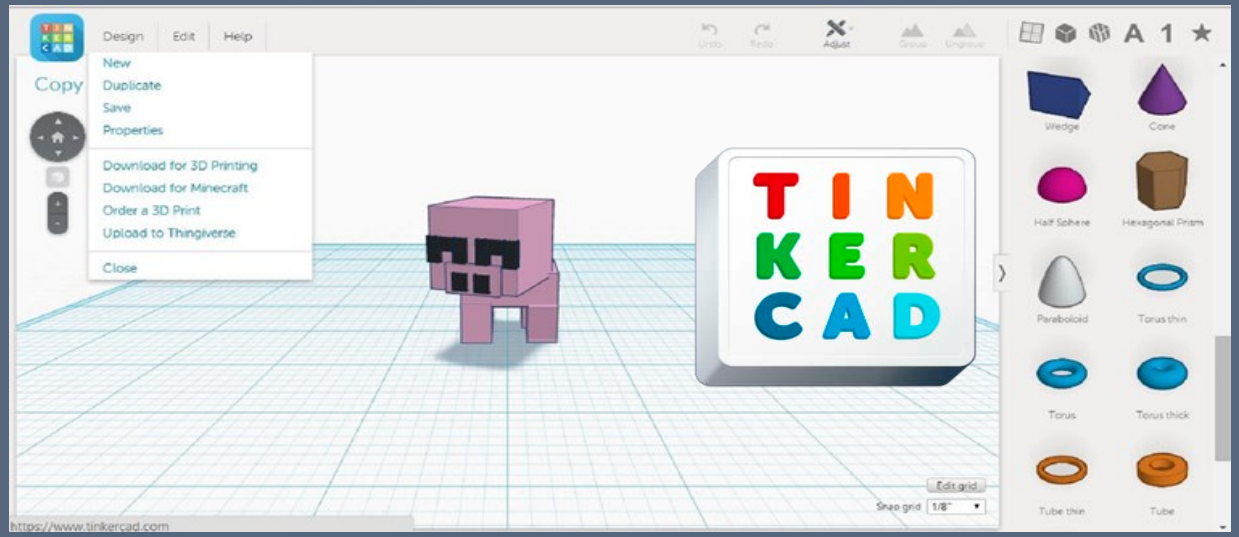



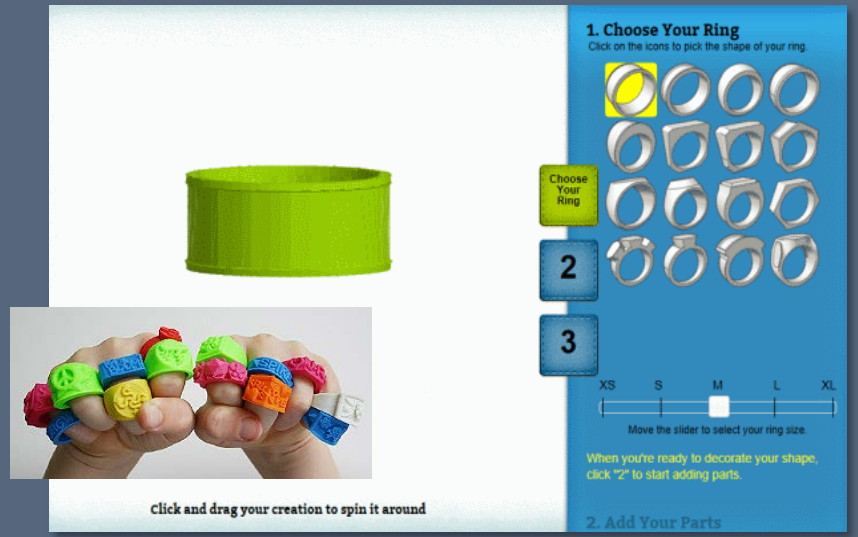




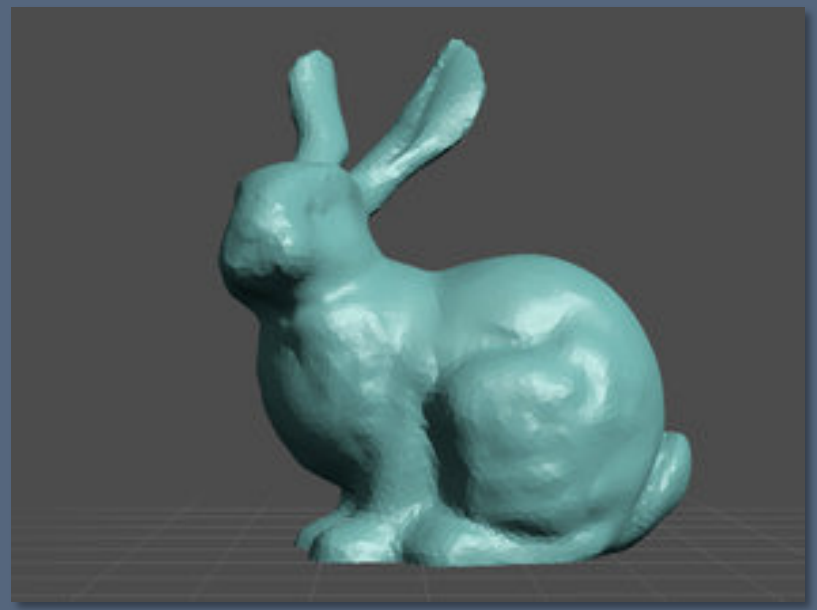
# FIT FABLAB – Web-based Apps

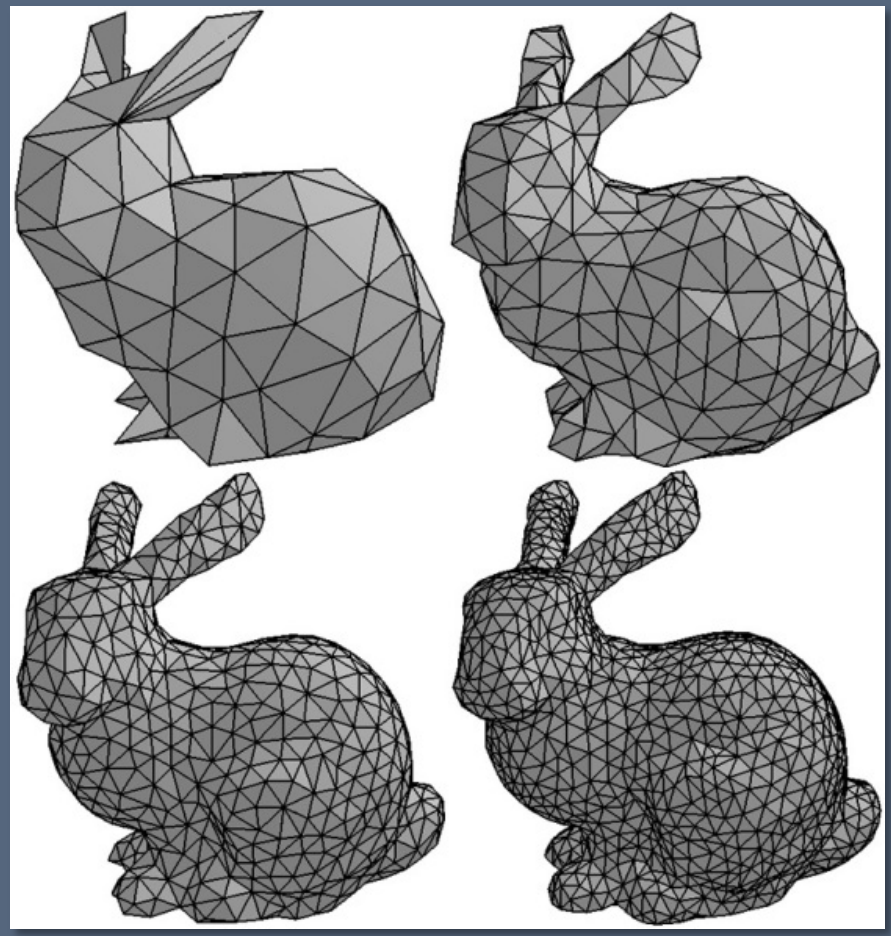



# FIT FABLAB – STL File Format

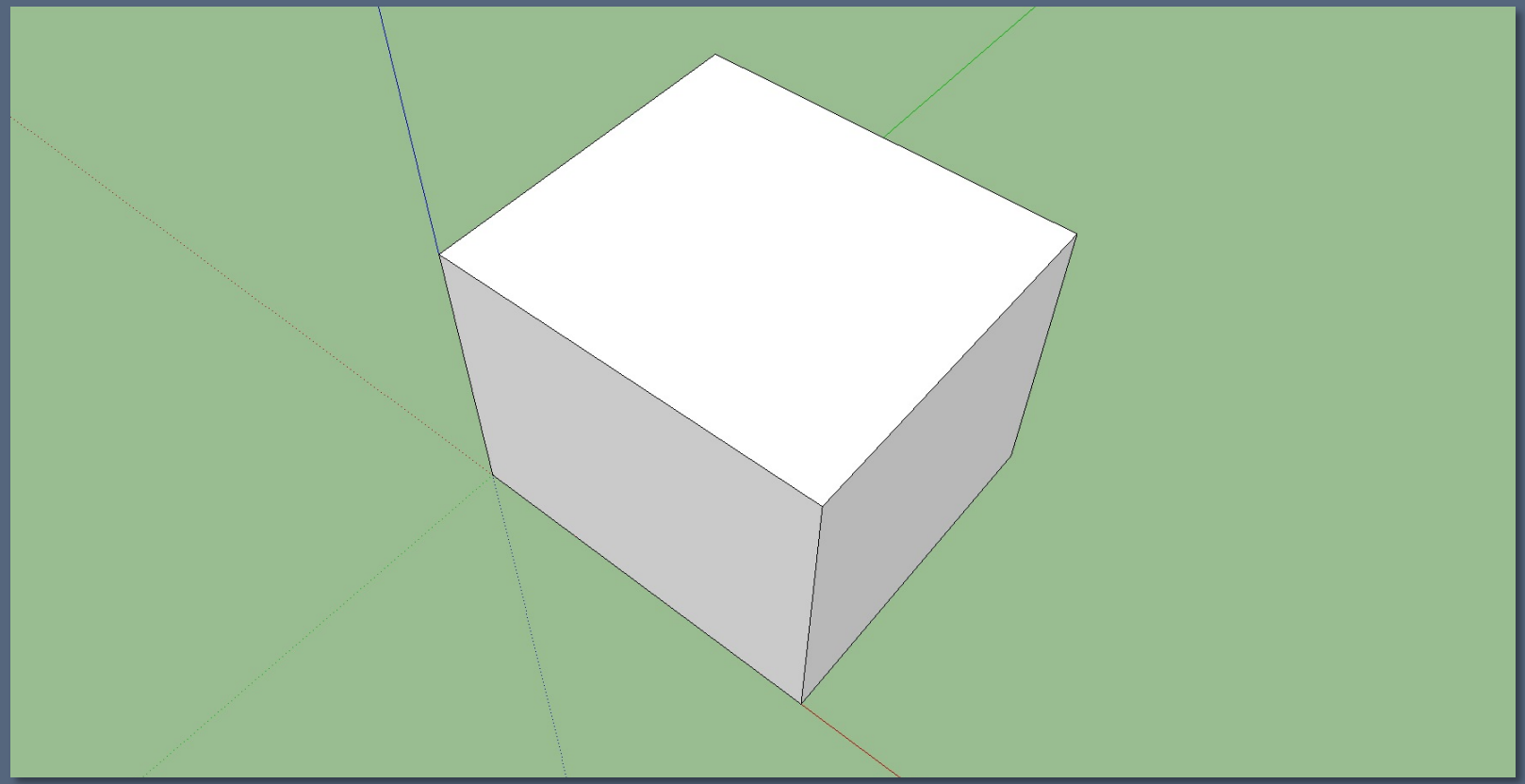




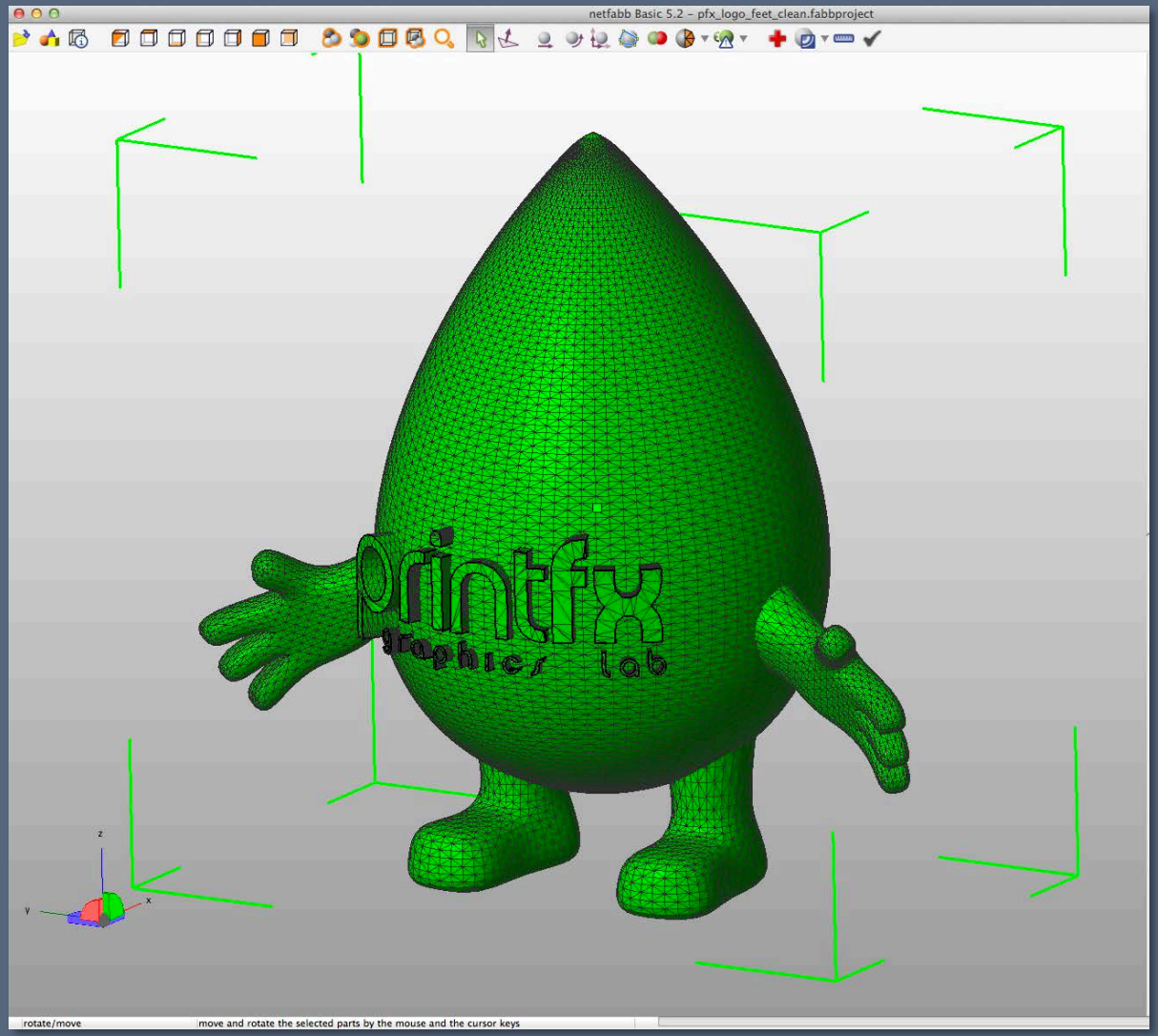
# FIT FABLAB – Common 3D Modeling Pitfalls

- Unsealed Edges
- Flipped Normals
- Unnecessary Debris
- Improper Wall Thickness
- Loss of Object Scale

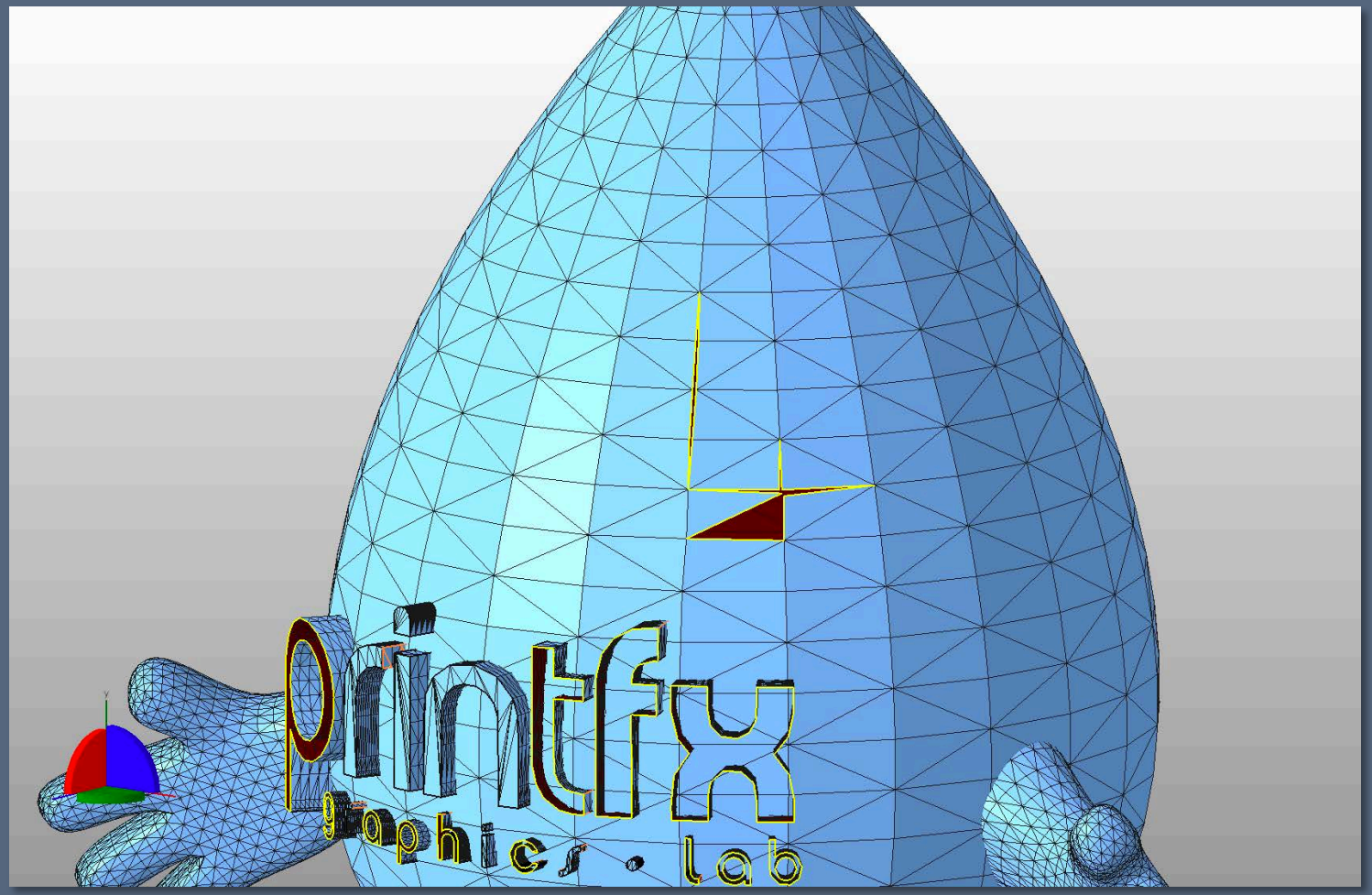
# FIT FABLAB – Simple Geometry Model



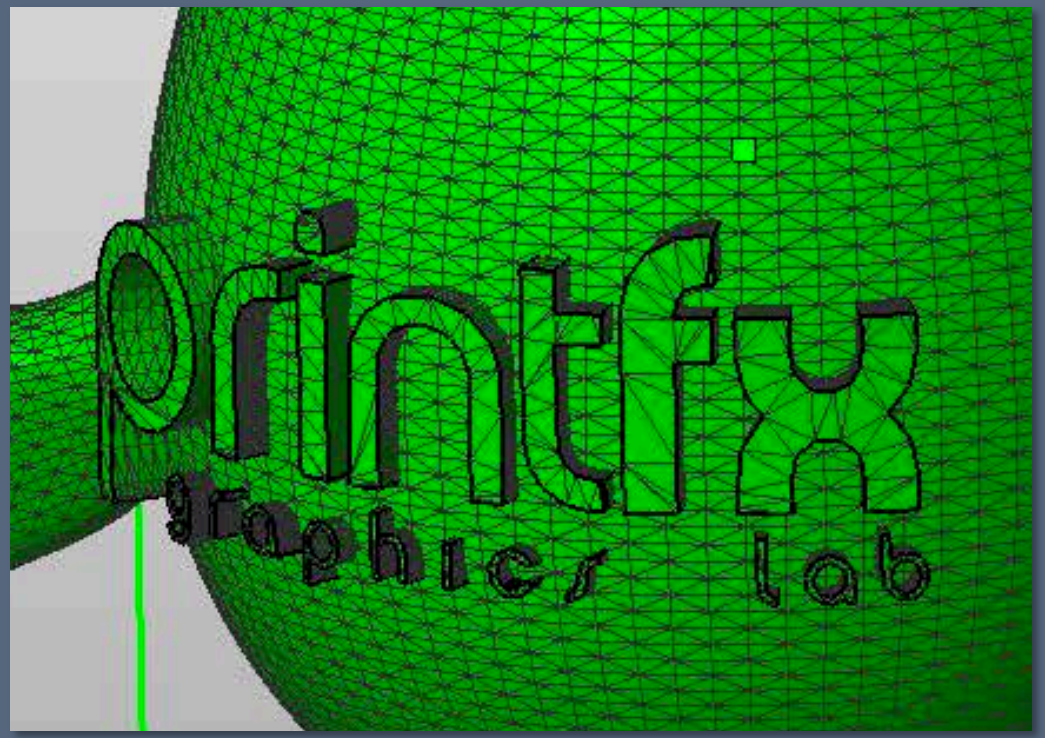
# FIT FABLAB – Complex Geometry Model

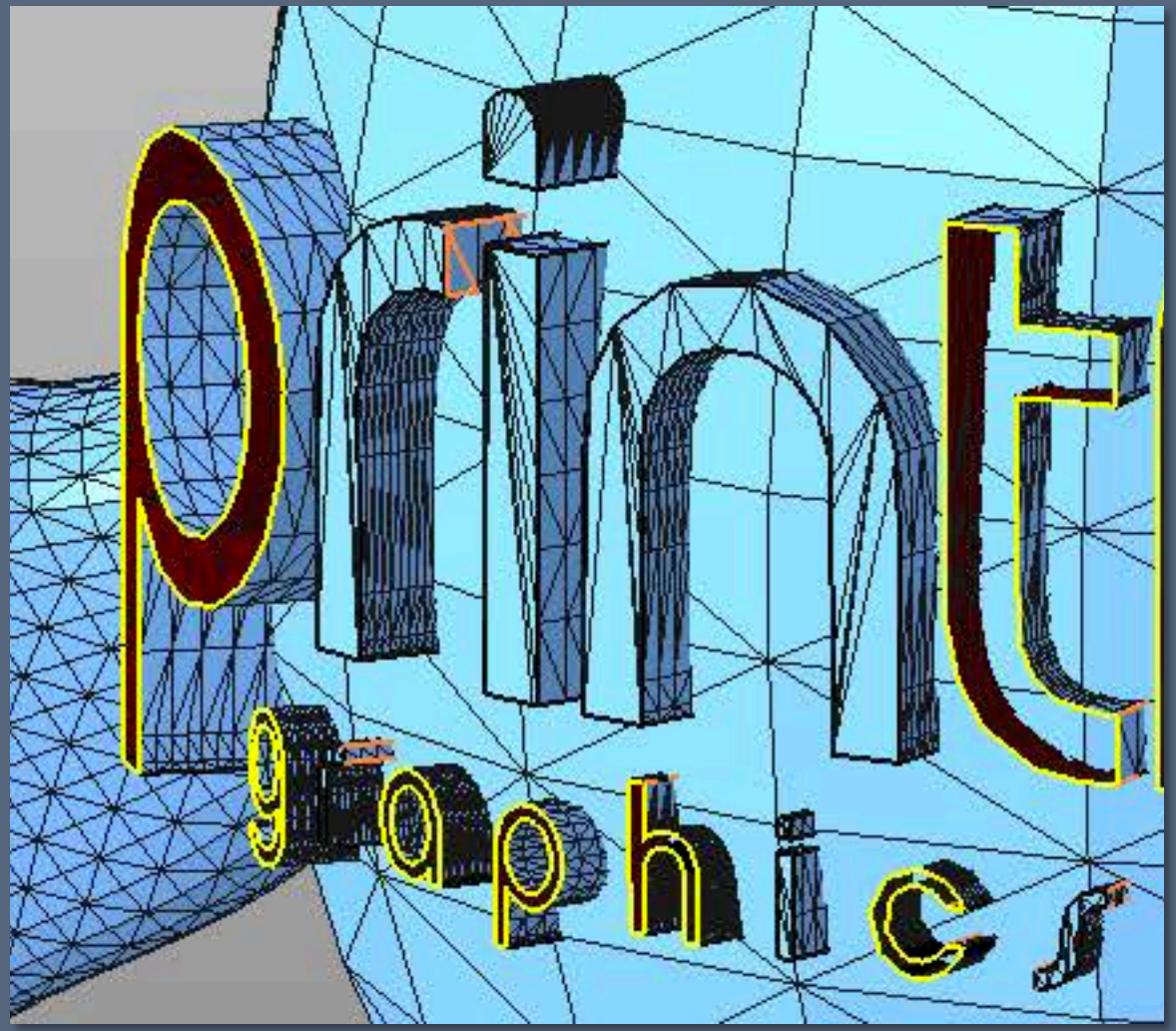


# FIT FABLAB – Unsealed vs Watertight Models

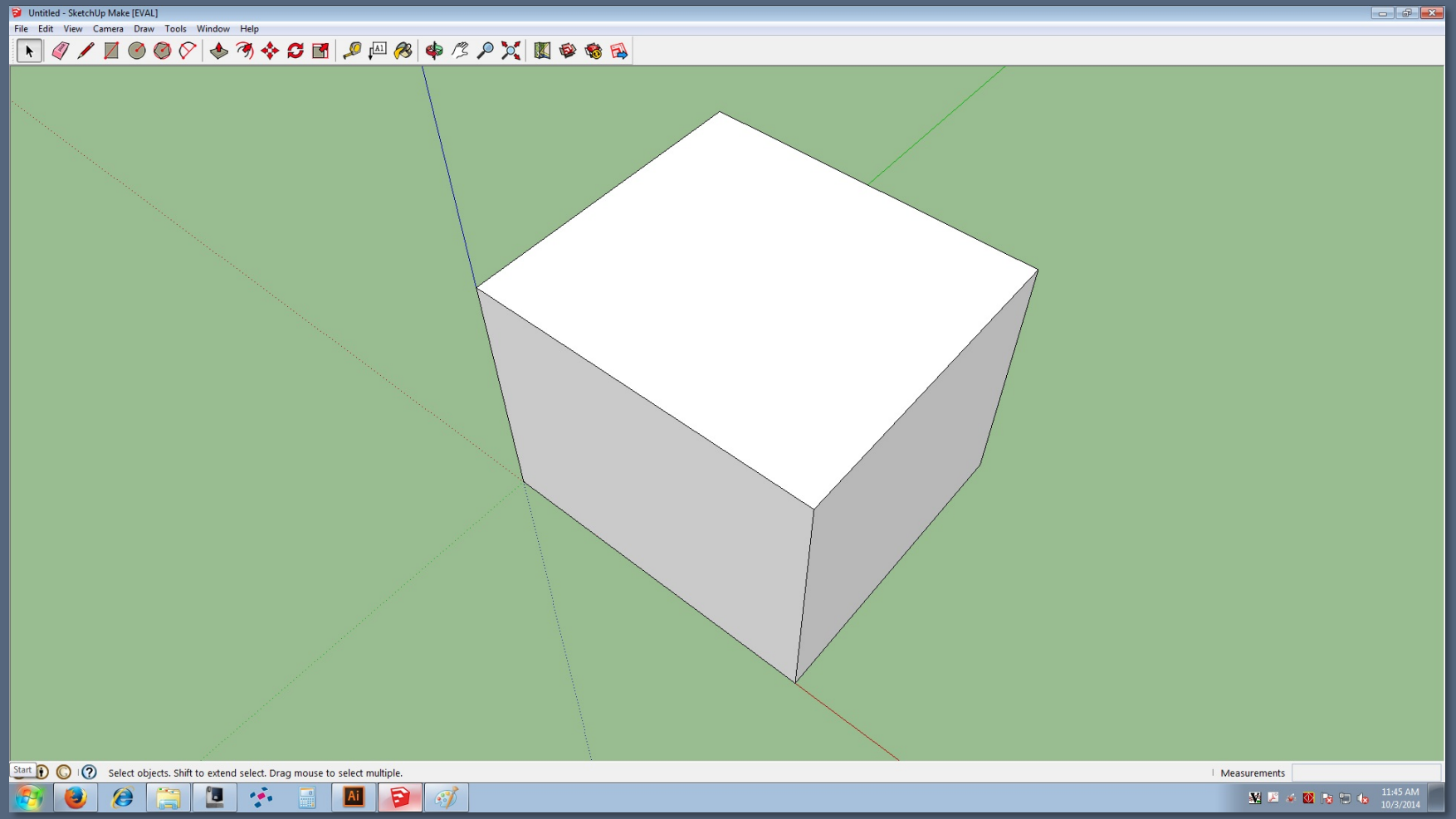


# FIT FABLAB – Missing Faces



# FIT FABLAB – Normals vs Flipped Faces



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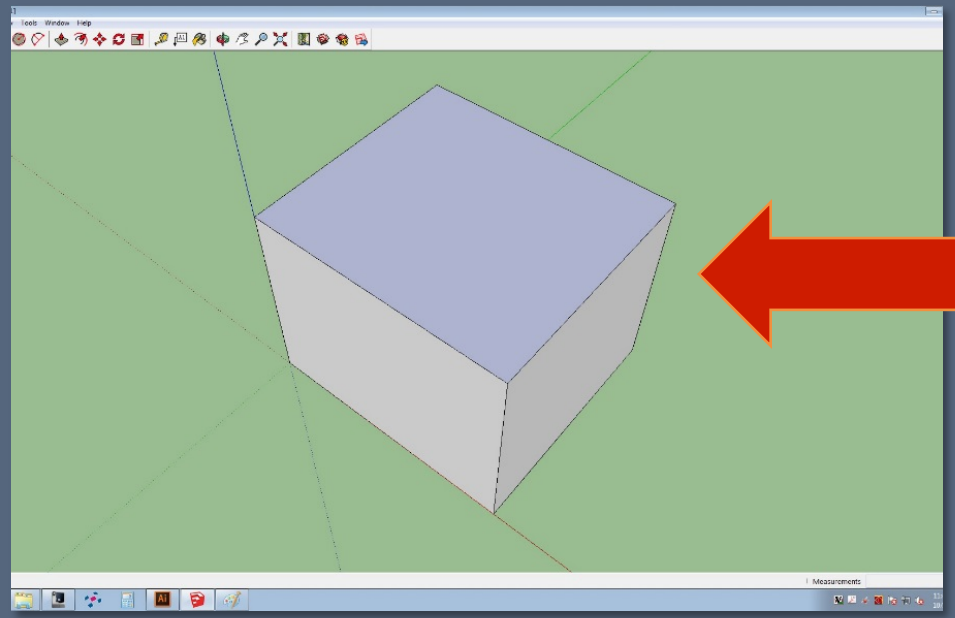
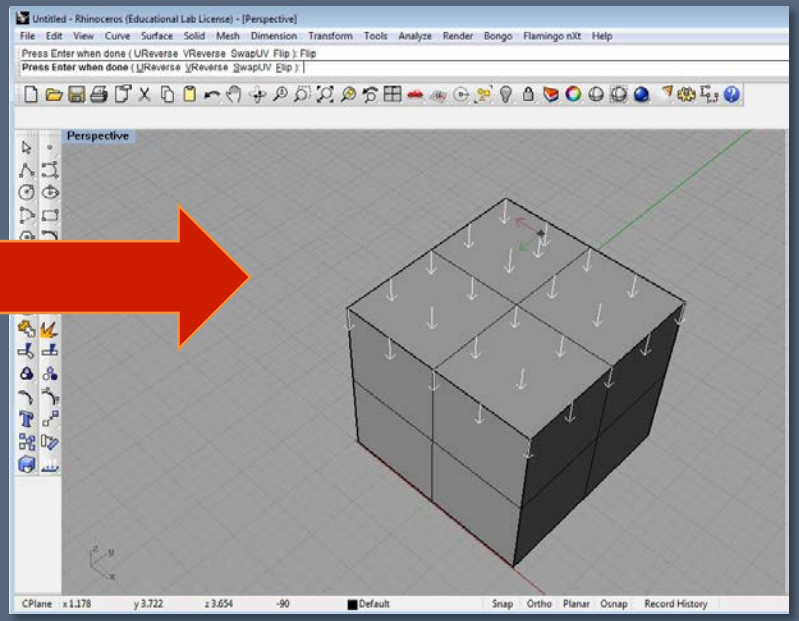


Inversed Faces



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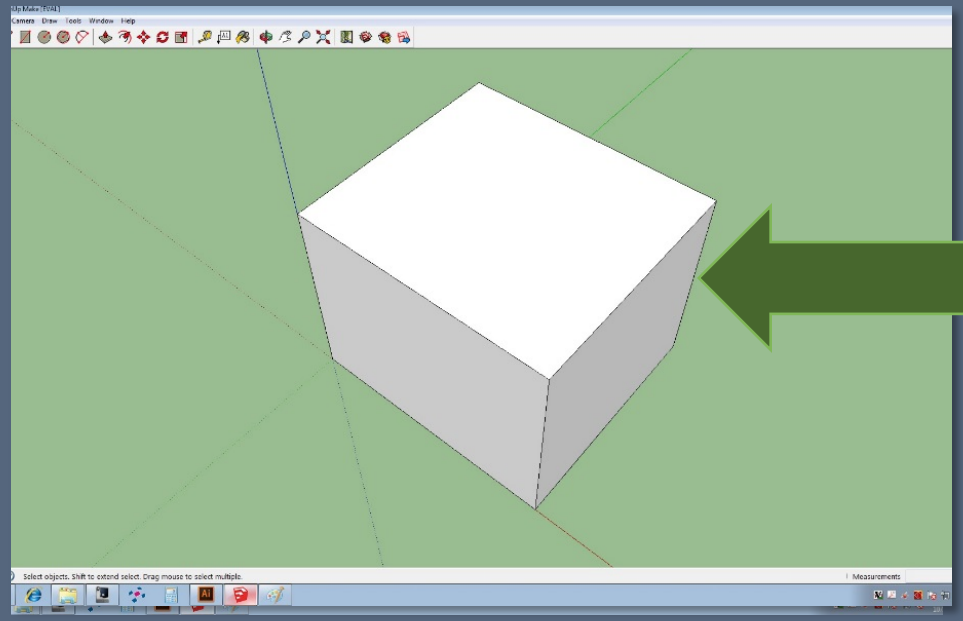
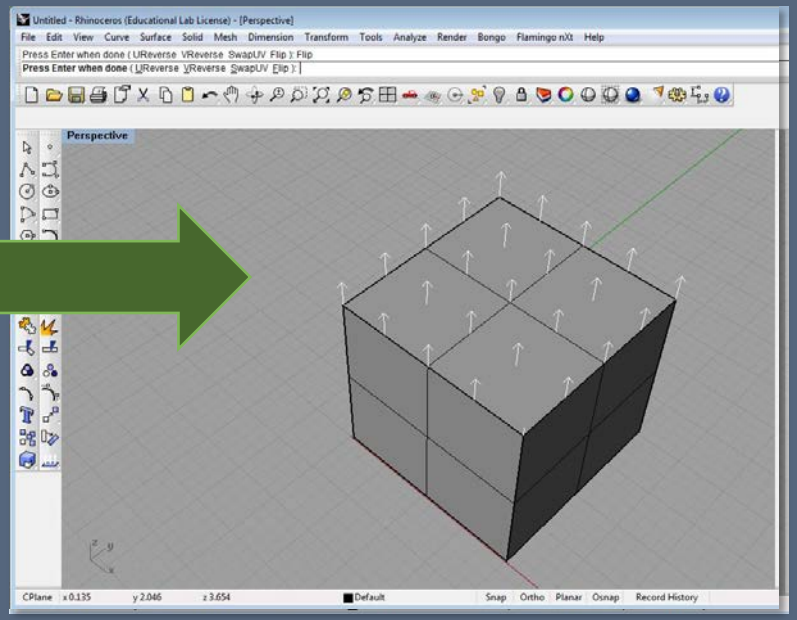
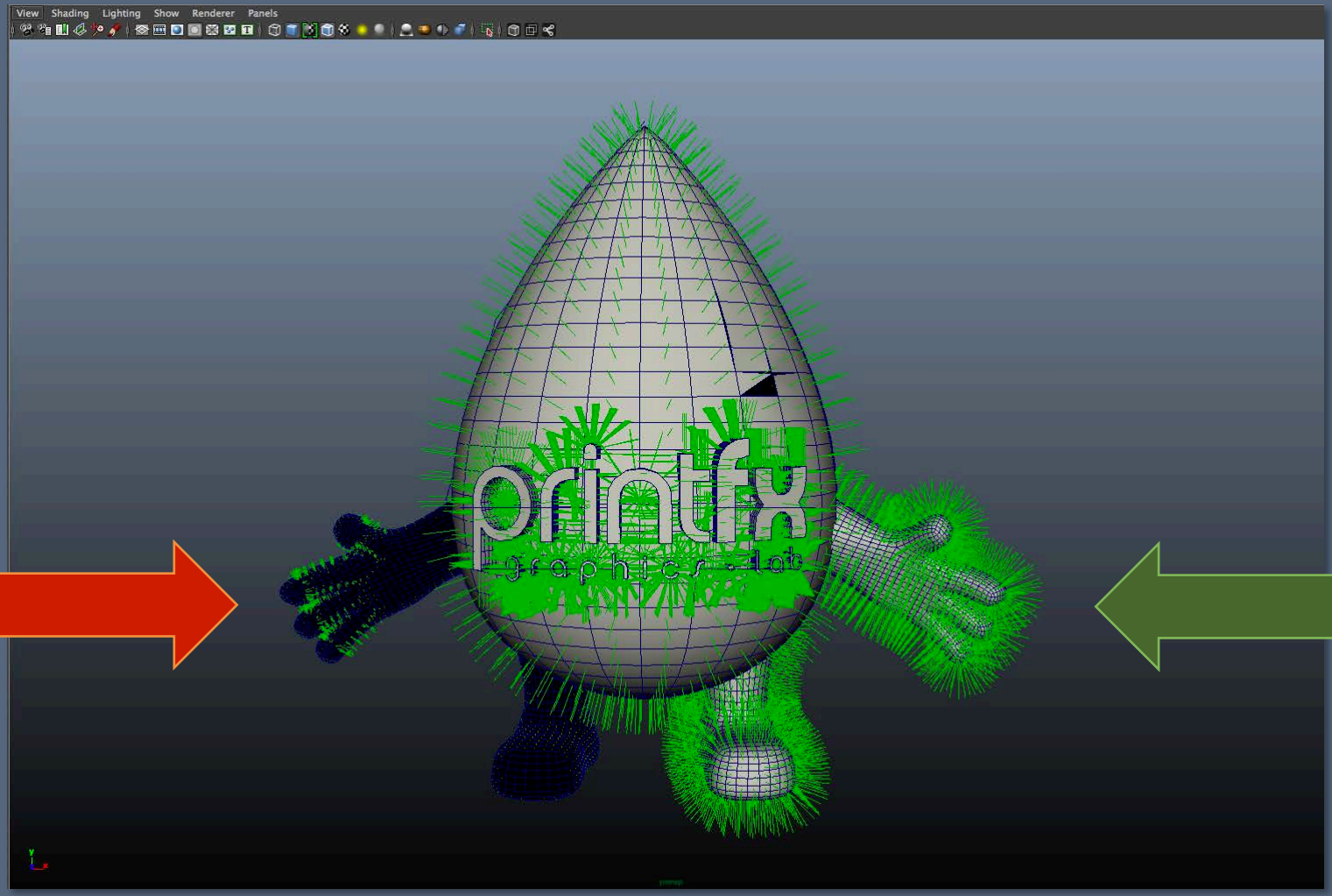


Normals



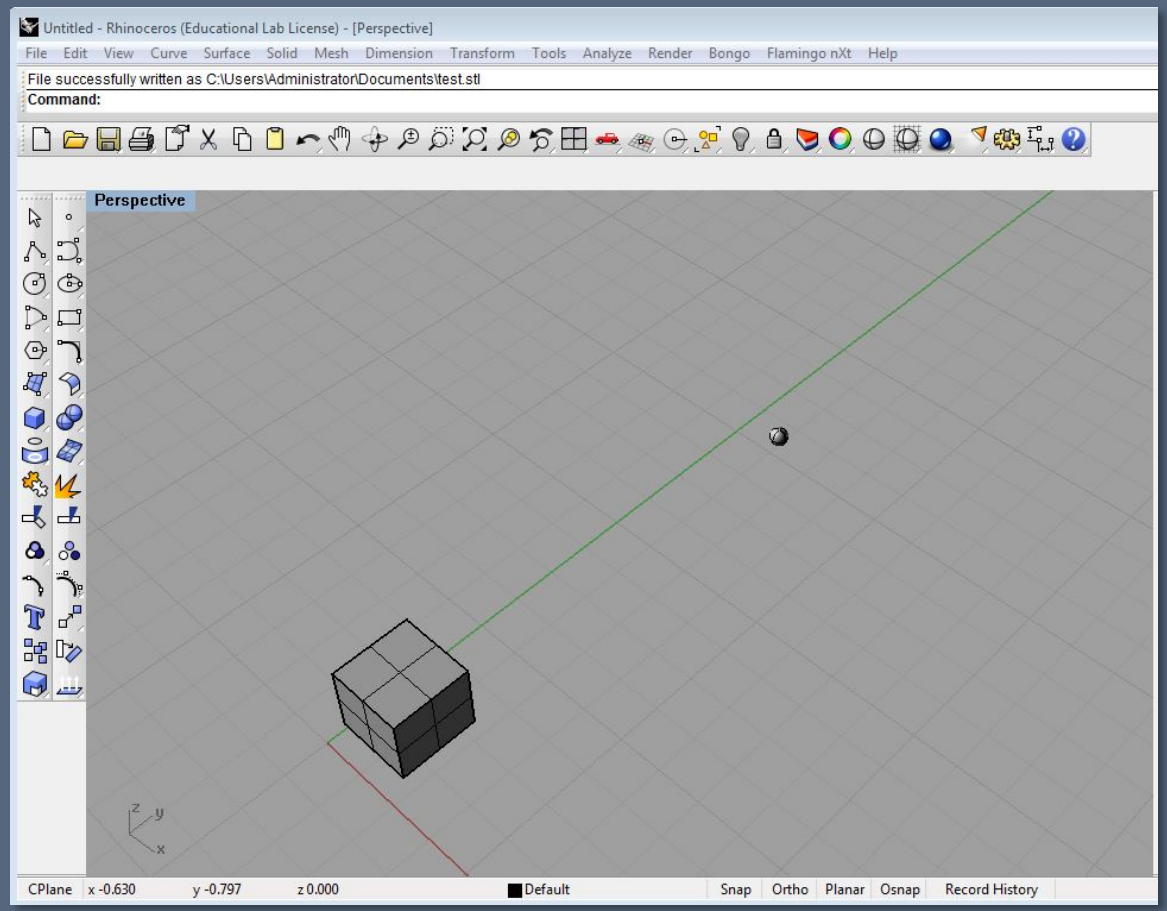
# FIT FABLAB – Normals vs Flipped Faces

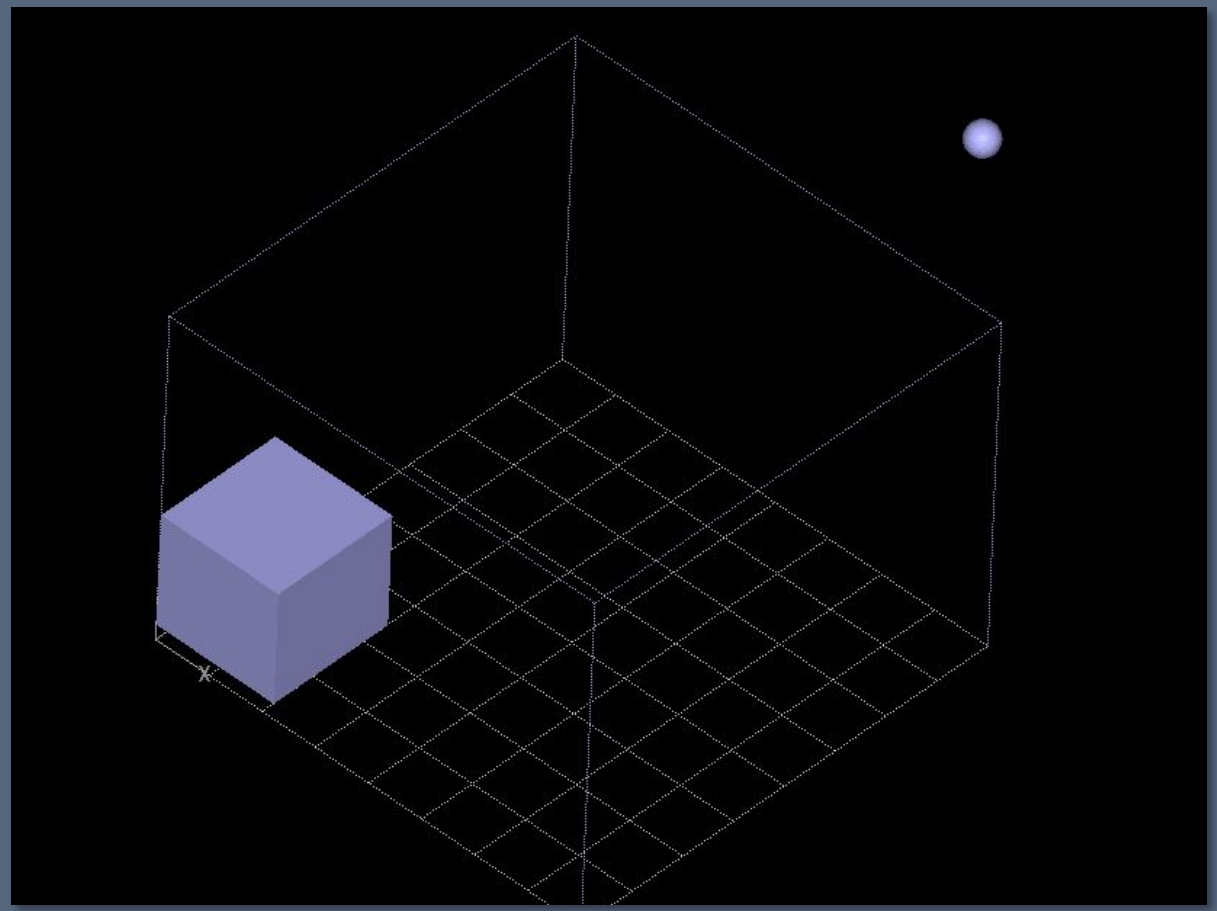
Inversed Faces



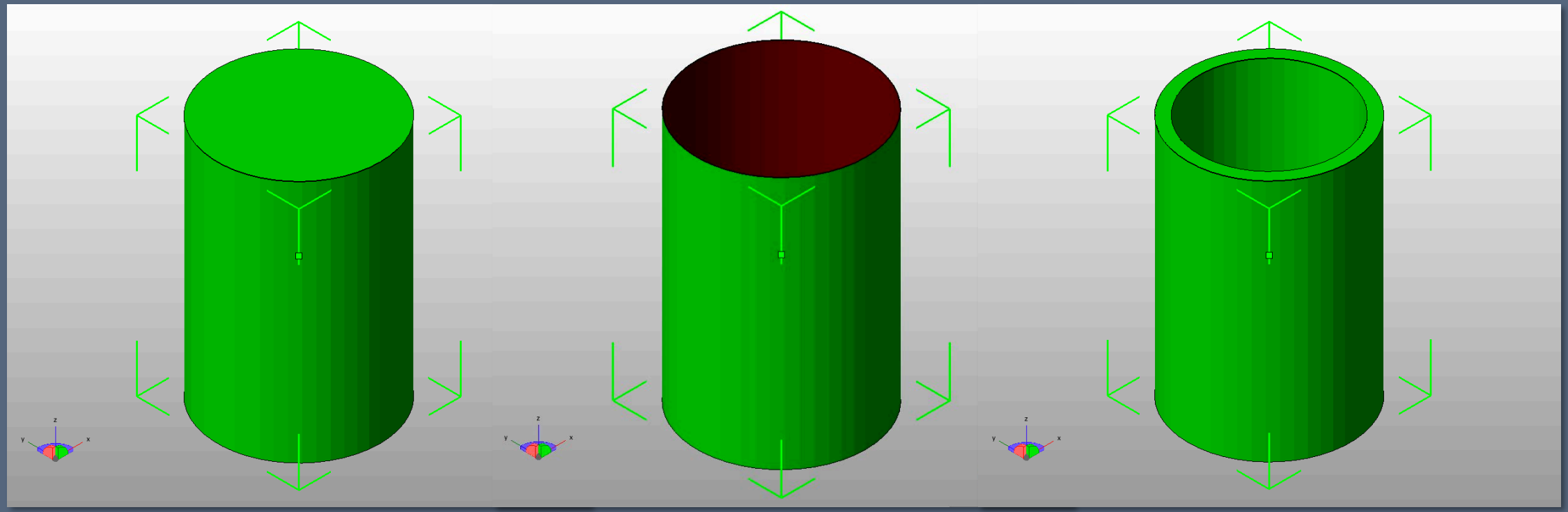

Normals

# FIT FABLAB – Unnecessary Debris

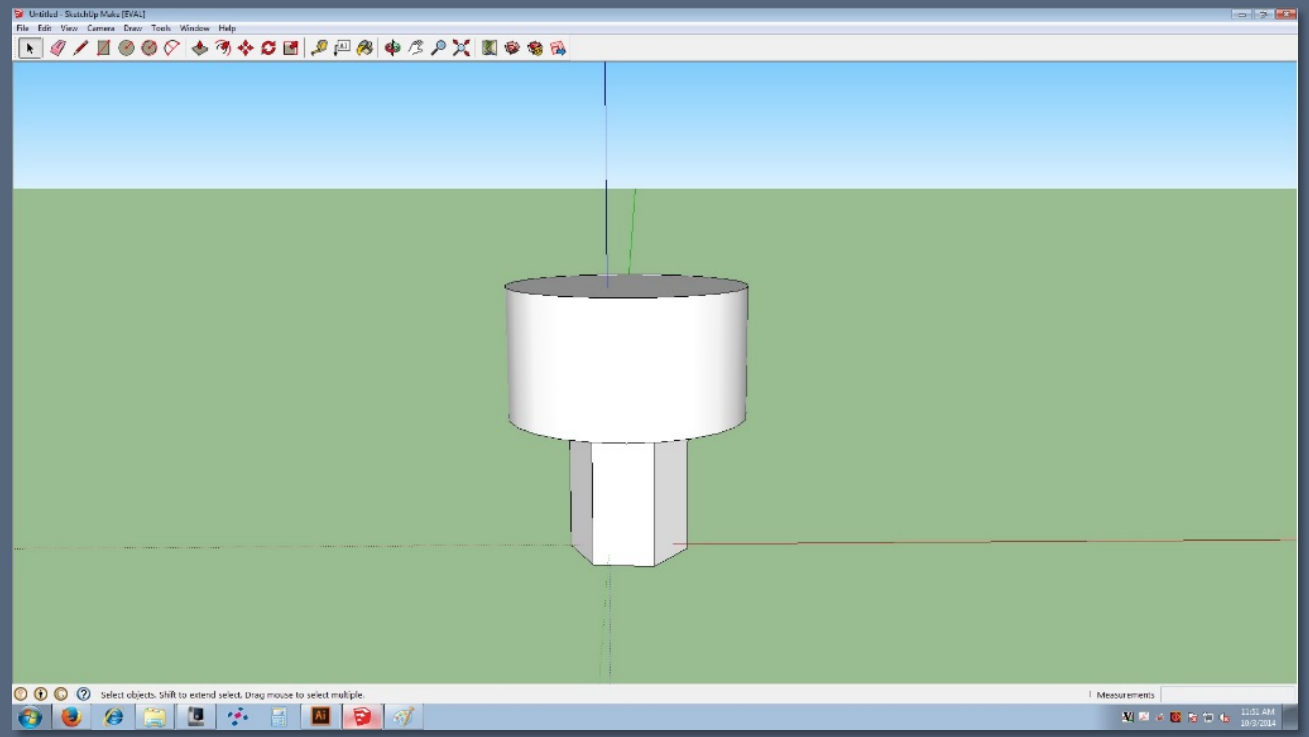


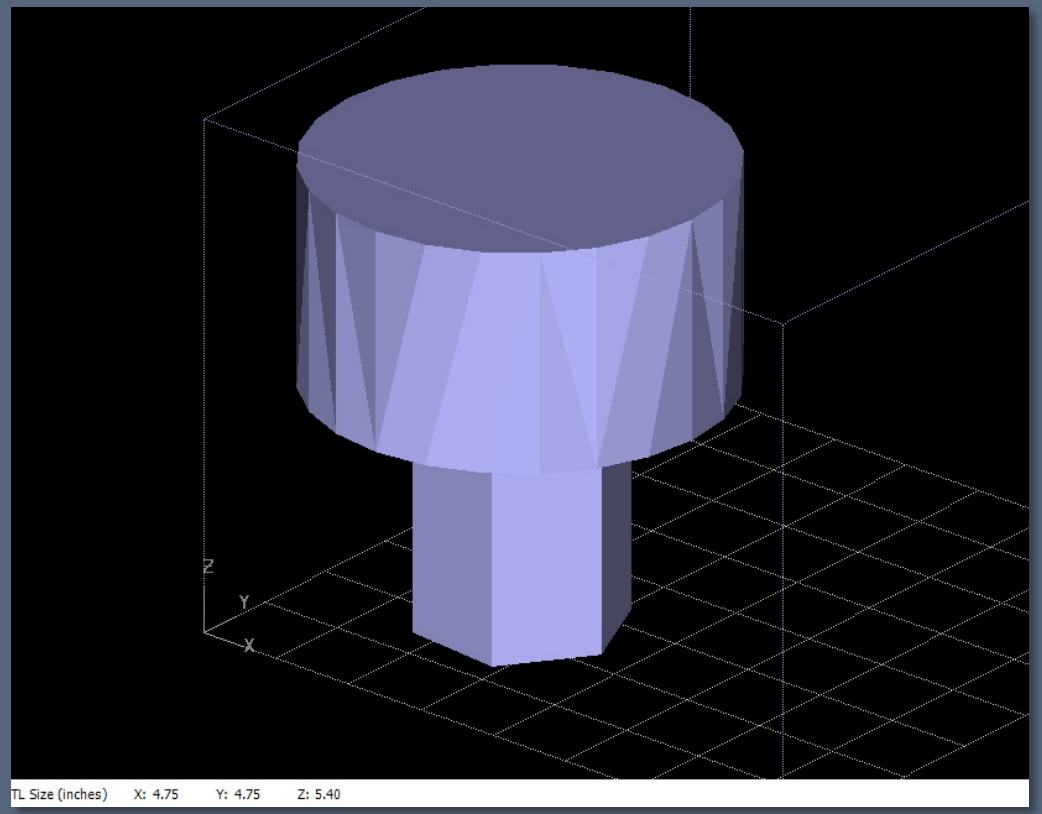



# FIT FABLAB – Wall Thickness



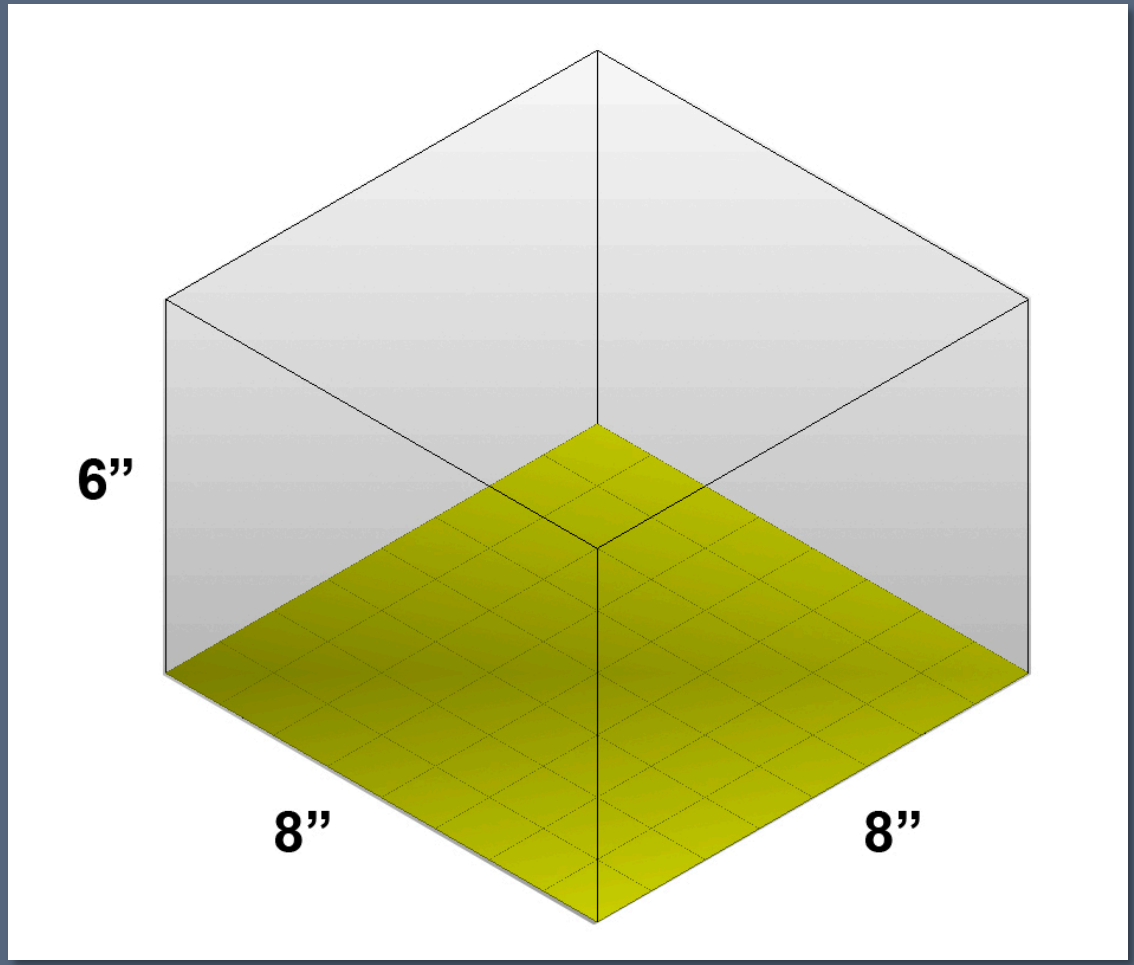
# FIT FABLAB – Loss of Object Scale





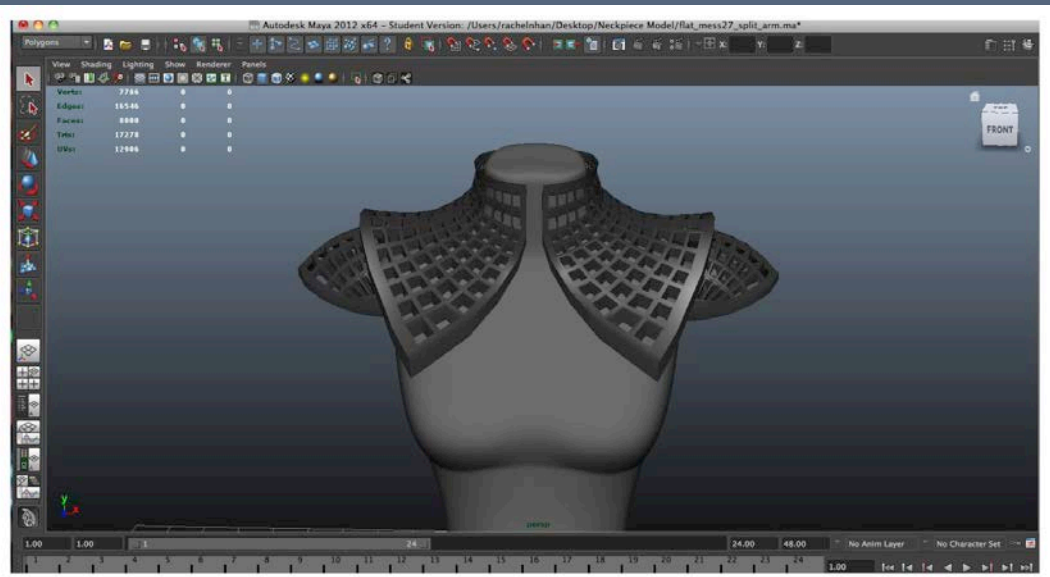
# FIT FABLAB – Working with Object Scale

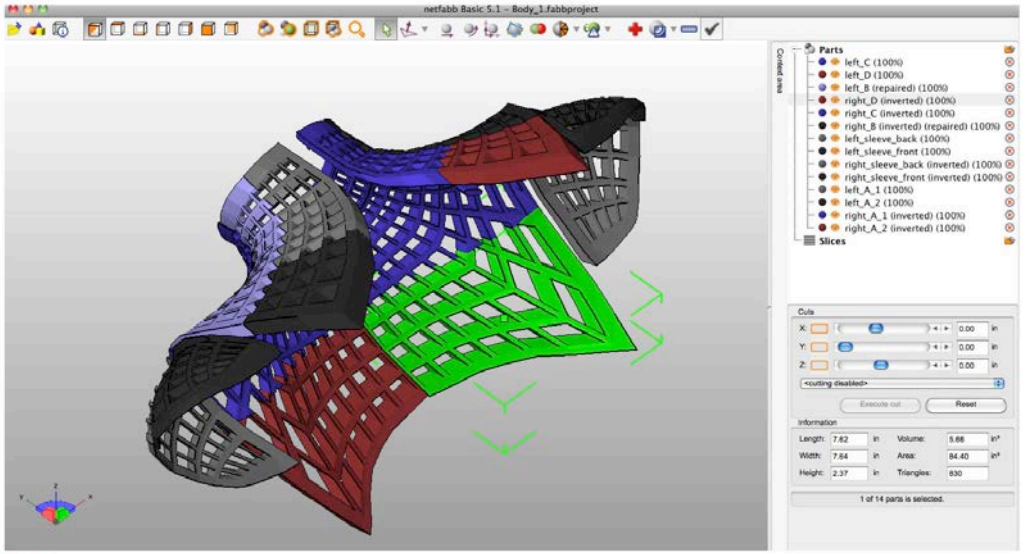
- The uPrint Plus SE has a bed size of 8” x 8” x 6”
- Files submitted to 3D print in the FabLab must fit within this area

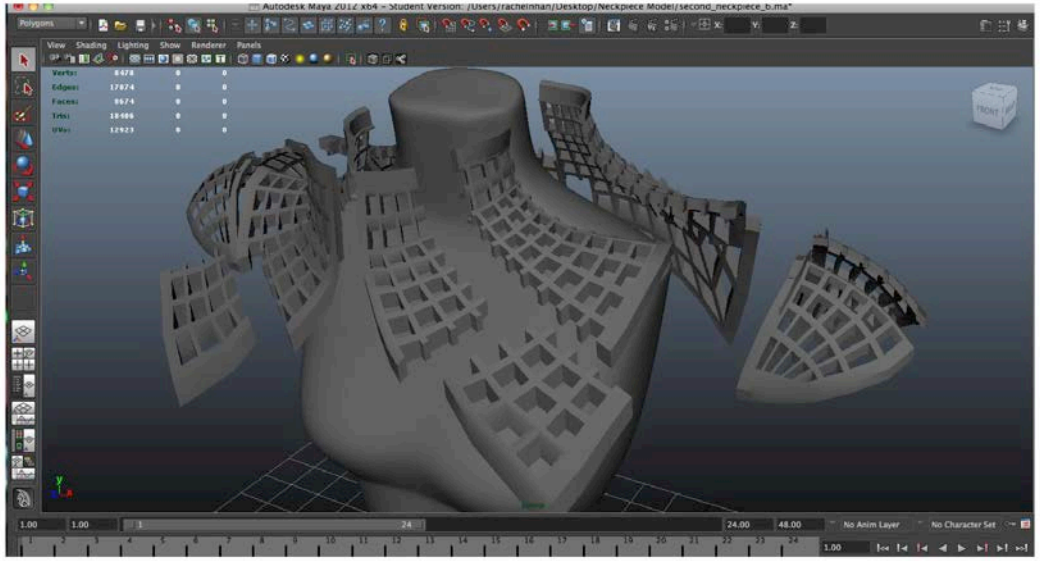


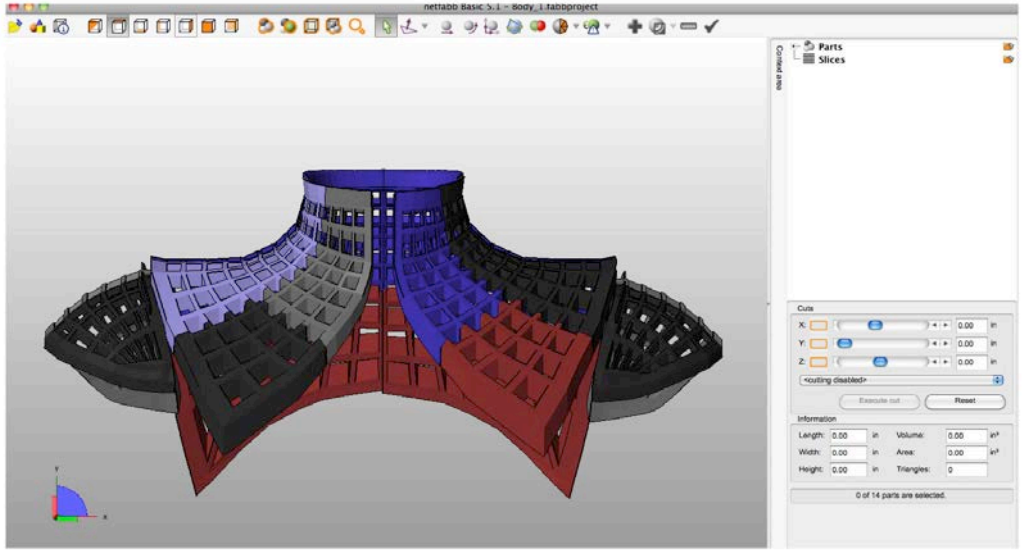
# FIT FABLAB – Working With Bed Size Limitations

# FIT FABLAB – Working With Bed Size Limitations



# FIT FABLAB – Working With Bed Size Limitations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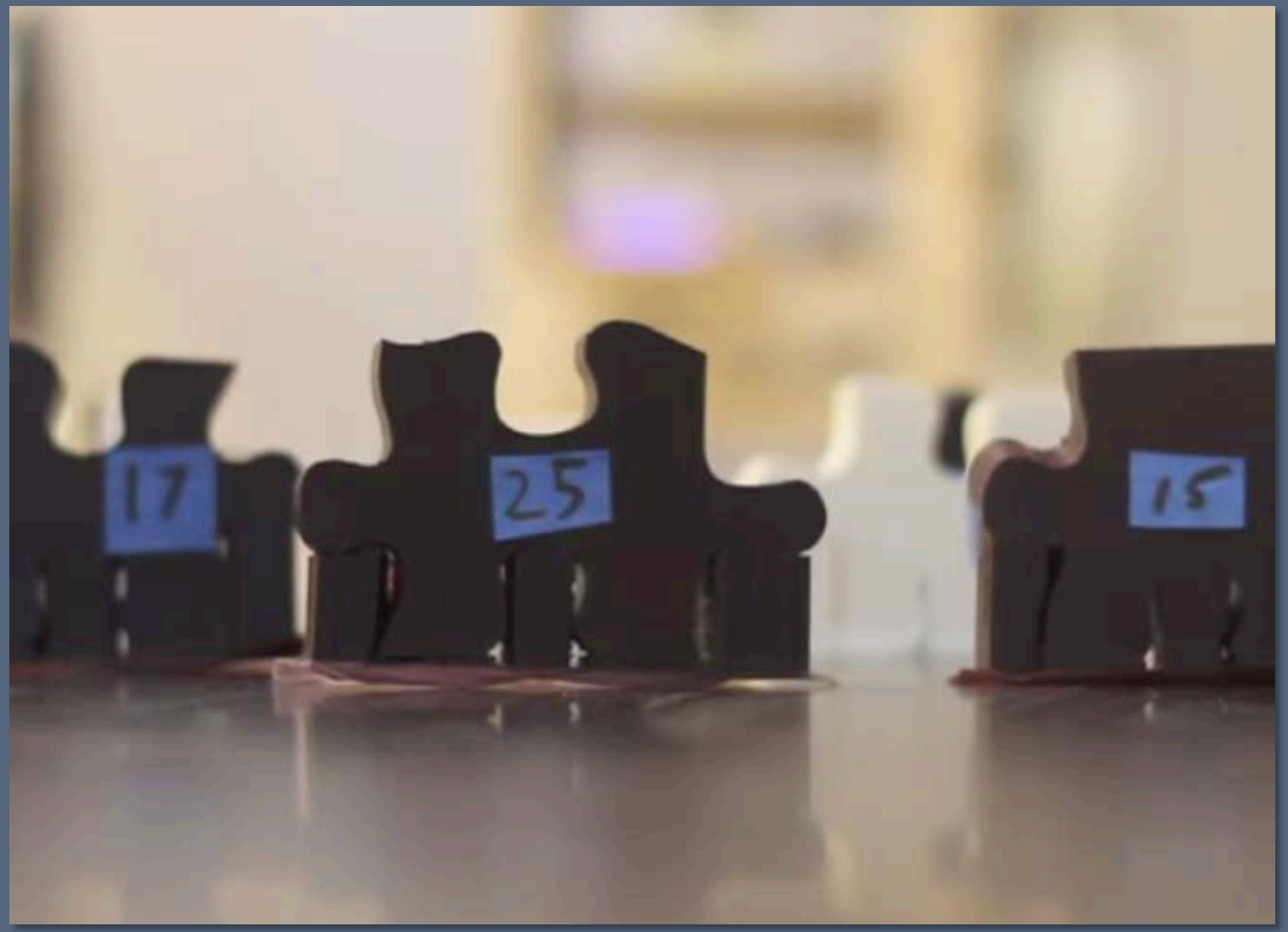


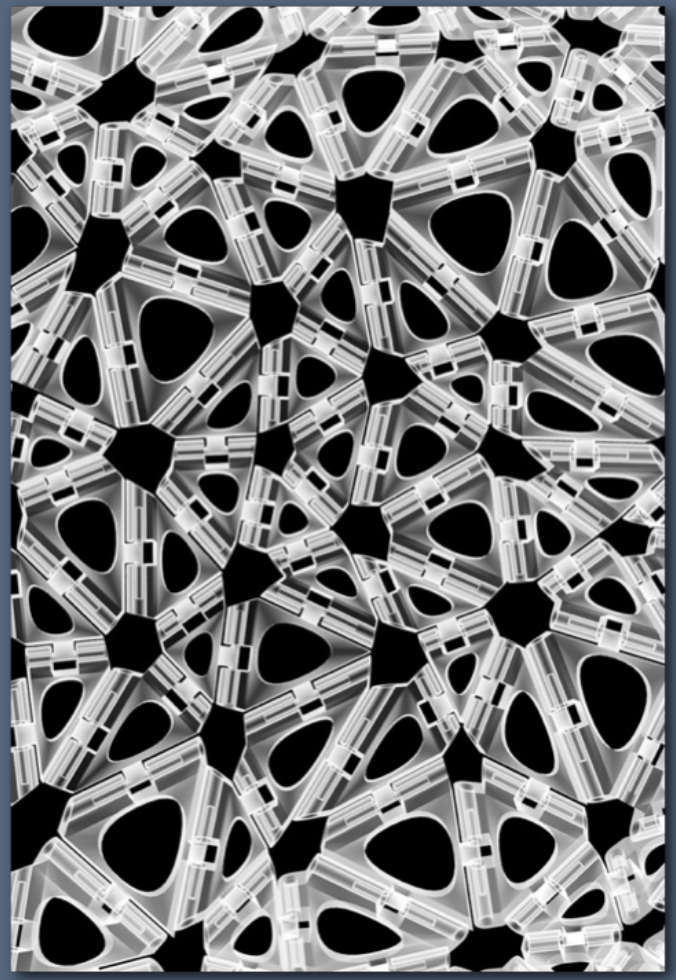
# FIT FABLAB – Working With Bed Size Limitations

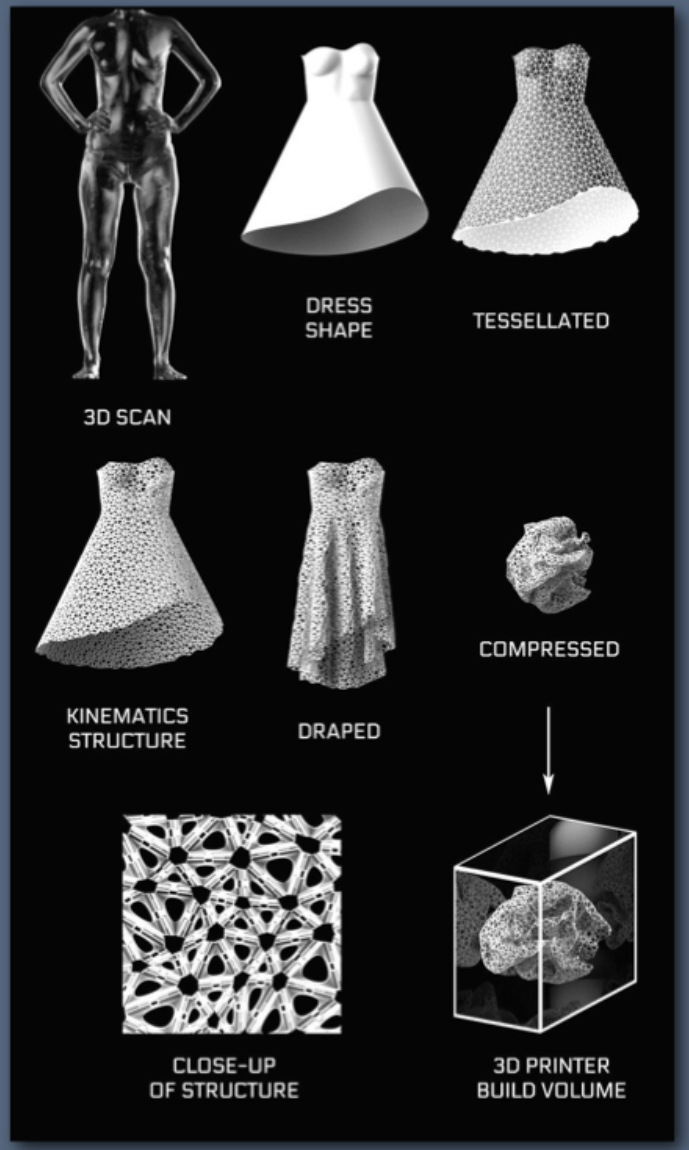
**CROWD FABRICATION**

FOR THE FIRST PROTOTYPE WE ASKED THE HELP OF A 3D PRINTING HUB TO CREATE THE WORLDS FIRST CROWD FABRICATED CHAIR. THE FIRST CHAIR IS GENERATED OUT OF A SINGLE SHEET FRACTIONATED IN 202 3D JIGSAW PUZZLE PARTS.

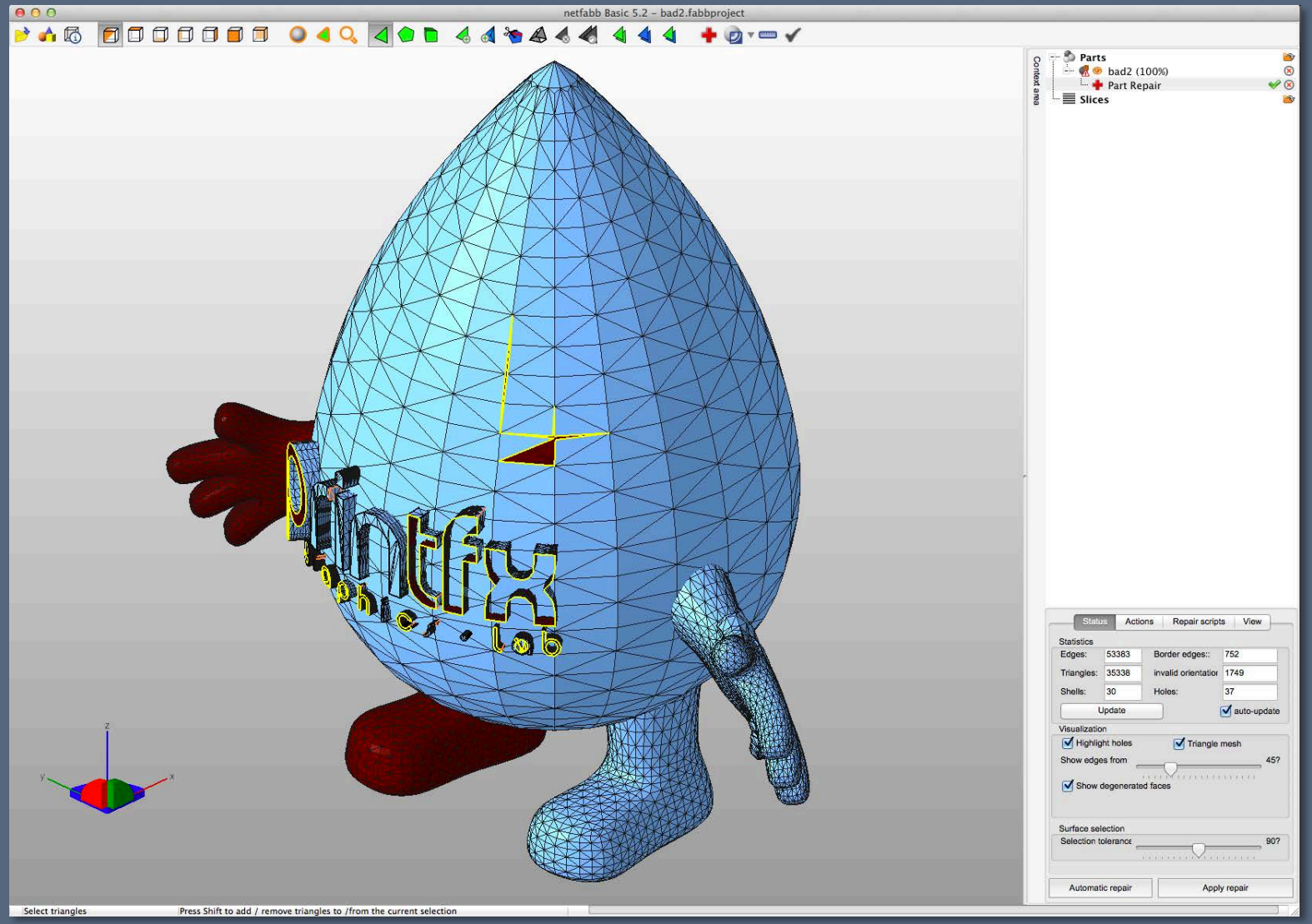
# FIT FABLAB – Working With Bed Size Limitations

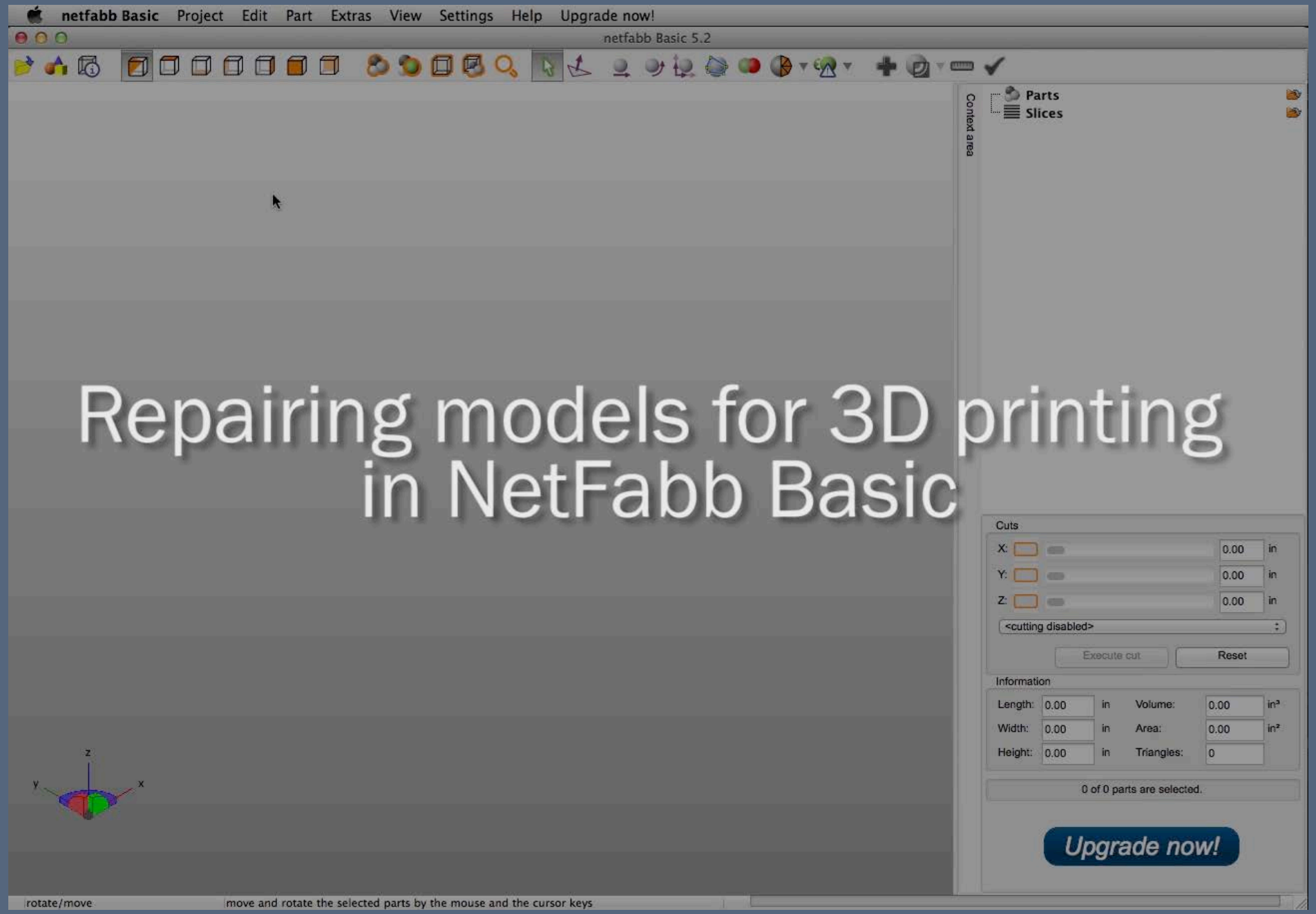
# FIT FABLAB – Working With Bed Size Limitations

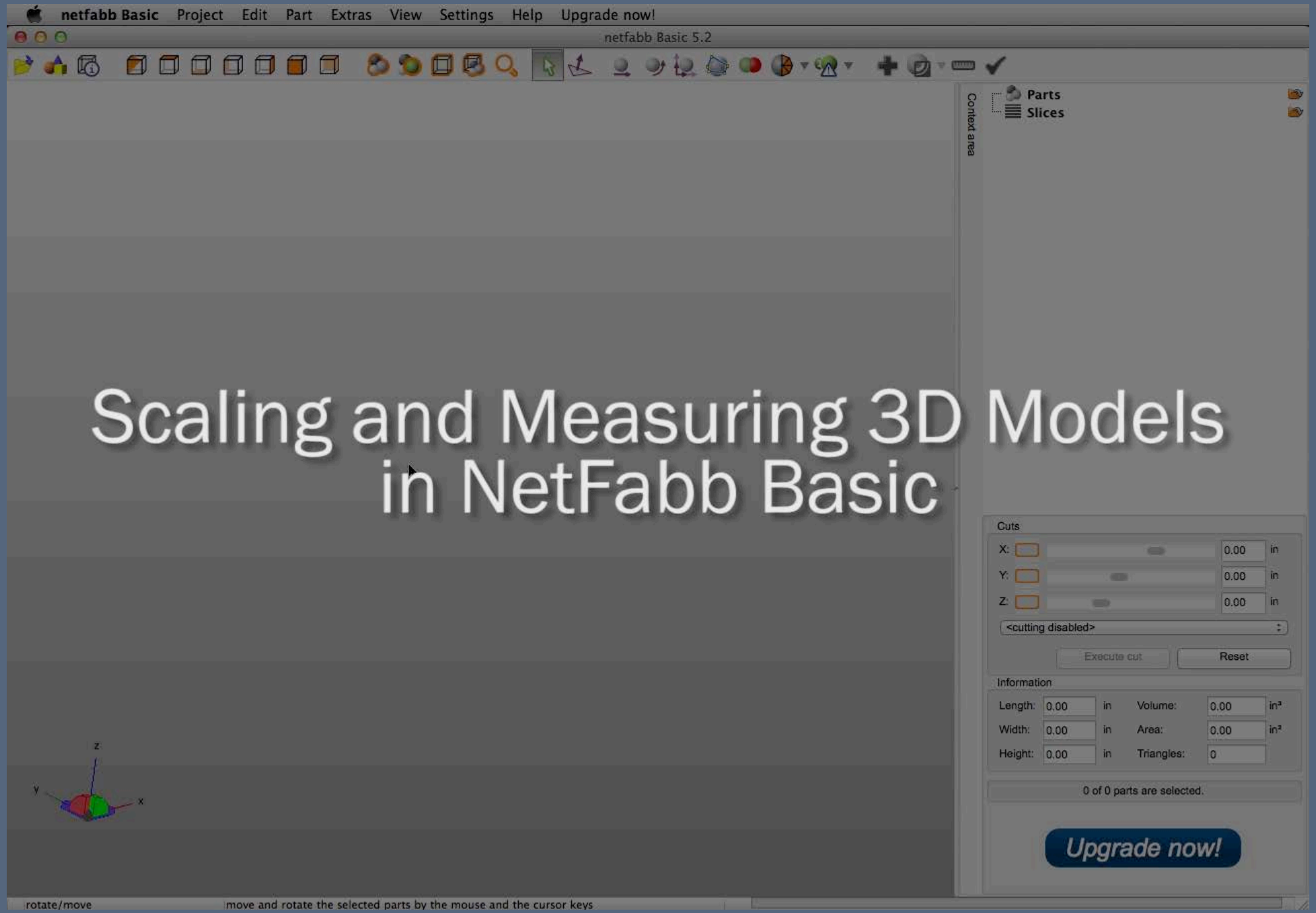




# FIT FABLAB – STL Repair in Netfabb Basic

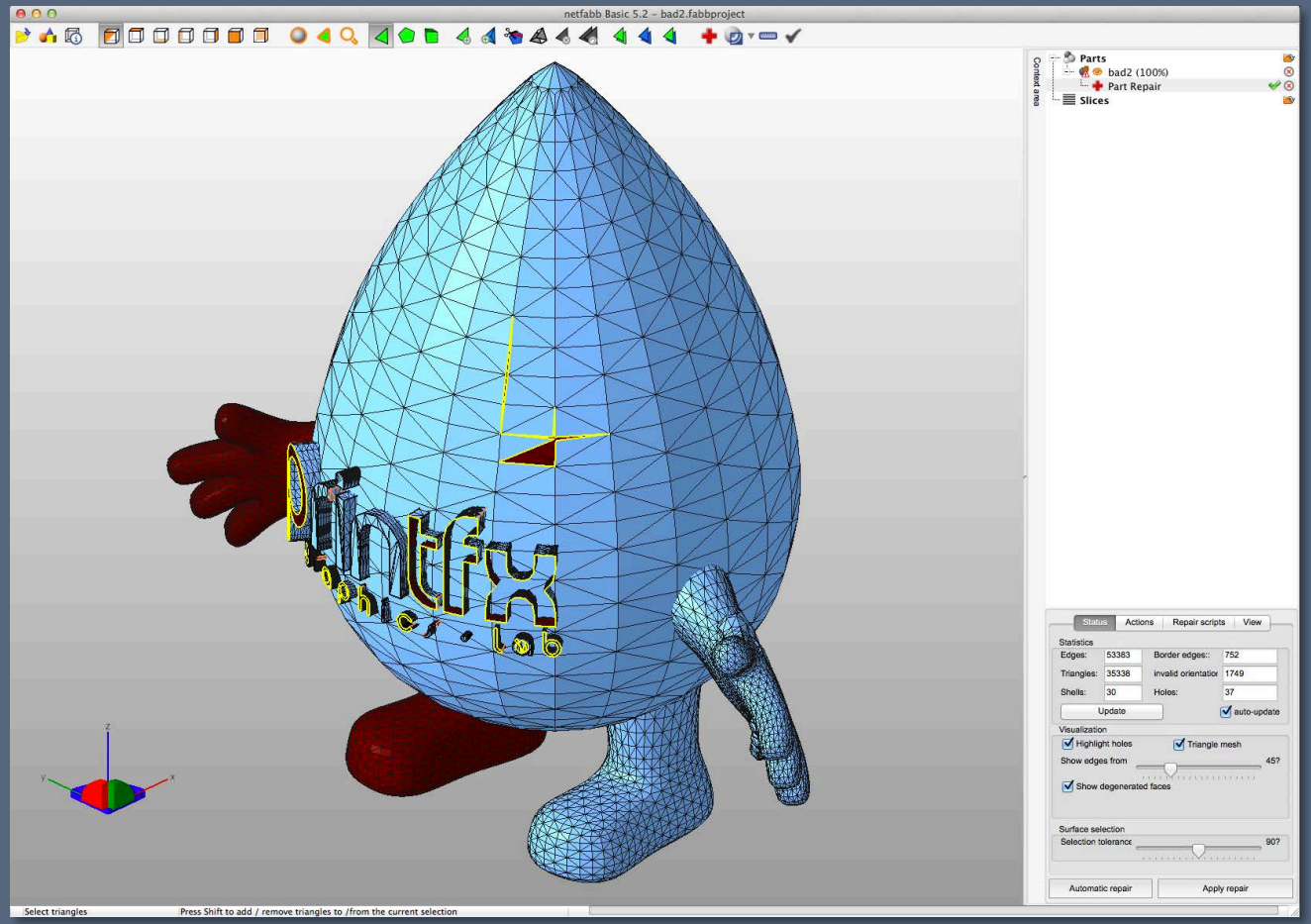



netfabb Basic Project Edit Part Extras View Settings Help Upgrade now!
netfabb Basic 5.2
Context area
Parts
Slices
Repairing models for 3D printing
in NetFabb Basic
Cuts
X: 0.00 in
Y: 0.00 in
Z: 0.00 in
<cutting disabled>
Execute cut
Reset
Information
Length: 0.00 in
Width: 0.00 in
Height: 0.00 in
Volume: 0.00 in³
Area: 0.00 in²
Triangles: 0
0 of 0 parts are selected.
Upgrade now!
z
y
x
rotate/move
move and rotate the selected parts by the mouse and the cursor keys

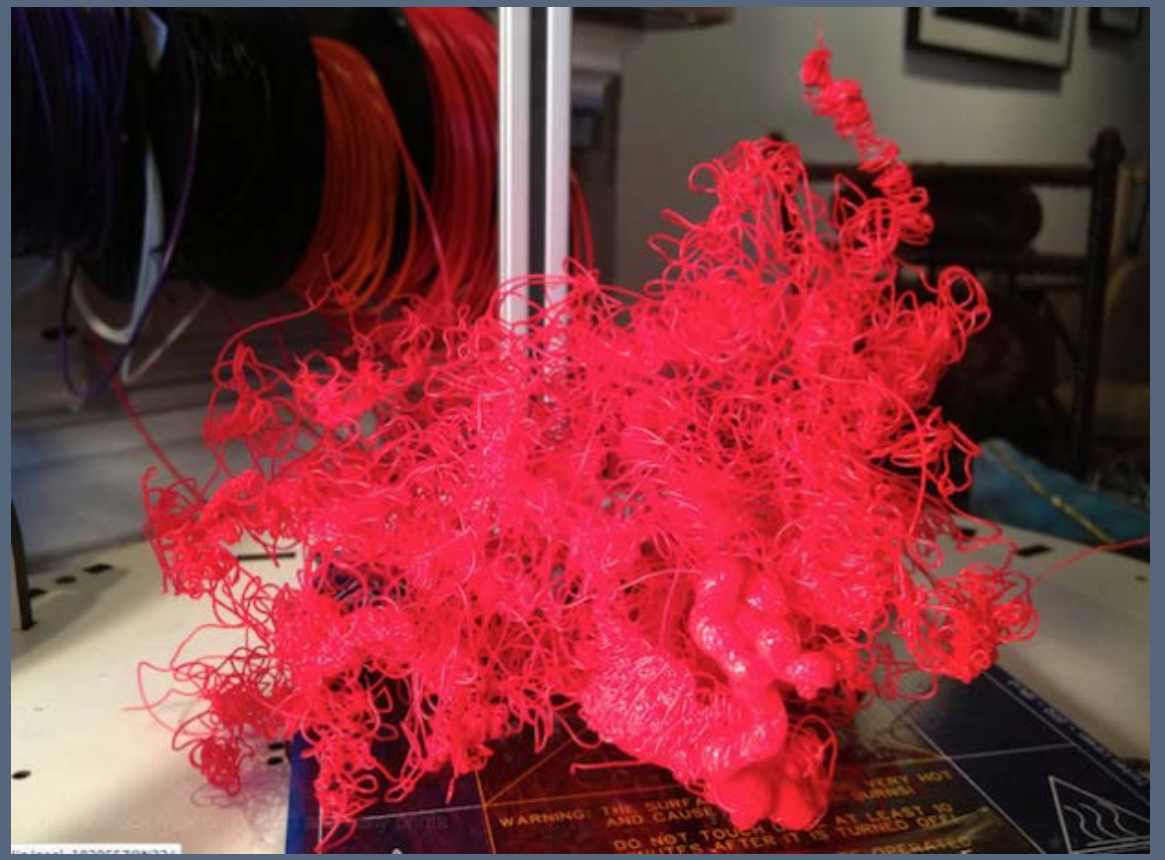

netfabb Basic Project Edit Part Extras View Settings Help Upgrade now!
netfabb Basic 5.2
Parts
Slices
Context area
Scaling and Measuring 3D Models
in NetFabb Basic
Cuts
X: 0.00 in
Y: 0.00 in
Z: 0.00 in
<cutting disabled>
Execute cut
Reset
Information
Length: 0.00 in
Width: 0.00 in
Height: 0.00 in
Volume: 0.00 in³
Area: 0.00 in²
Triangles: 0
0 of 0 parts are selected.
Upgrade now!
z
y
x
rotate/move
move and rotate the selected parts by the mouse and the cursor keys

# FIT FABLAB – FabLab Policies and Procedures

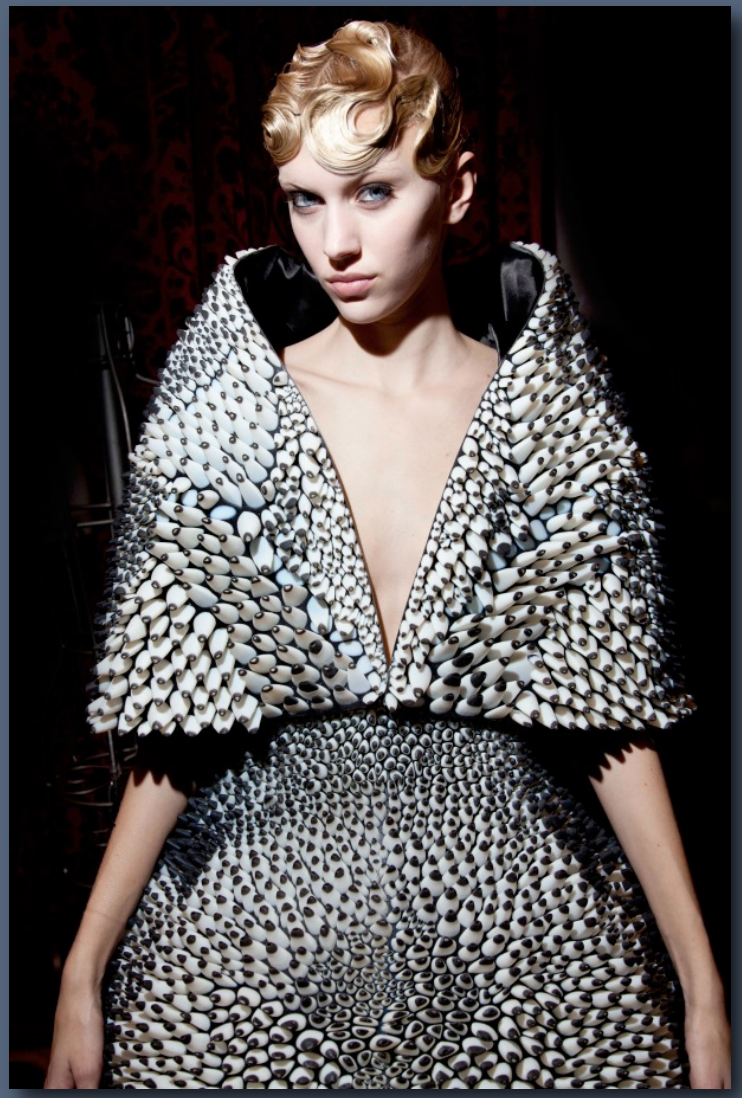
- FabLab staff will make an attempt to repair basic errors your files
- Files wit comple errors will b returned to the student for repair
- W highly recommend students pre an repai thei files in Netfabb prior to submitting a 3D print



# FIT FABLAB – Failed 3D Prints



# FIT FABLAB – 3D Printing in Various Industries



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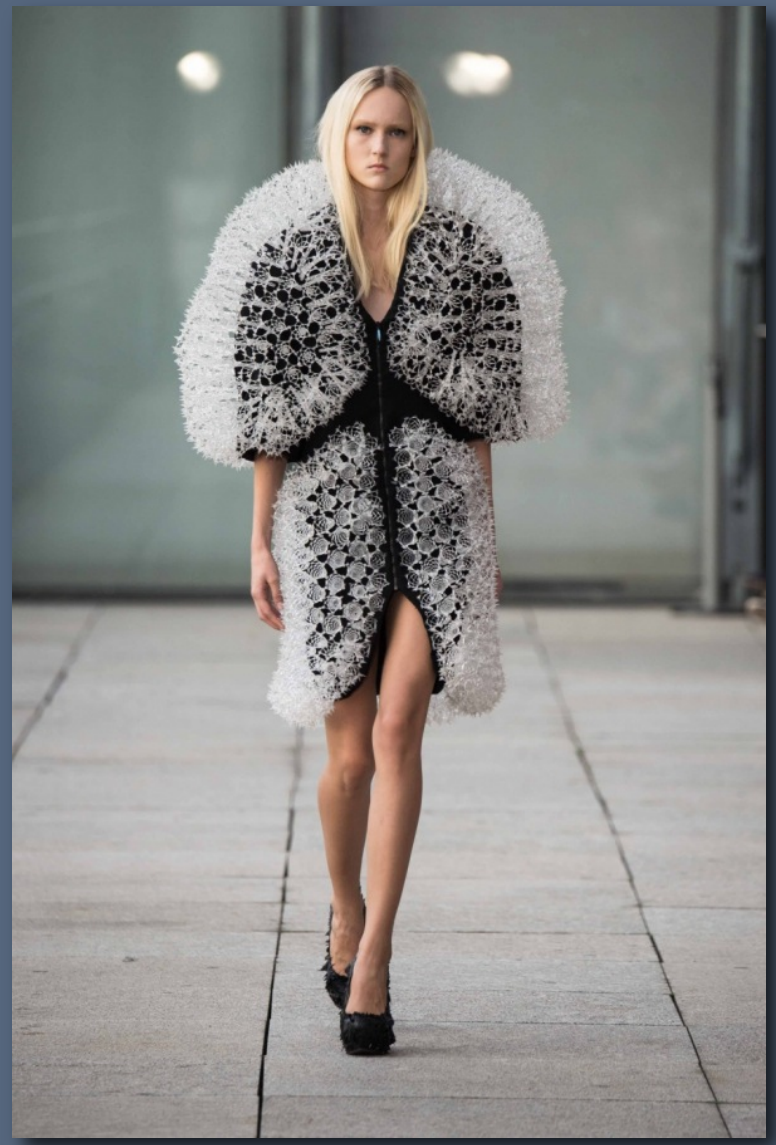

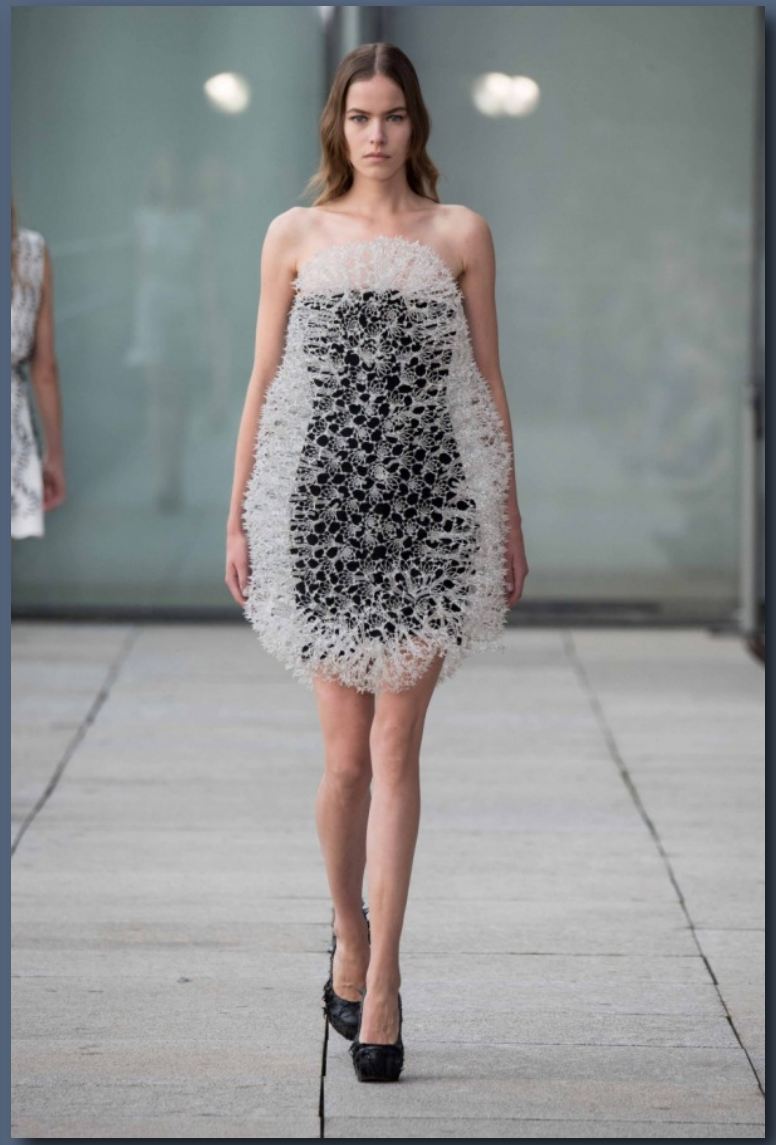

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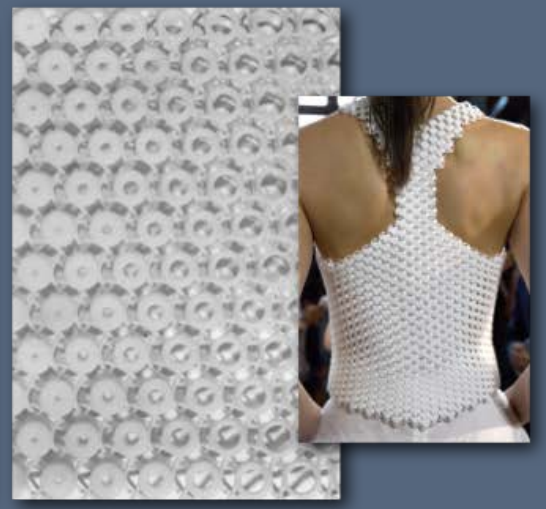

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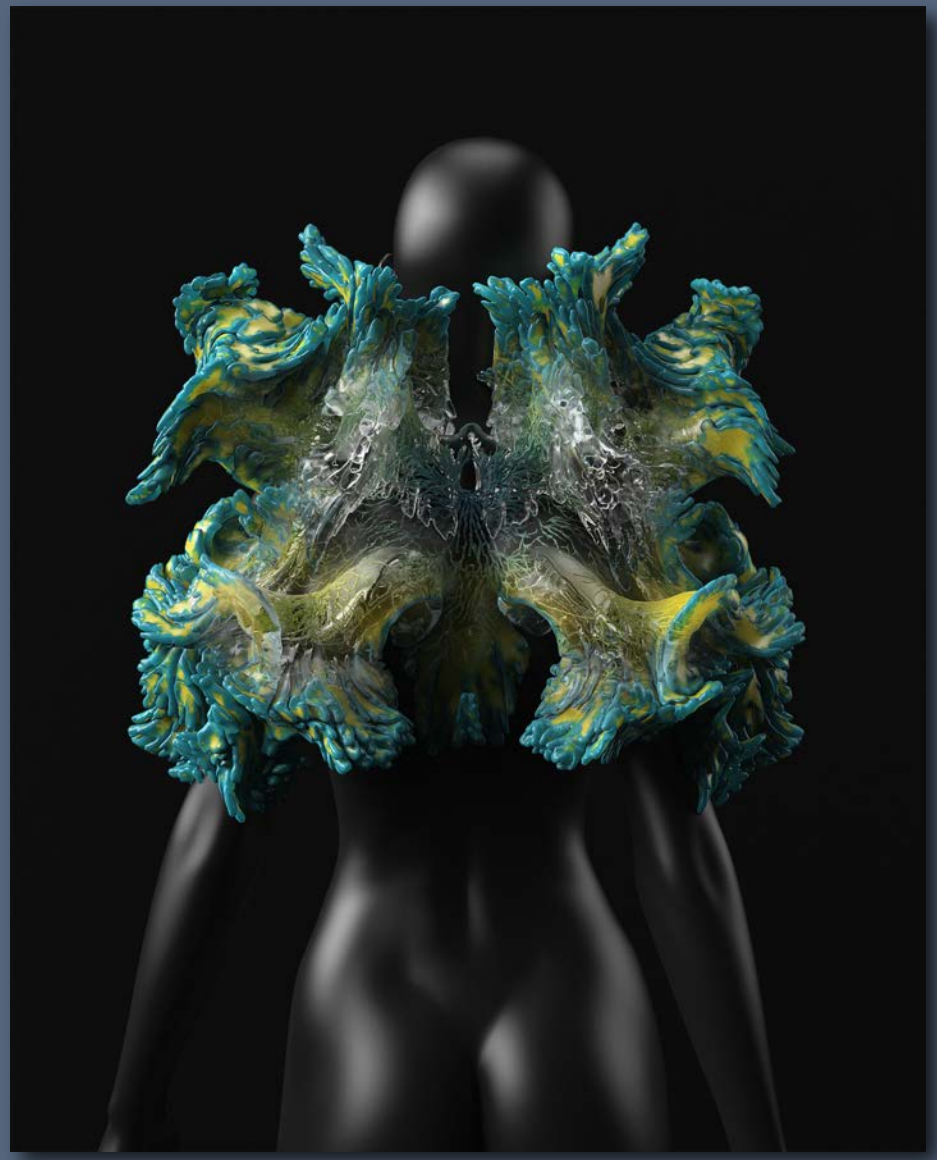

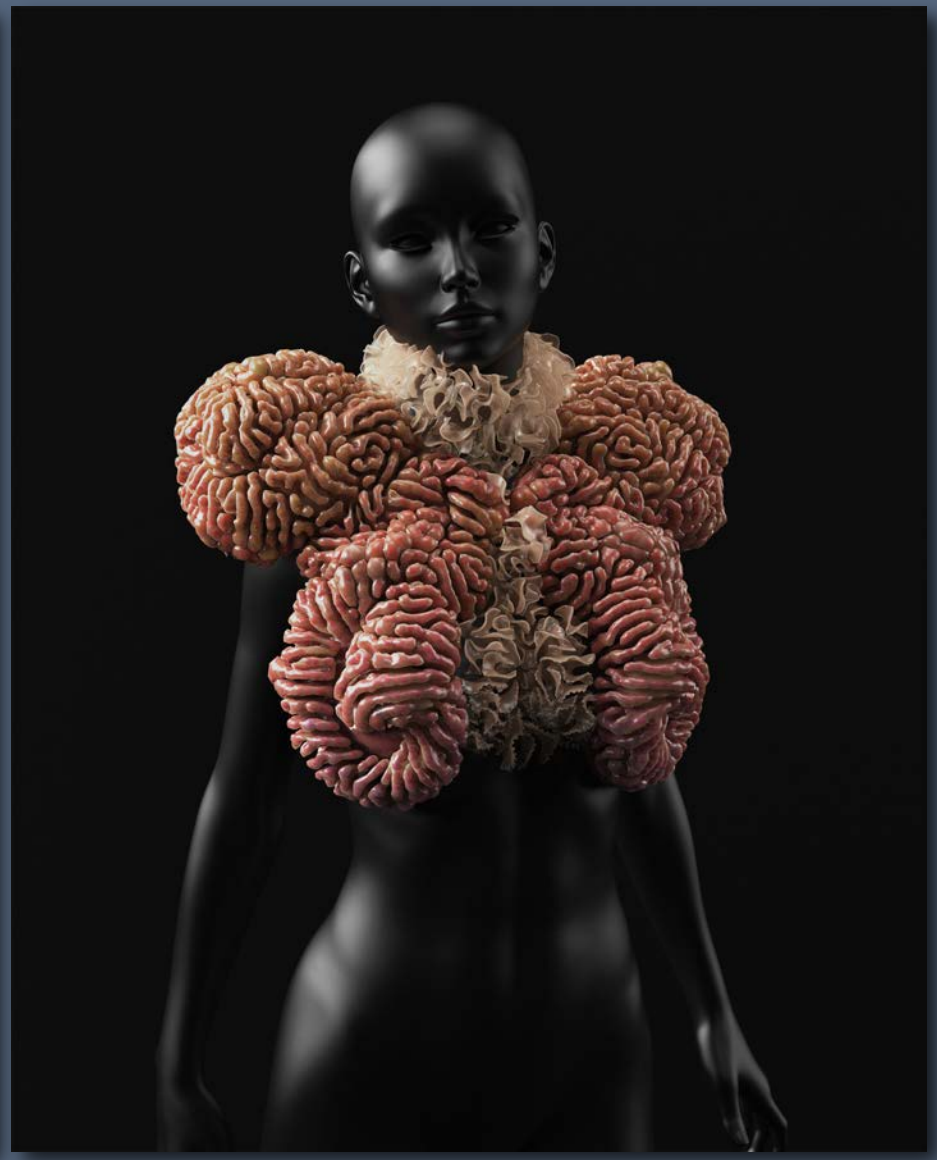

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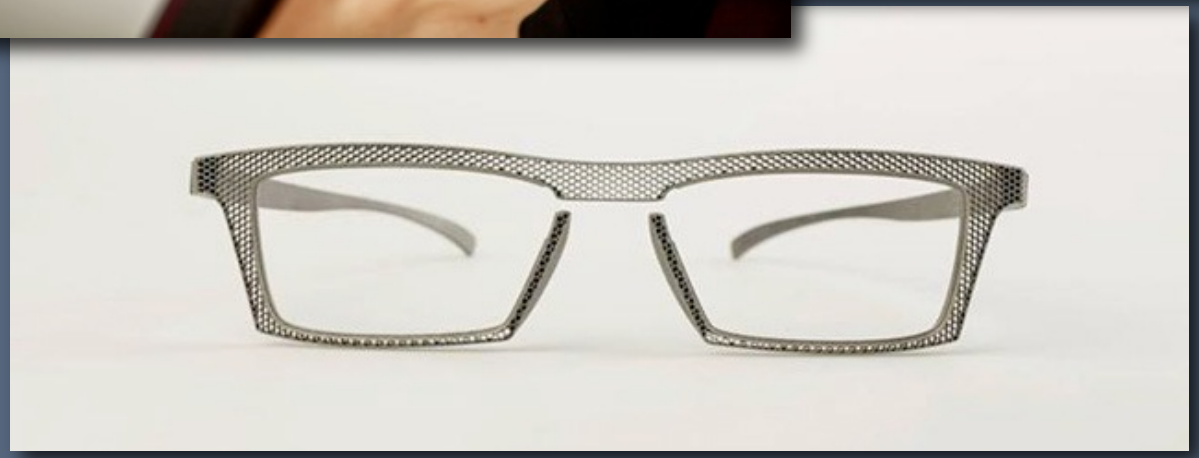

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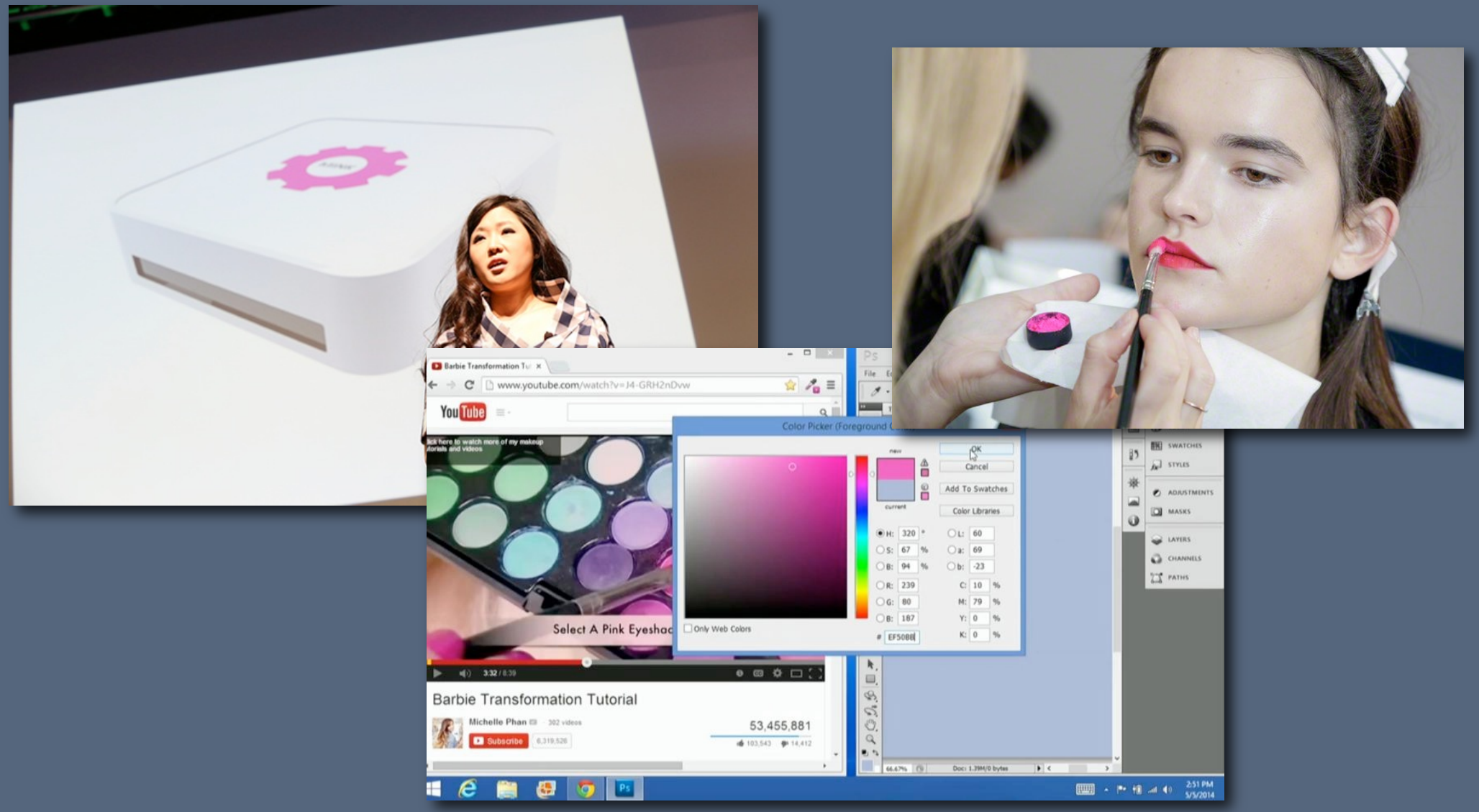

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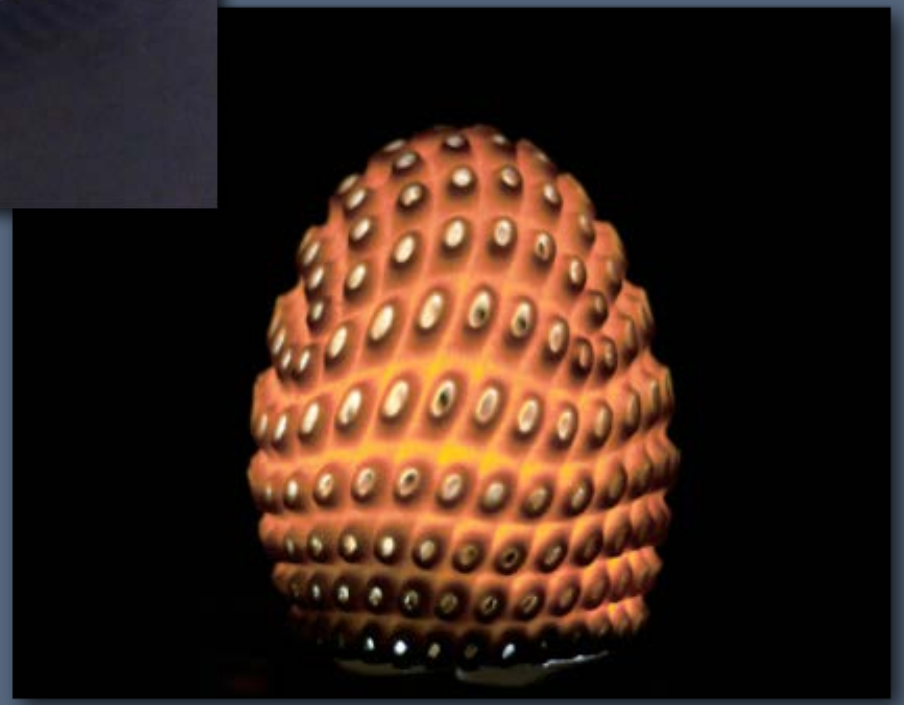

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# Q&A

FabLab/PrintFX
Pomerantz Center, room D529A

Regular Hours:
Mon-Thurs: 9am-7pm, Fri: 9am-6:30pm

Phone: (212) 217-5470
Web: www.fitnyc.edu/printfx