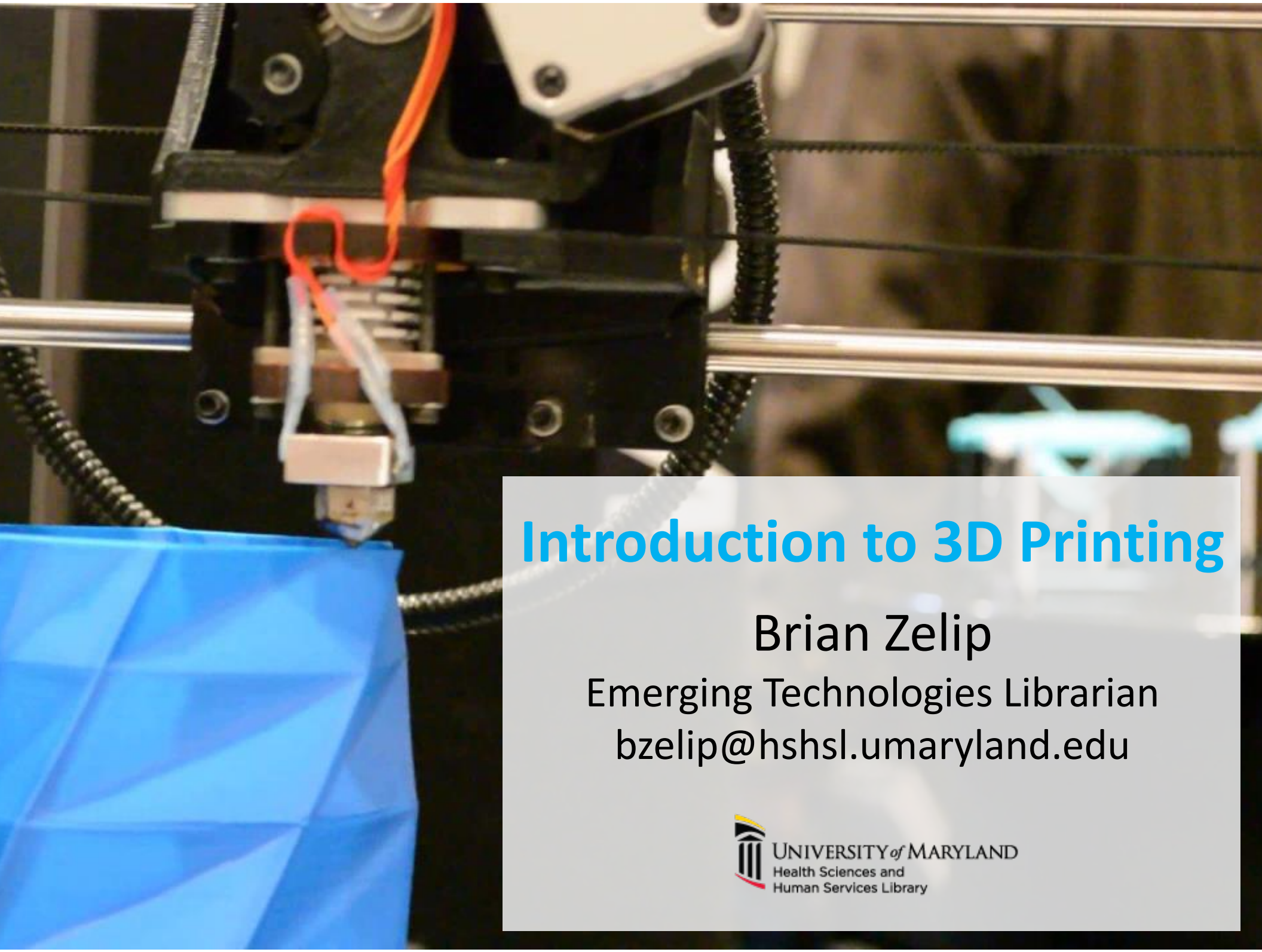


Introduction to 3D Printing

Brian Zelip

Emerging Technologies Librarian

bzelip@hshsl.umaryland.edu

University of Maryland
Health Sciences and
Human Services Library

What’s your interest in 3D printing?

What We Will Cover Today

1. How 3D printing works
2. 3D printing in the health sciences
3. Finding 3D models online
4. A look at our Innovation Space upstairs
   See a detailed how-to-guide at
   http://guides.hshsl.umaryland.edu/ispace

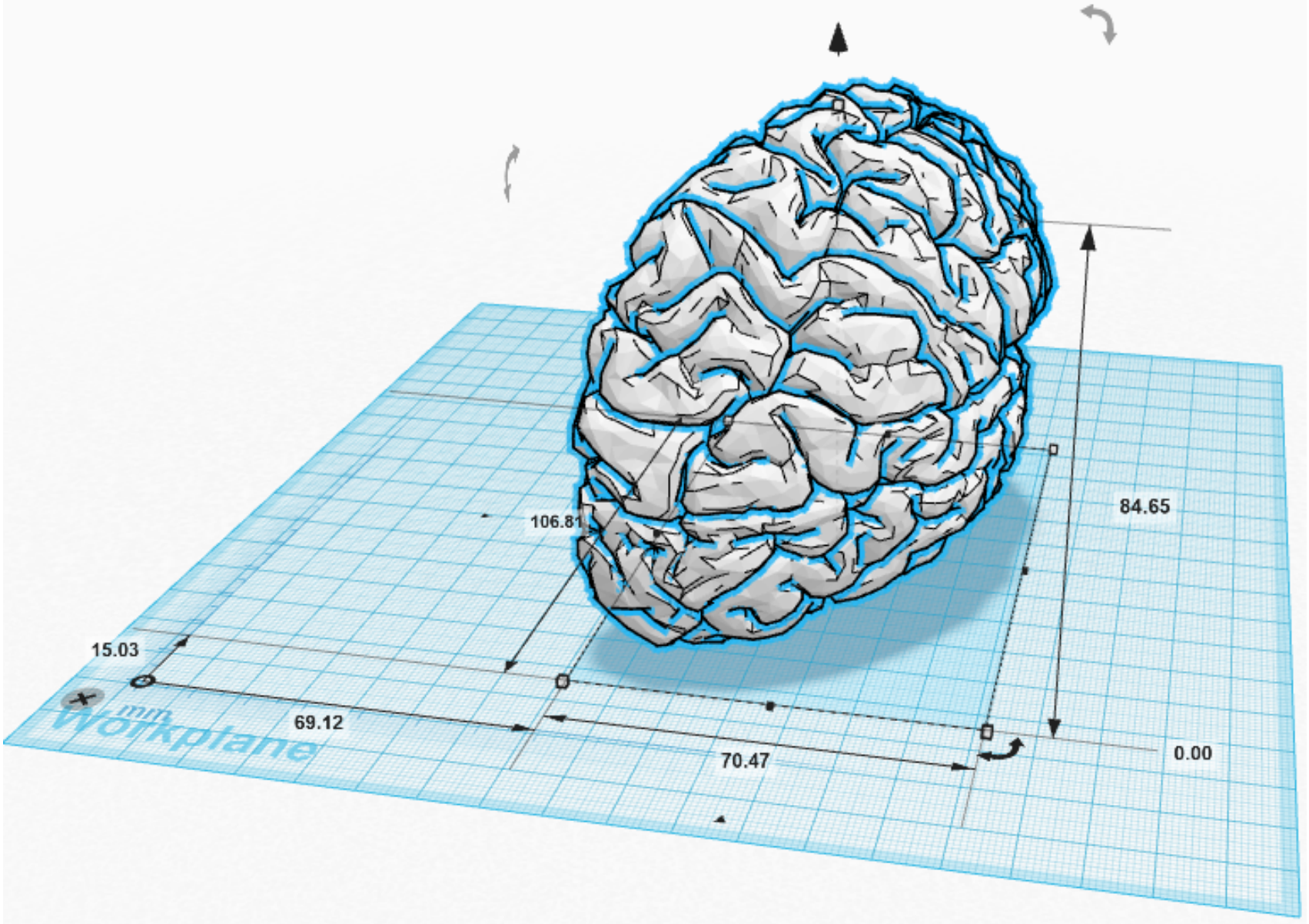
General Points About 3D Printing

- “Additive manufacturing” is different from conventional manufacturing.
- The process starts with a 3D model.
- The object is printed layer by layer.
- Printing materials include plastics, metals, bio matter, and more.
- There are multiple printing methods.
- Consumer printers differ from industrial printers, but the process is similar.

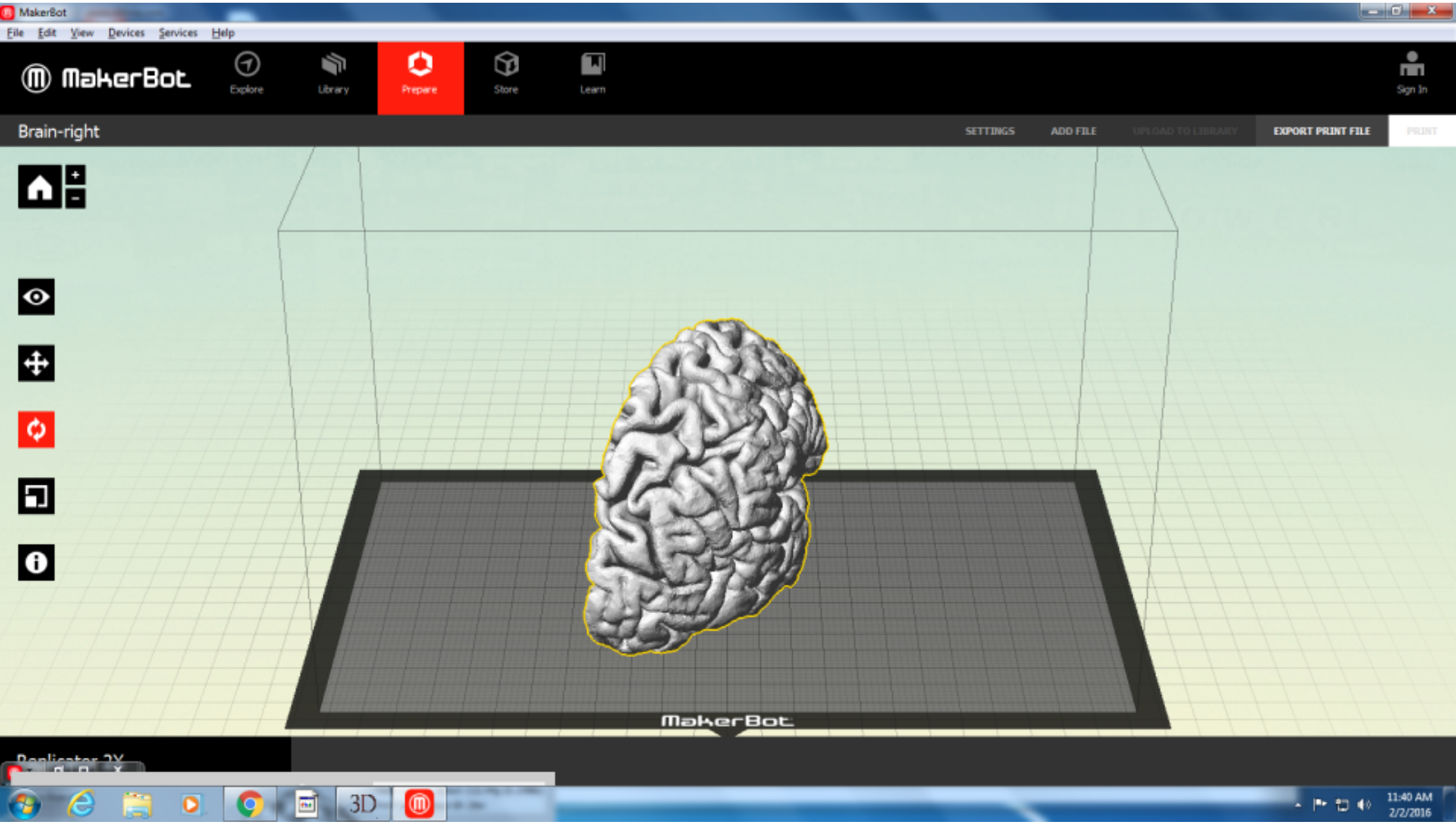
Preparing the Model for 3D Printing

- The original 3D model gets “sliced” into many tiny layers (< 1mm) by “slicing” software.
- The “slicing” software can also add support structures to the model for printing difficult angles (> 45^{o}).
- Printing with supports increases material use and printing time.
- Supports need to be carefully removed when printing is complete.

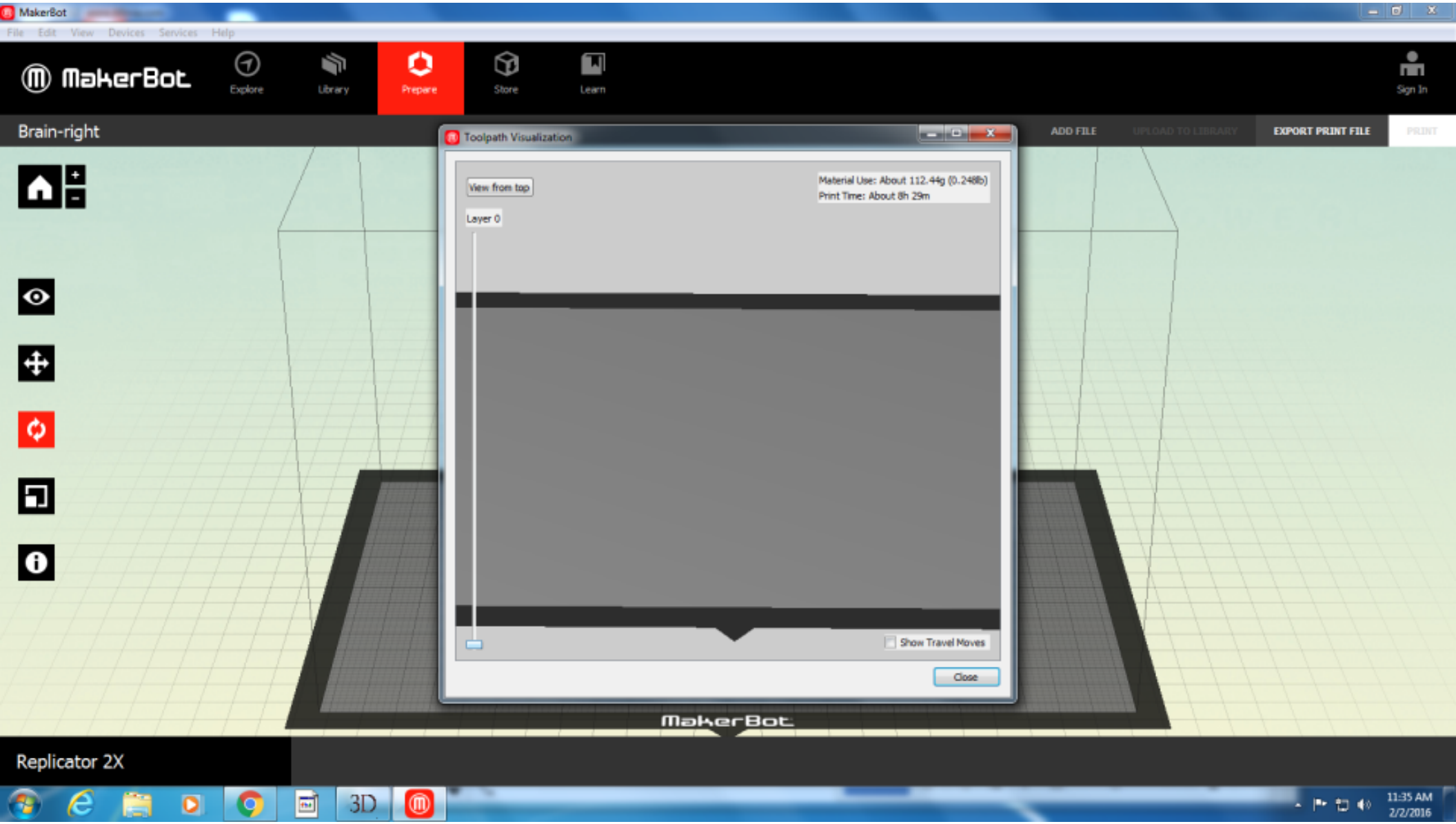
A Model in a Design Program



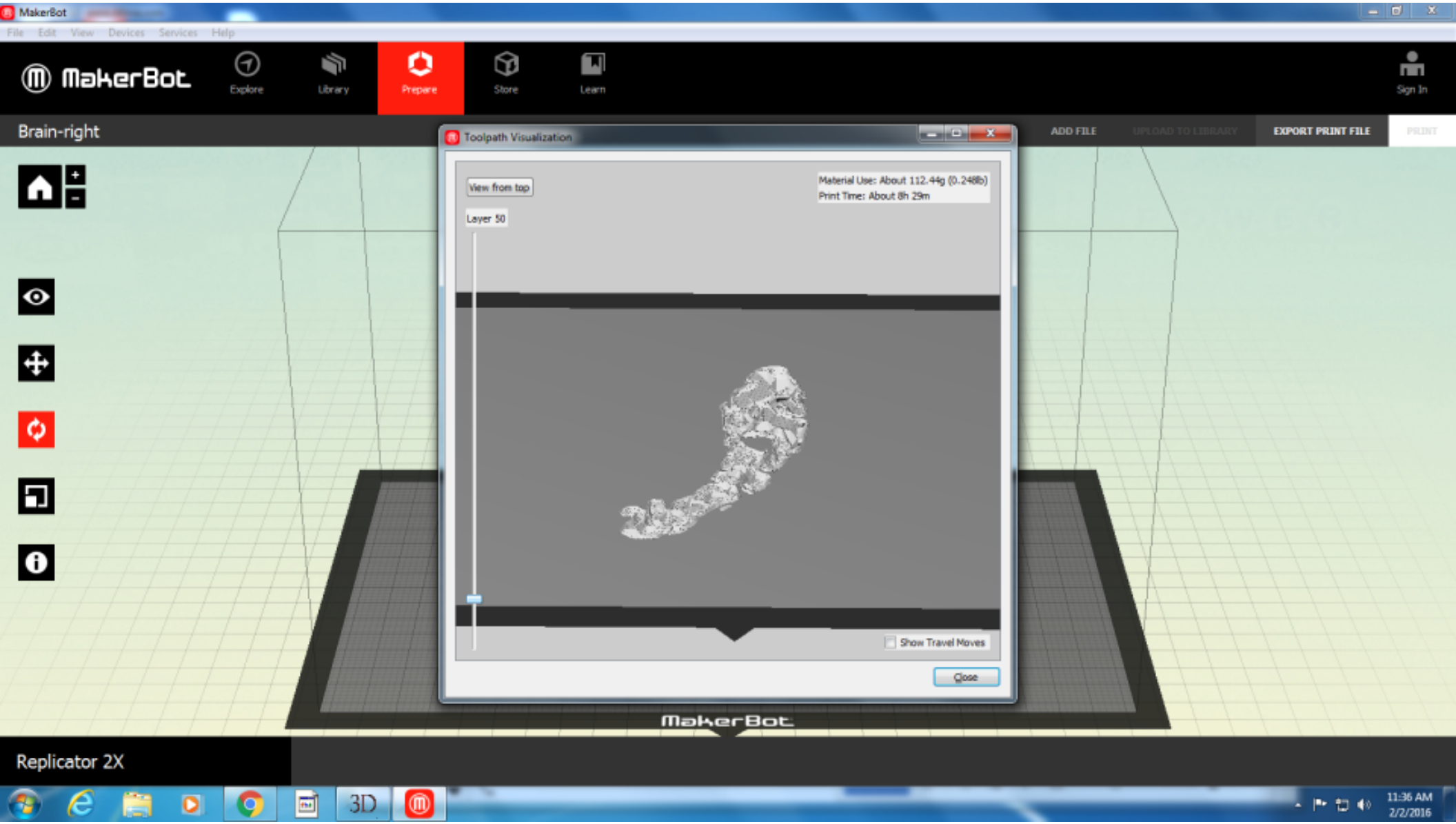
A Model in a Slicing Program



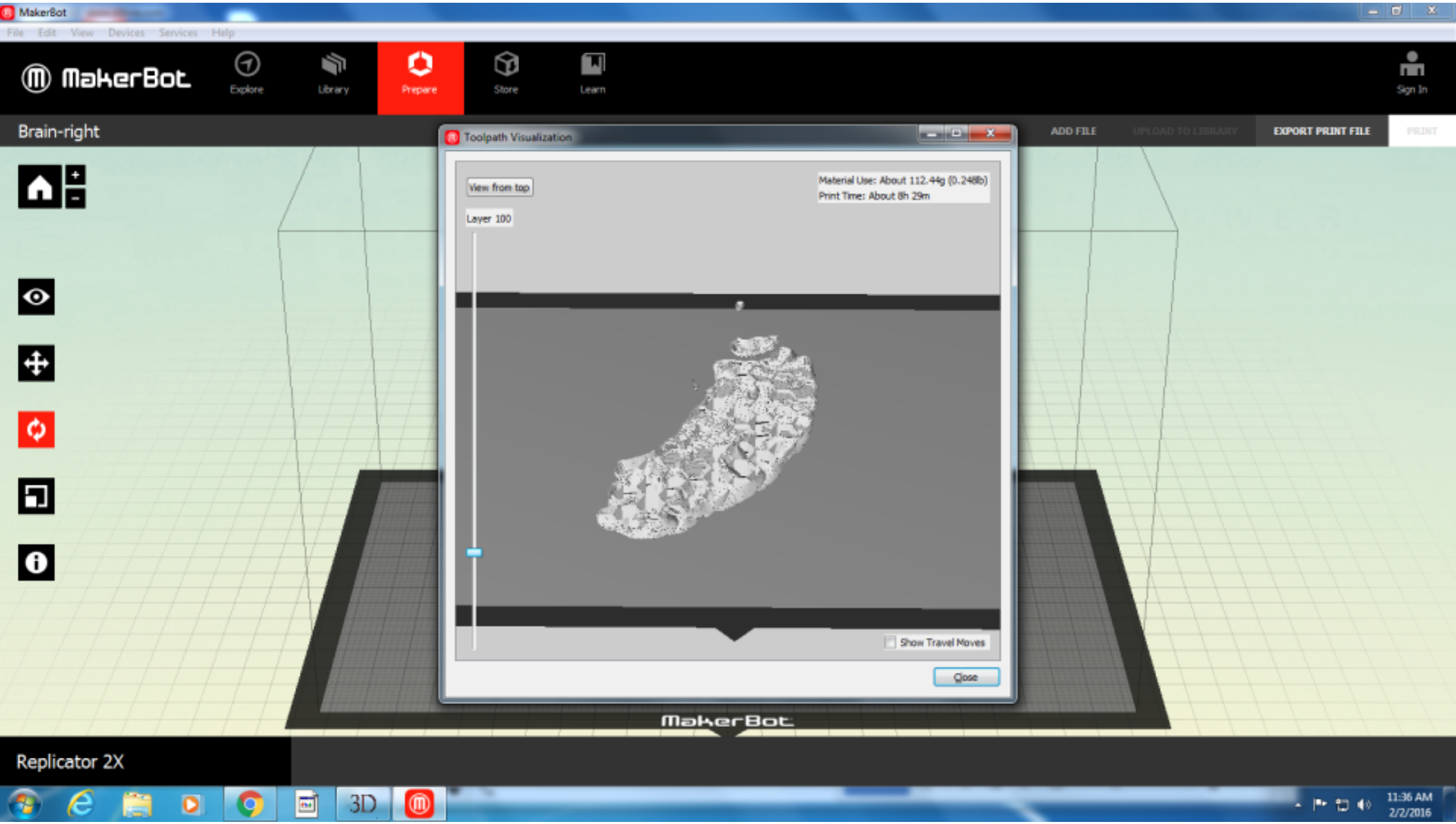
A Preview of Layer 0



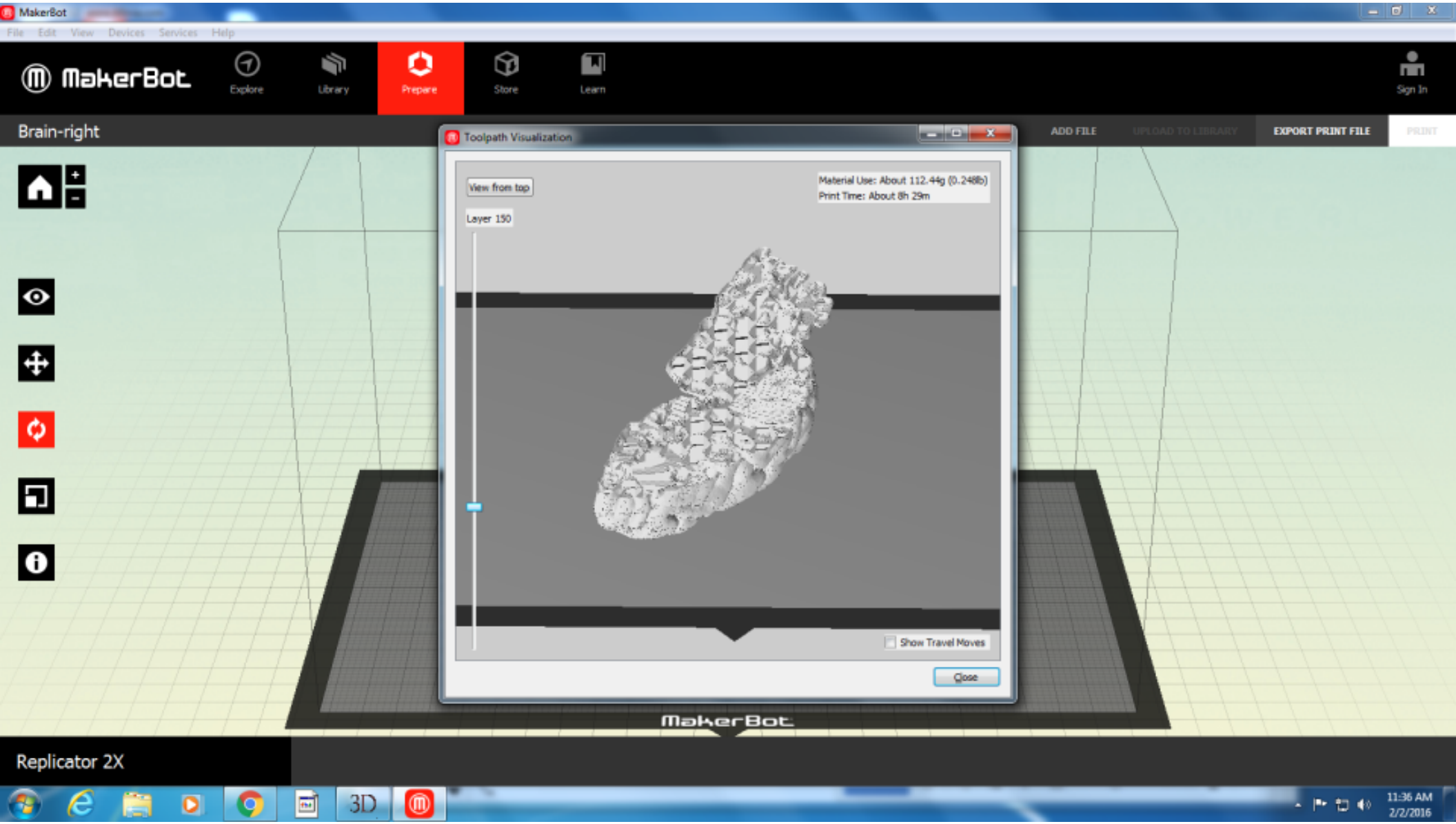
A Preview of Layer 50



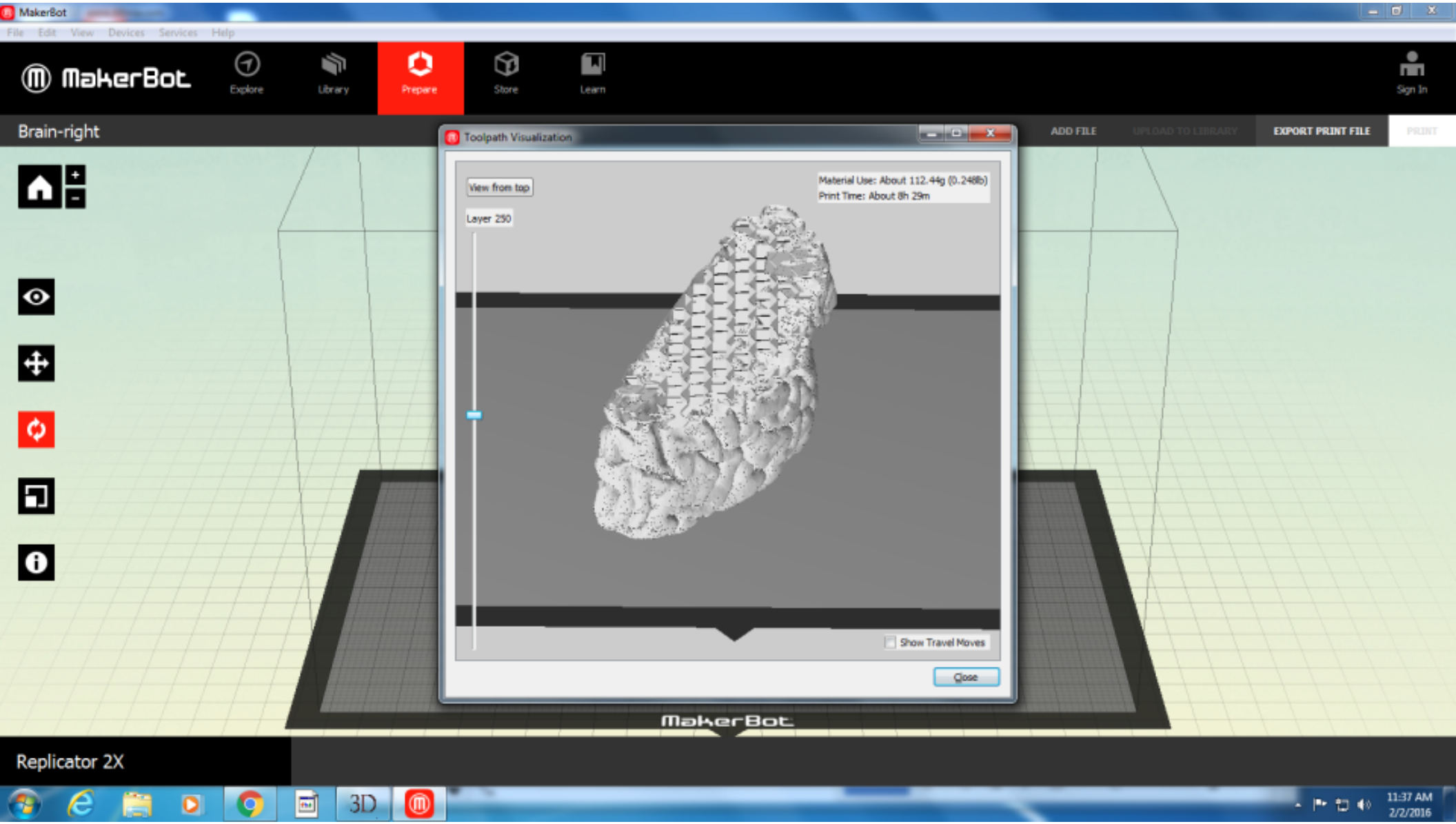
A Preview of Layer 100



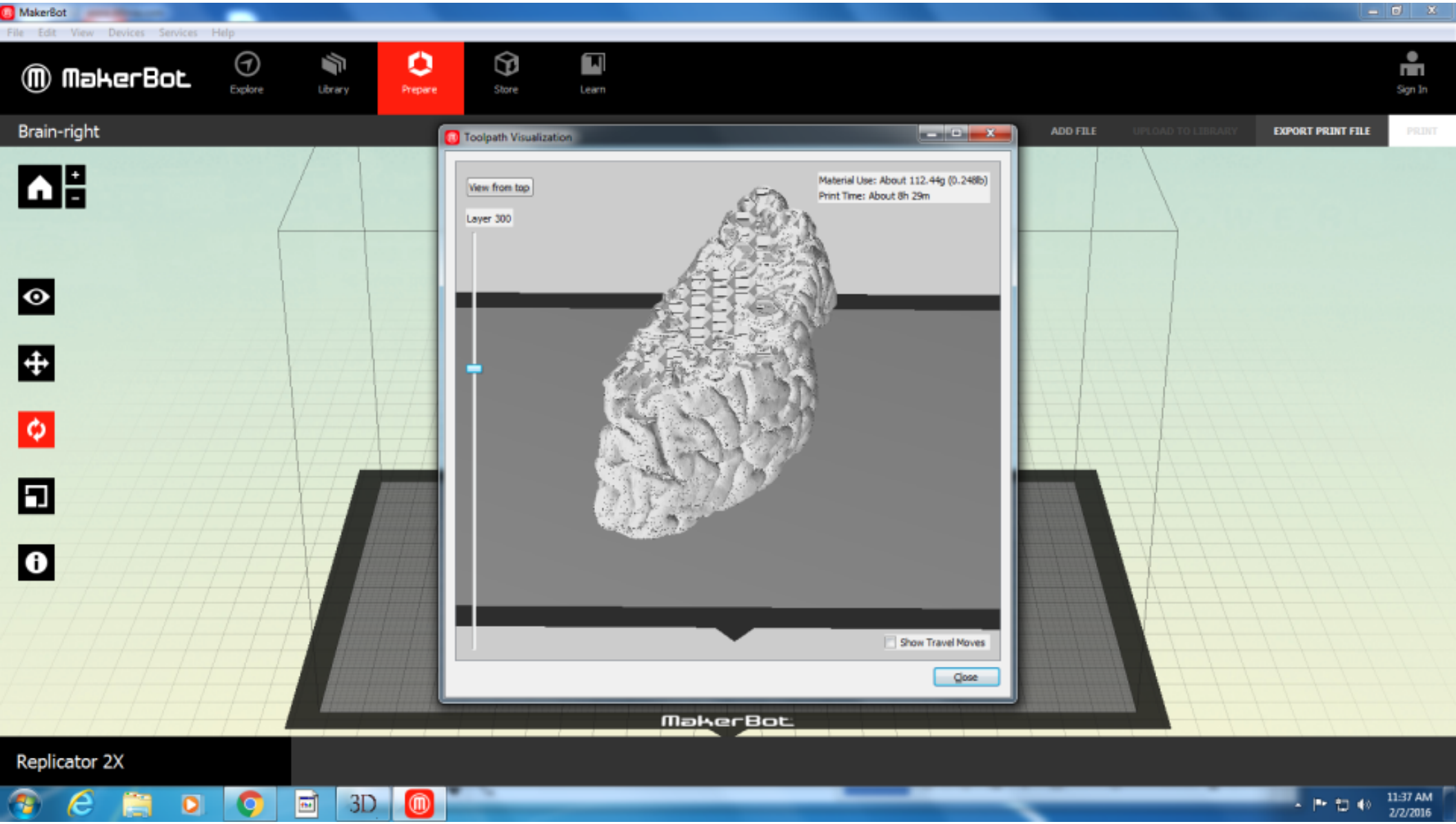
A Preview of Layer 150



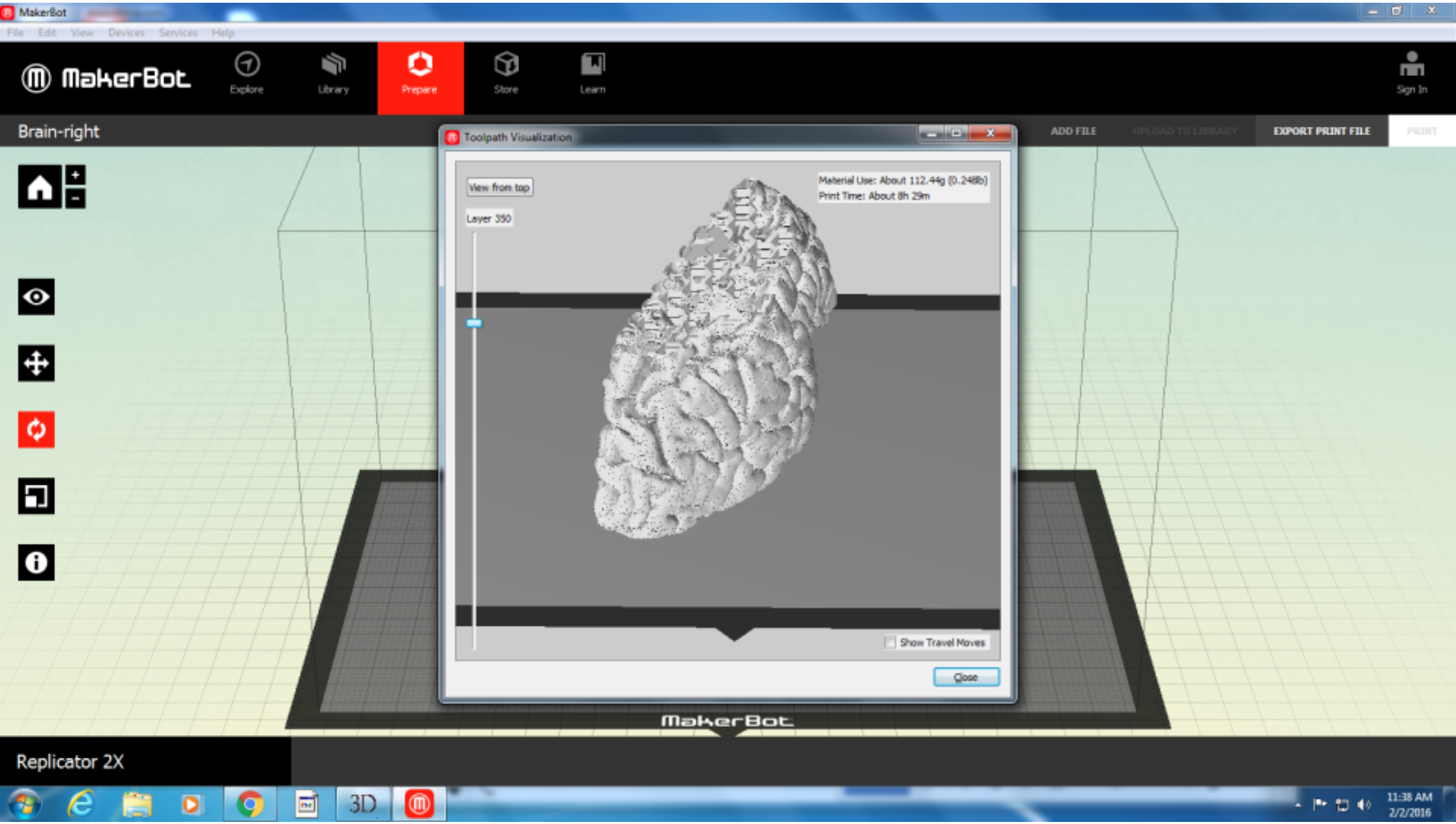
A Preview of Layer 250



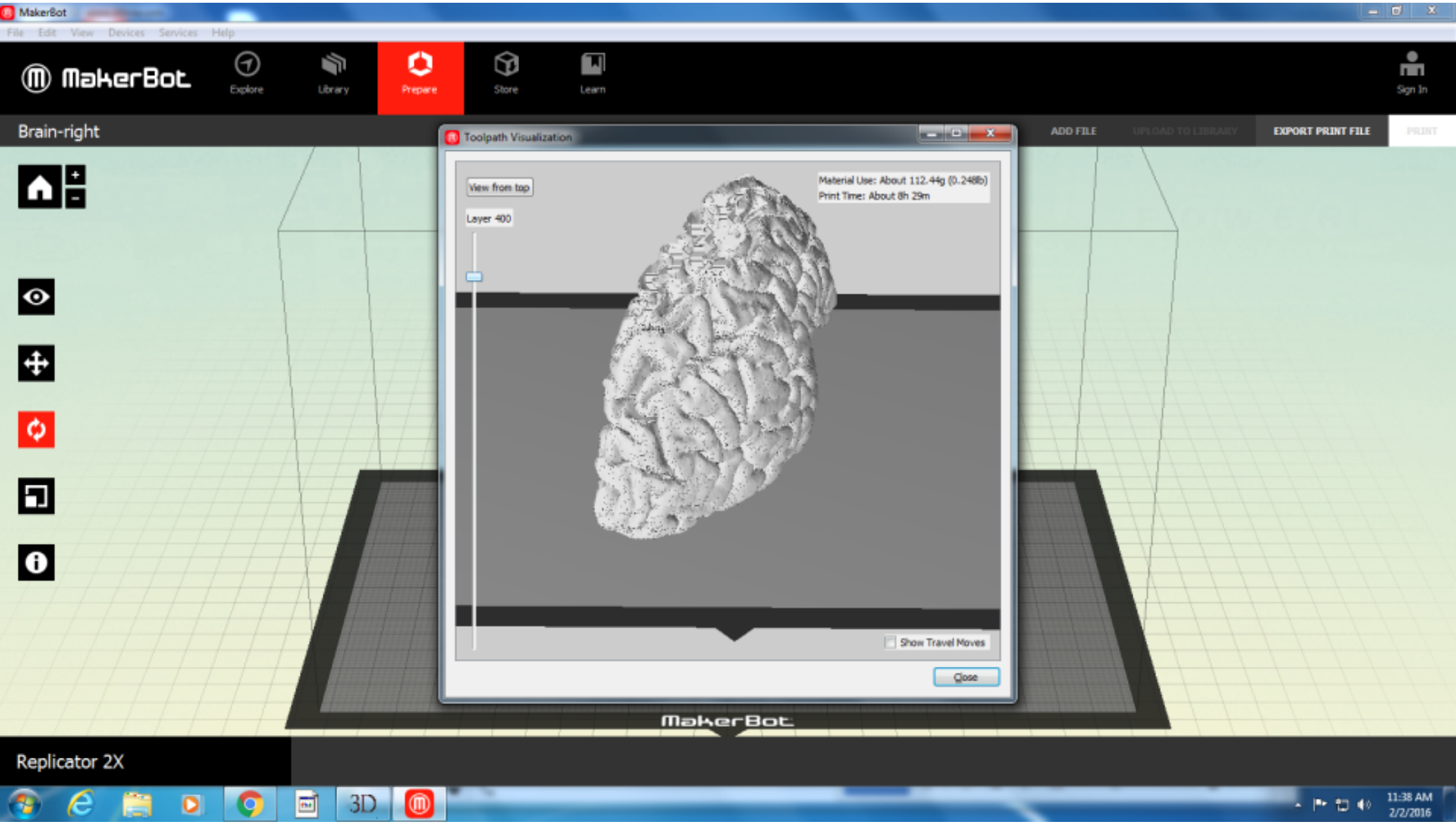
A Preview of Layer 300



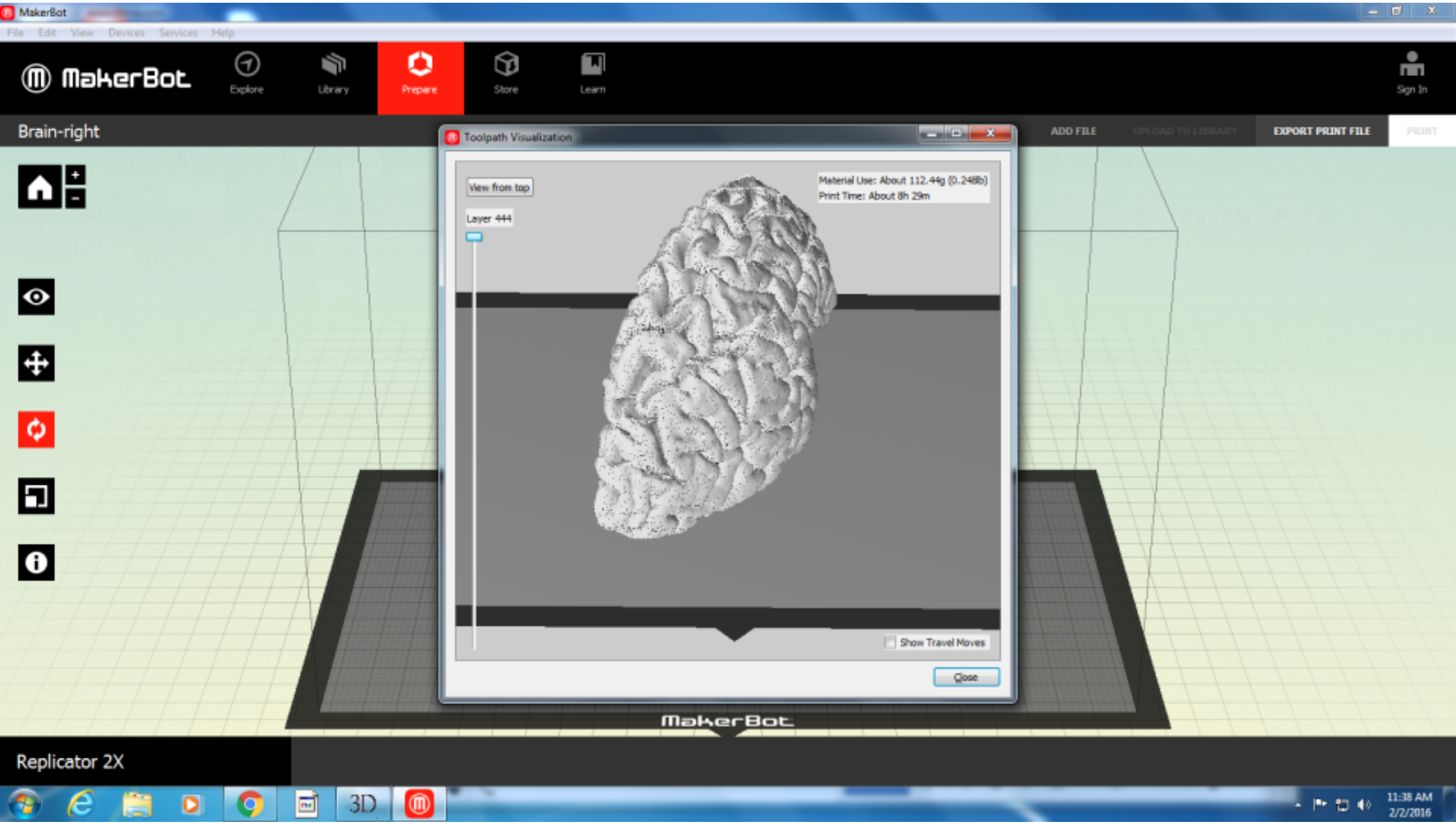
A Preview of Layer 350



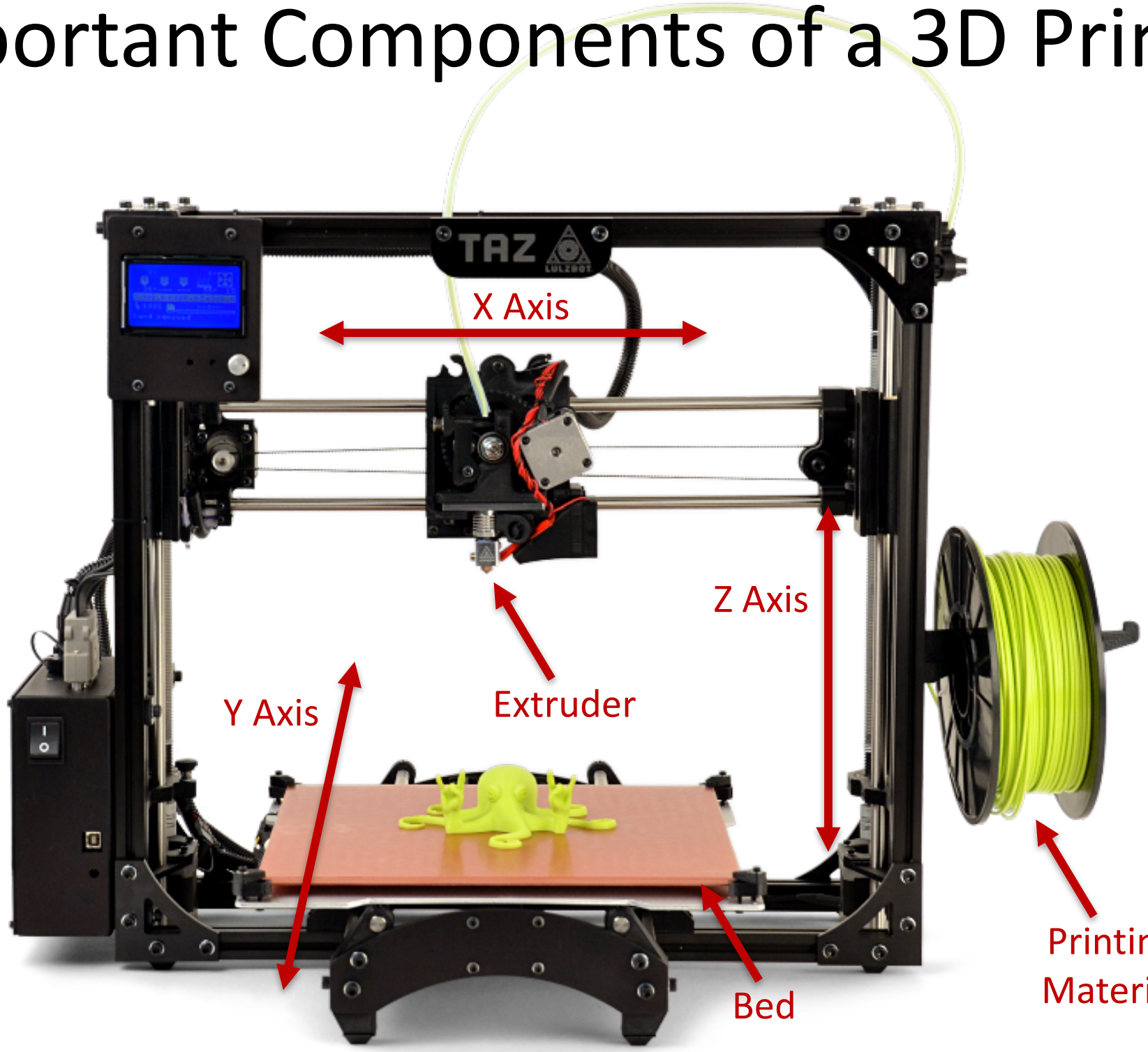
A Preview of Layer 400



A Preview of the Final Layer (444)

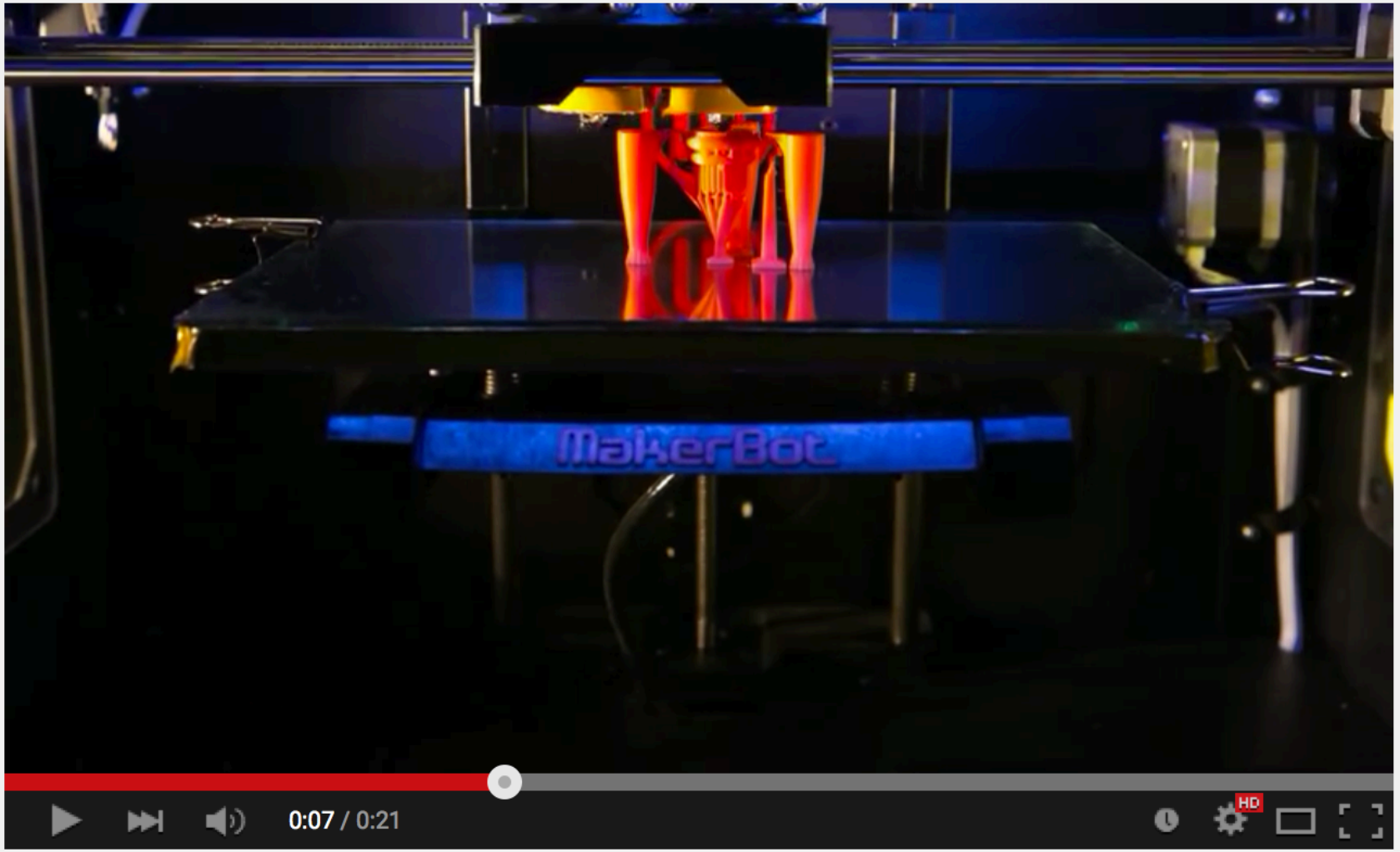


Important Components of a 3D Printer



Consumer 3D Printing in Action

https://www.youtube.com/watch?v=-gaC5BpXljU



MakerBot 3D Printing Timelapse

Consumer 3D Printing in Action

Introduction to Stereolithography

Formlabs

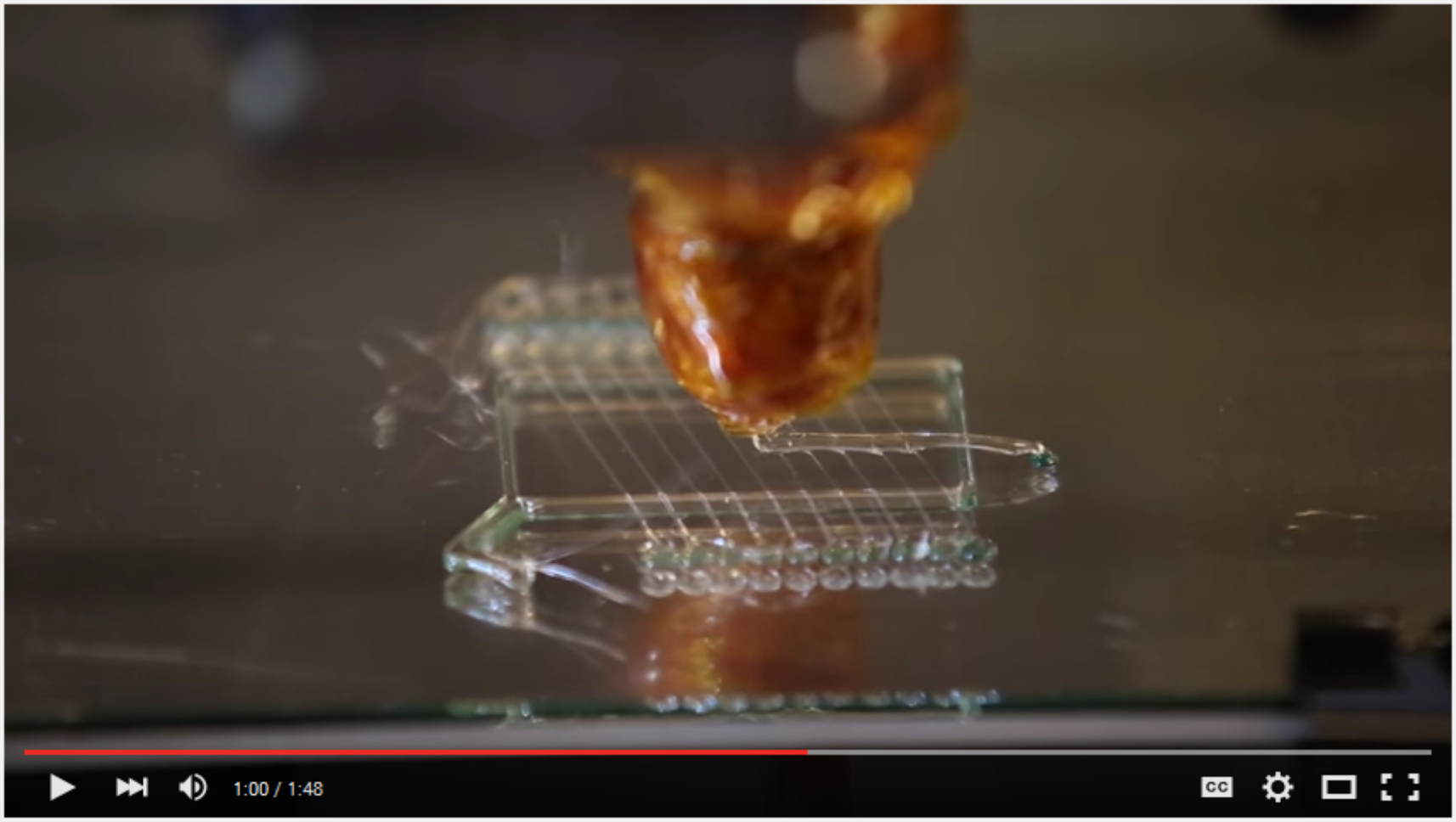
Subscribe

https://youtu.be/yW4EbCWaJHE?t=16s

17,249 views

Add to Share More 83 1

Scientific 3D Printing in Action



Rep Rap 3D Printing Blood Vessel Networks

University of Pennsylvania

Subscribe 13,123

https://youtu.be/9VHFlwJQIkE?t=41s

158,101

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Industrial 3D Printing in Action

voxeljet technology VX 4000 industrial 3D printer

AIDA Mataró

Subscribe 9

https://youtu.be/uMMwtQts7pc?t=22s

2,709

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Use cases for 3D Printing across the Health Sciences

By: Press Release Nation

Baltimore Startup's Kickstarter Raises $7000+ in less than 24 hours

Discovery Channel's Big Brain Theory winning engineer, Corey Fleischer, introduces new product, The ARC, a 3D printed device for posture and pain relief, on Kickstarter,

http://stocks.moneyshow.com/intershow.moneyshow/news/read/27146844/baltimore_startup%E2%80%99s_kickstarter_raises_$7000+_in_less_than_24_hours

June 16, 2015

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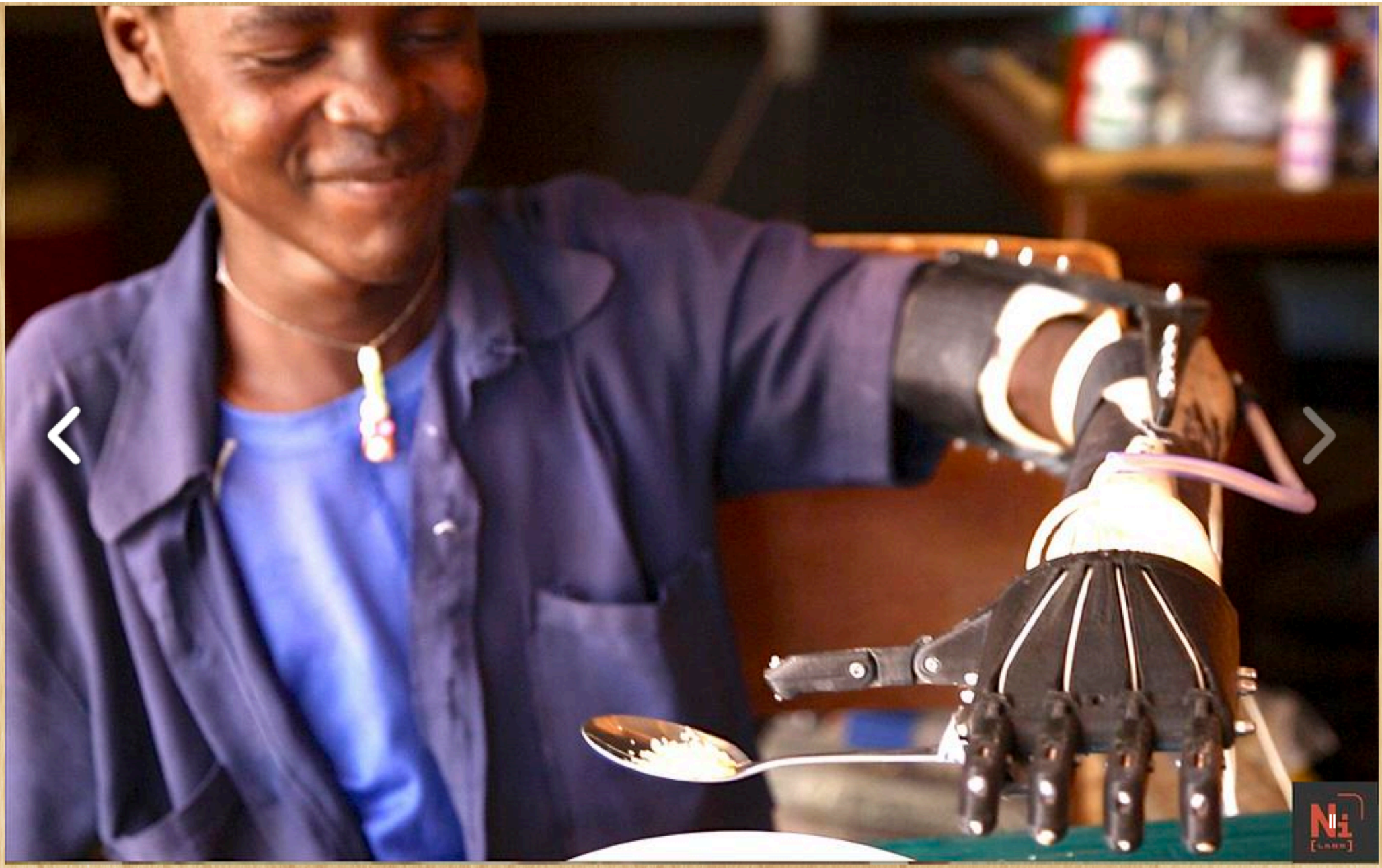
Dad Uses 3D Printer To Make His Son A Prosthetic Hand (VIDEO)

http://www.huffingtonpost.com/2013/11/04/dad-prints-prosthetic-hand-leon-mccarthy_n_4214217.html

Posted: 11/04/2013 7:05 pm EST | Updated: 11/04/2013 7:05 pm EST

Leon McCarthy was born without fingers on his left hand, but with some help from his dad, he can now draw, pick up food and hold a water bottle using a homemade prosthetic.



DEC 2013

NOT IMPOSSIBLE'S "PROJECT DANIEL" USES 3D PRINTERS TO MAKE PROSTHETIC ARMS FOR CHILDREN OF WAR IN SOUTH SUDAN

Just before Thanksgiving 2013, Mick Ebeling returned home from Sudan's Nuba Mountains where he set up what is probably the **world's first 3D-printing prosthetic lab** and training facility. More to the point of the journey is that Mick managed to give

http://www.notimpossiblenow.com/labs/project-daniel

JOIN US!

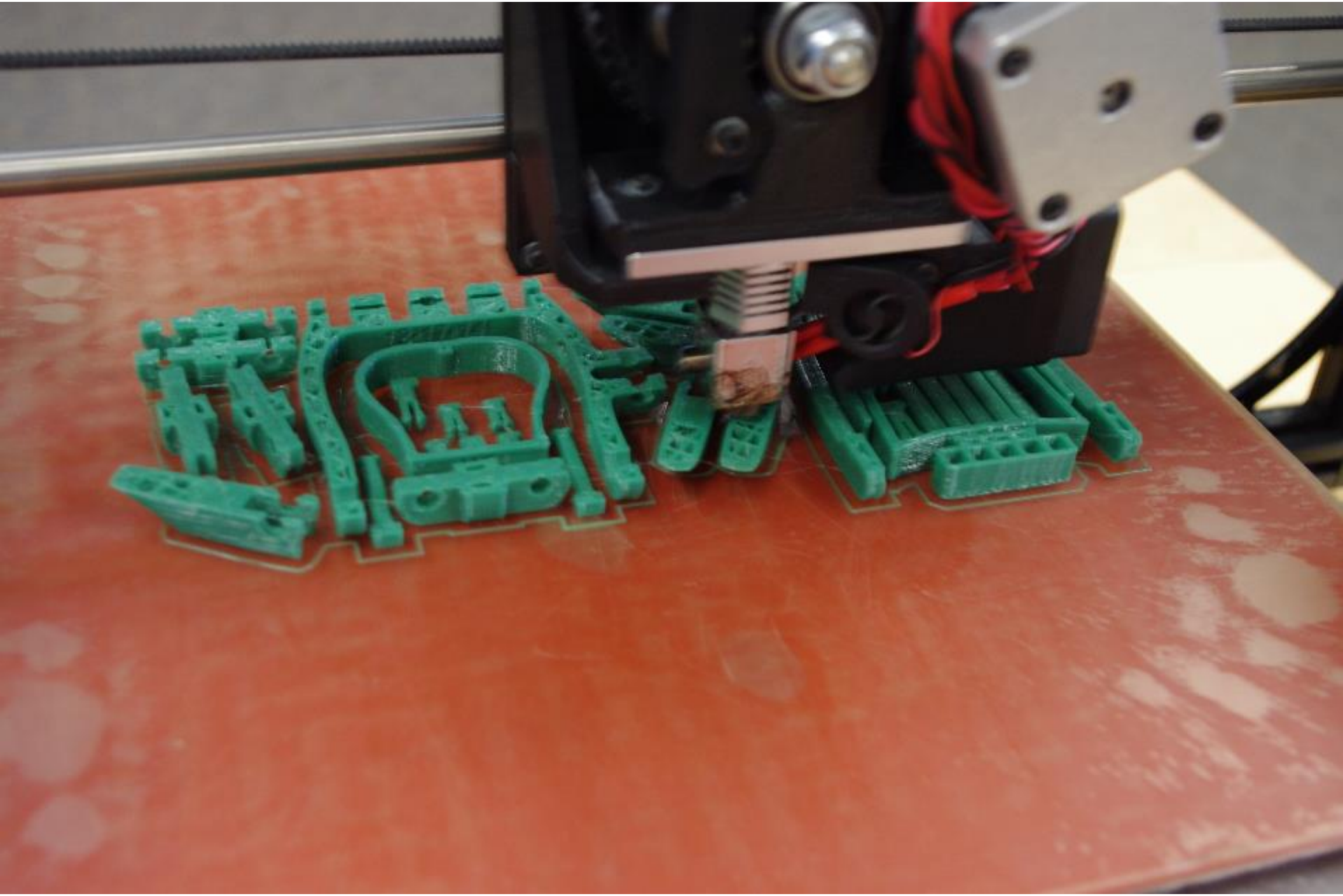
Tweet

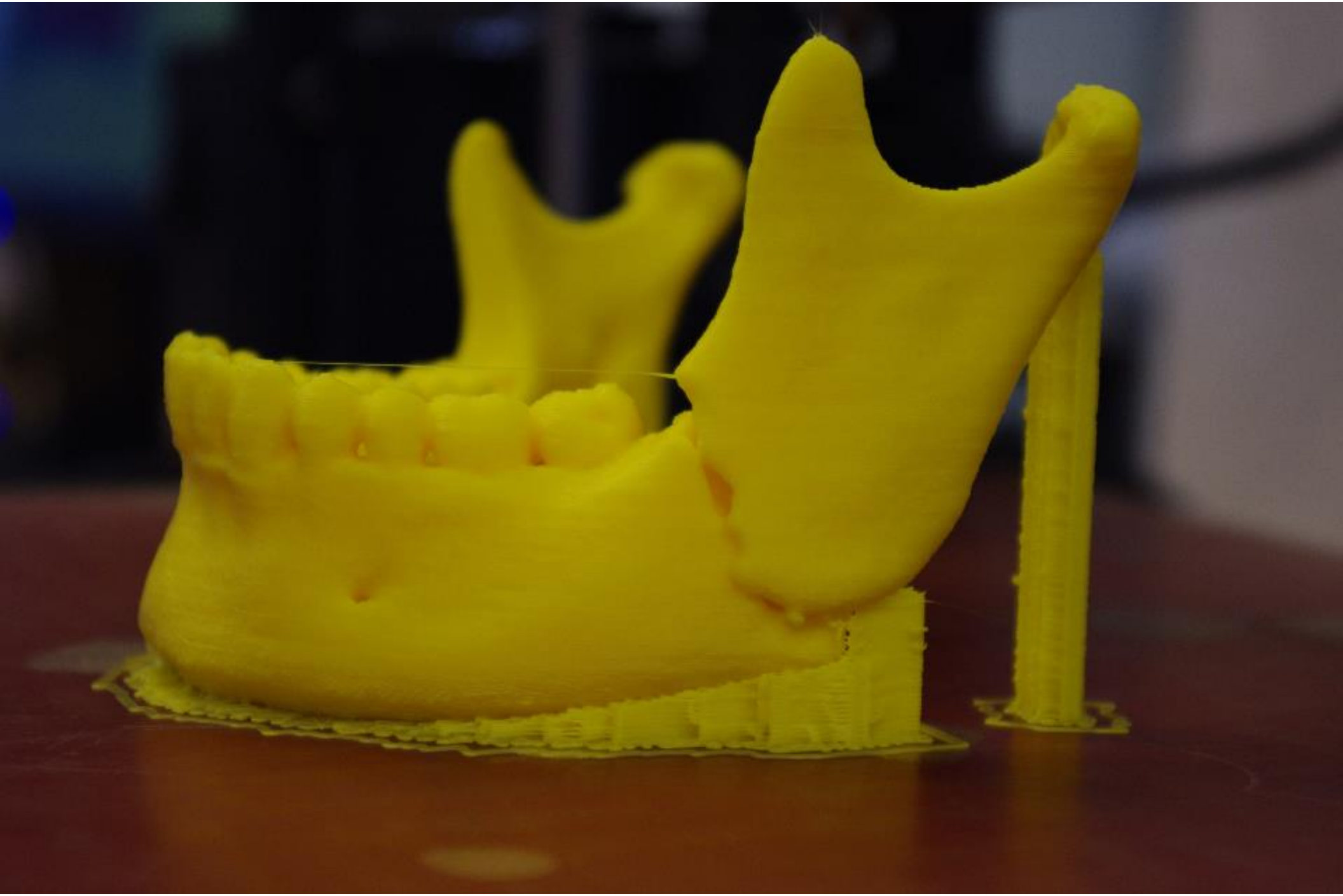
Recommend 45

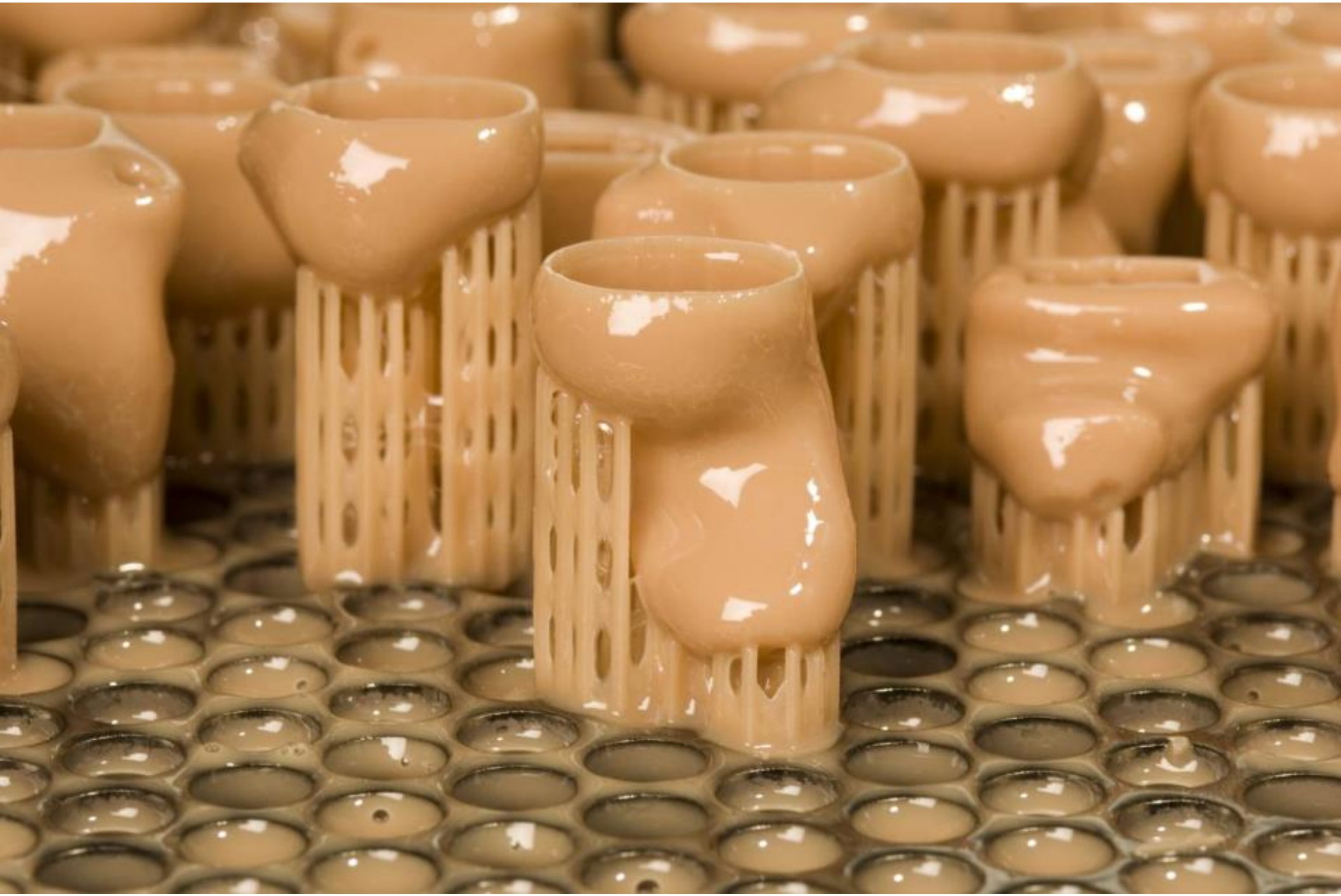
+1

Read the Full Press Release

Source: http://3dprintingindustry.com/2015/08/19/5-year-old-throws-orioles-opening-pitch-with-3d-printed-prosthetic-hand



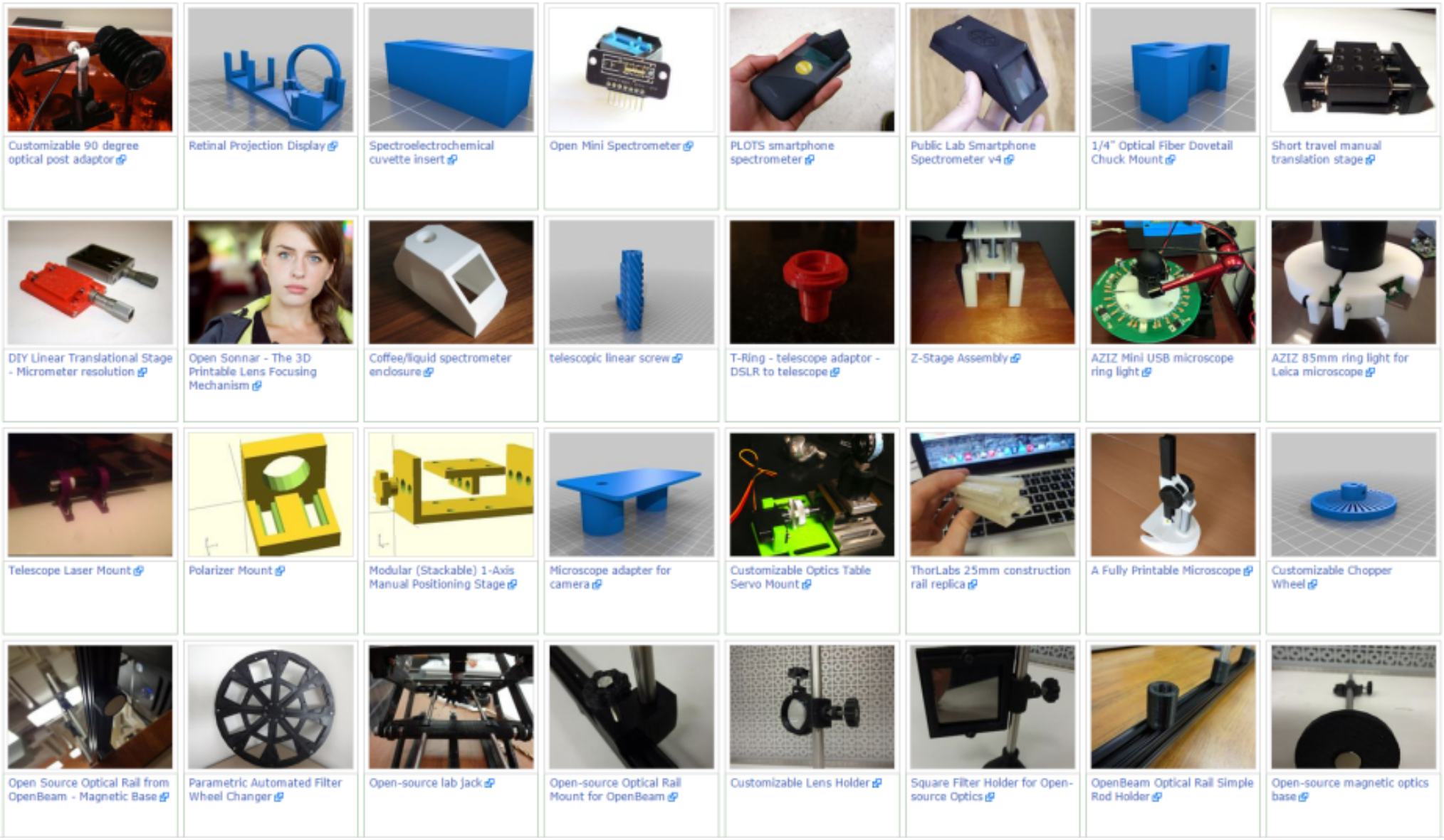




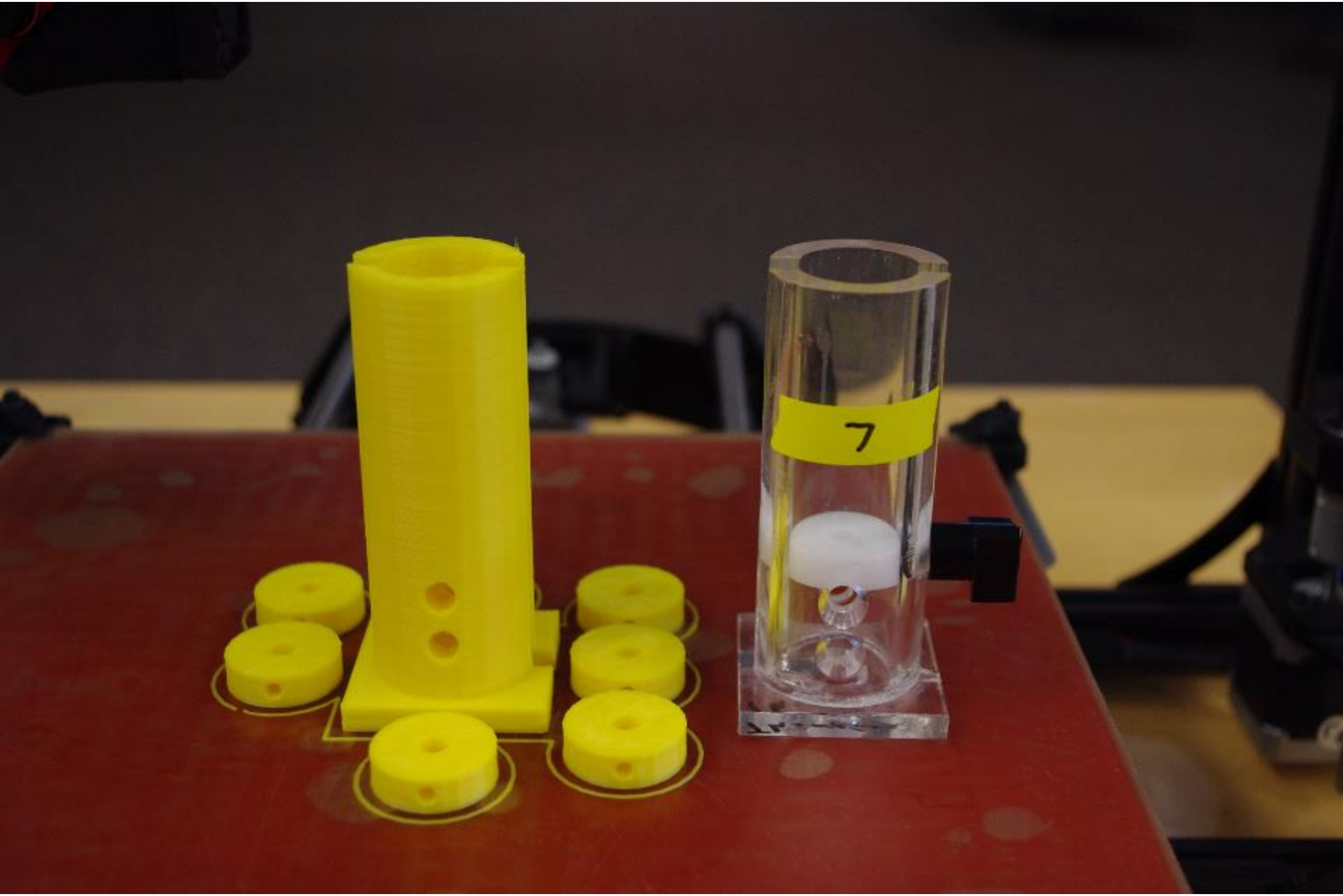
The FDA has approved the first drug made by a 3D printer

Source: http://qz.com/471030/the-fda-has-approved-the-first-drug-made-by-a-3d-printer/

Custom Lab Equipment



source: http://www.appropedia.org/Open_source_optics


7

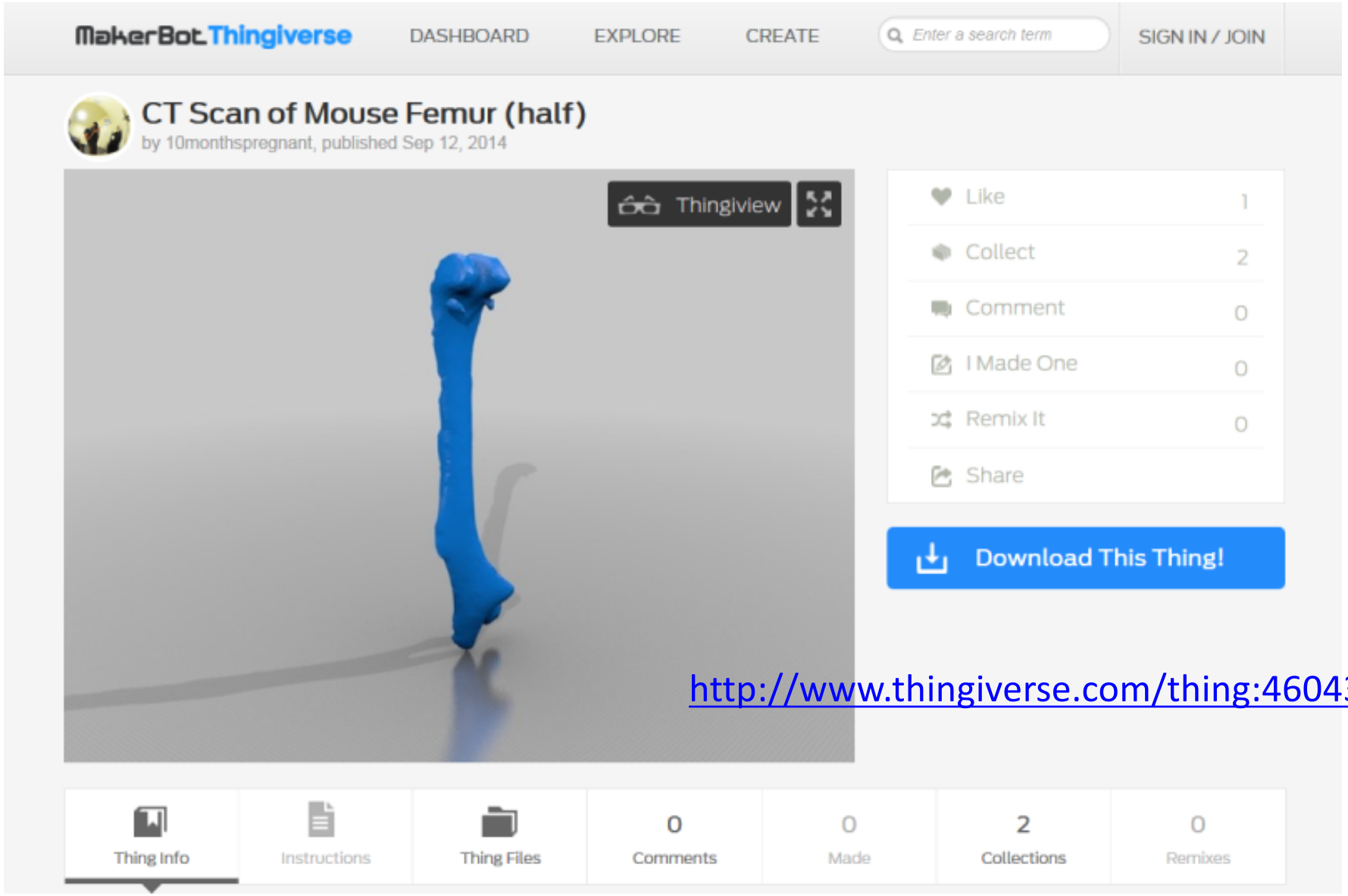
Common uses of 3D Printing across the Health Sciences

- Anatomical objects
- Prosthetic limbs
- Medical & clinical devices
- Custom lab equipment
- Bio matter - cells/tissue/organs, food, drugs

3D Printing Going Mainstream

- Broadly adopted in health sciences and beyond
- Commercially available desktop printers
- Global & local “maker space” movement
- UMB’s Innovation Space has 3D printers and scanners

3D Model Examples



http://www.thingiverse.com/thing:460437

Finding .STL 3D Model Files

- NIH 3D Print Exchange
- Thingiverse
- Instructables
- 3D Warehouse
- GrabCAD
- Ponoko
- Nervous System
- Not all 3D model files found here are 3D printable!

More information at http://guides.hshsl.umaryland.edu/c.php?g=163717&p=1075331

MakerBot Thingiverse DASHBOARD EXPLORE CREATE Enter a search term SIGN IN / JOIN

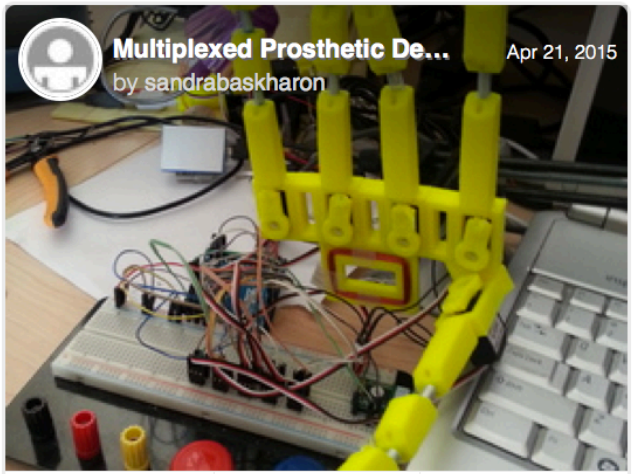
Advanced Search

http://www.thingiverse.com/

131 results for "prosthetic": THINGS Sort: RELEVANT

37 46 3

33 41 1



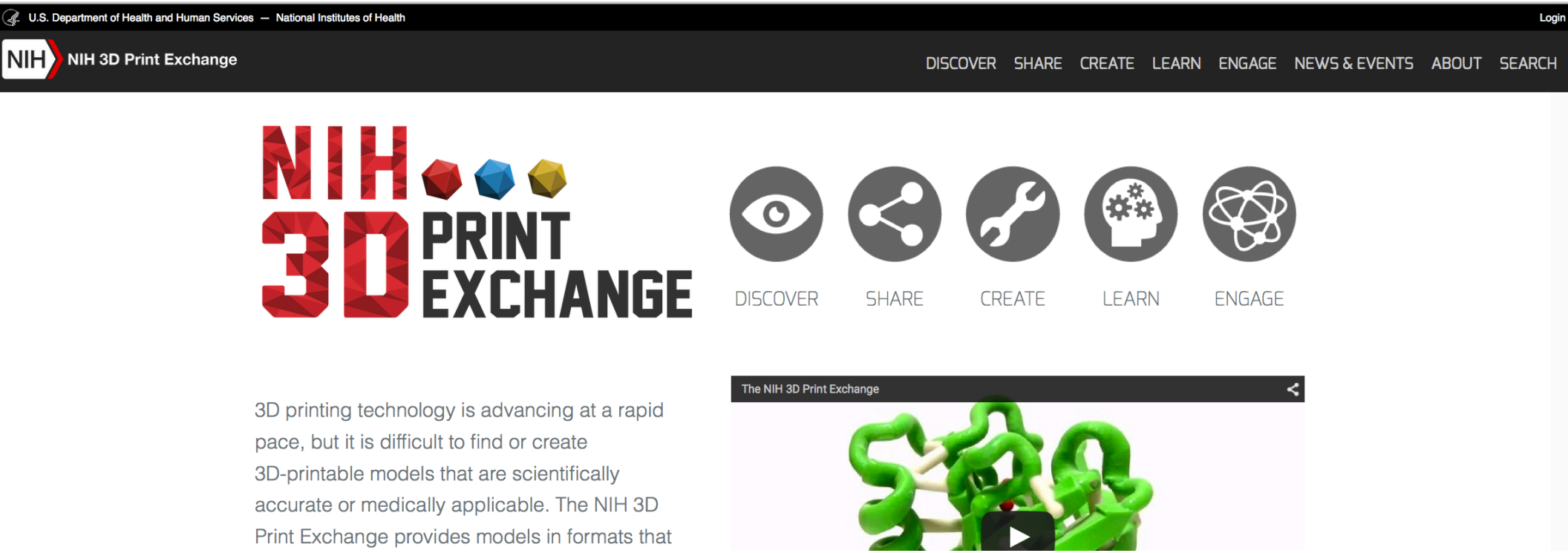
9 3 0

59 54 6

144 153 8

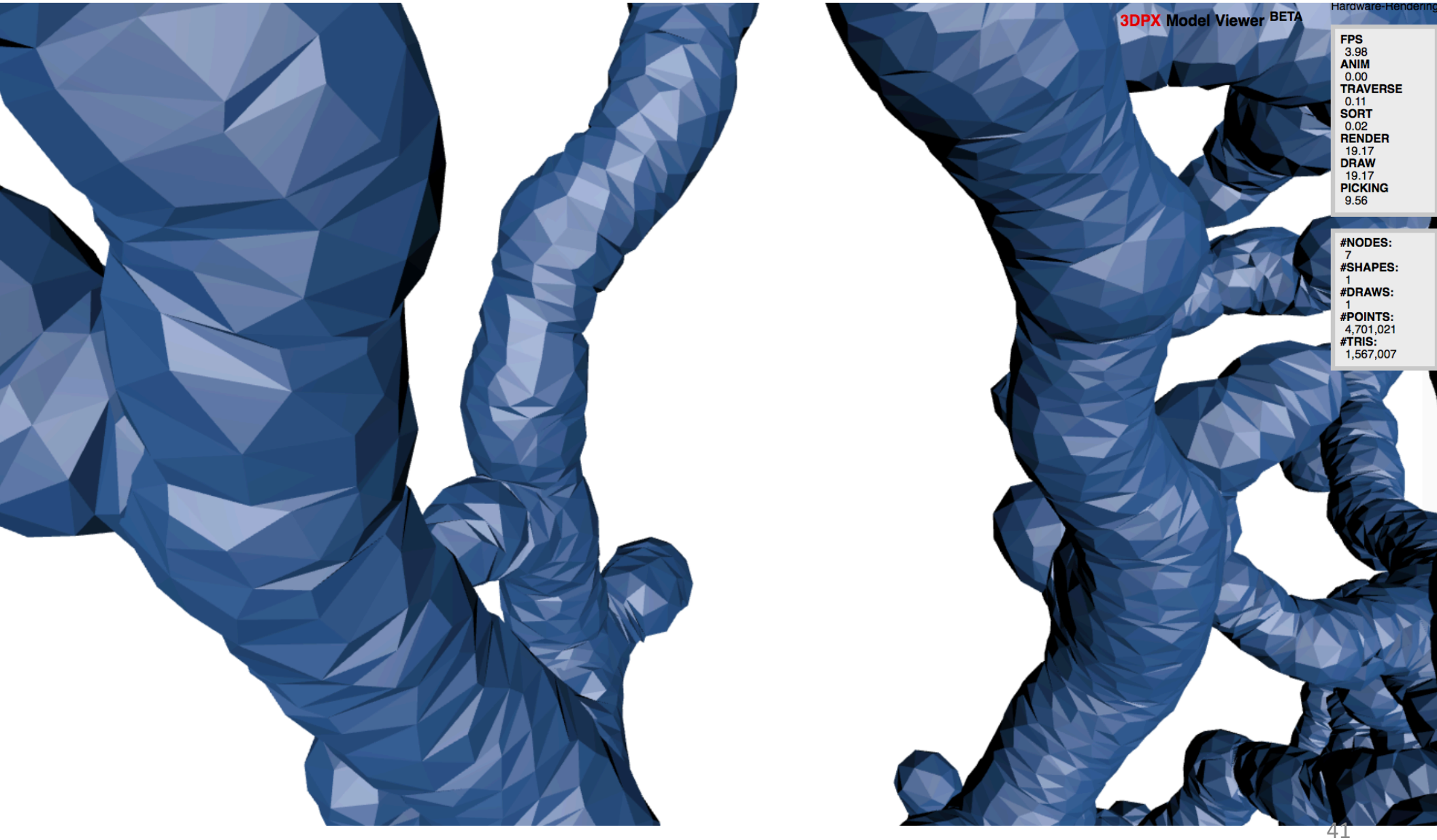
99 94 11

NIH 3D Print Exchange



http://3dprint.nih.gov/

Triangles in a Mesh



3D Mesh Modeling

- A **mesh** is a collection of vertices, edges, and faces that describe the shape of a 3D object.
  - A **vertex** is a single point.
  - An **edge** is a straight line segment connecting two vertices.
  - A **face** is a flat surface enclosed by edges. (Some other applications call these "polygons")
- Source: http://en.wikibooks.org/wiki/Blender_3D:_Noob_to_Pro/What_is_a_Mesh%3F

Check if the File Can be 3D Printed

- **Correct Non-Manifold Geometry Issues**
- Is your 3D model solid/watertight and has the valid 3D geometry?
  - This means that all faces are closed and they form one or more closed entity.
  - There must be no open gaps/holes, non-manifold edges, self-intersections, zero-length edges, naked edges, degenerate faces, duplicate faces, or inverted triangles.
  - Upload and repair your file through the free NetFabb Cloud Service - https://netfabb.azurewebsites.net/
  - Download the repaired version.
  - (Optionally, you may use other software to do the repair.)

http://www.hshsl.umaryland.edu/services/ispace/

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HS/HSL Innovation Space

Welcome to the HS/HSL Innovation Space!

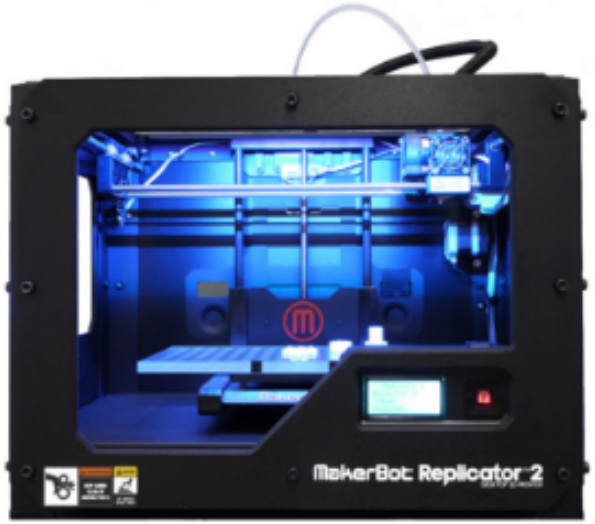
The Innovation Space is designed for innovative and collaborative hands-on learning experience. It offers two 3D printers, a 3D scanner, over 3,500 video tutorials from Lynda.com, a large DNA model, two molecule kits, a button maker, and a 3D printing pen. The staff provides an orientation as well as workshops on a regular basis for those who are new to 3D printing and 3D scanning.

We encourage all UMB students, faculty, and researchers who are interested in experimenting with 3D printing and 3D scanning to visit our new Innovation Space. We are planning to expand this space in the near future with more equipment and programs. If you have any suggestions or ideas for collaboration, please contact us at ispace@hshsl.umaryland.edu.

What You Can Use at the Innovation Space

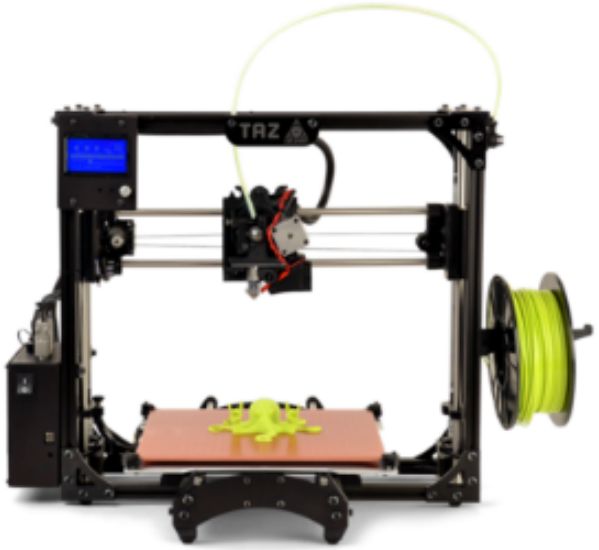
Makerbot Replicator 2X

Relicator 2X offers two extruders. You can use ABS or dissolvable filament. Bring a .STL file with you.



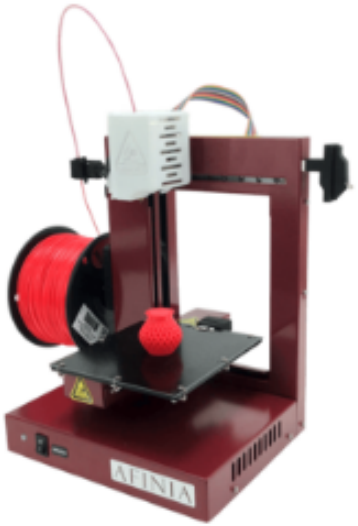
Lulzbot Taz 5

Transform your idea into a physical object with 3D printing! Taz 5 supports a variety of materials from HIPS, PLA, and ABS, to wood, metal, and stone-like.



Afinia H480 3D Printer

The Afinia H480 is a small but reliable 3D printer. It has one extruder and supports the PLA filament.



What You Can Use at the Innovation Space

Tutorials from Lynda.com

Great learning resource that offers 3,500 video tutorials by experts. Topics range from 3D modeling to computer programming. Learn how to operate a 3D printer, how to build a 3D model in Tinkercad or Blender, and how to program in Python or Ruby. (Available on-site only at the Innovation Space.)

lynda.com

NextEngine 3D Laser Scanner

Create high fidelity 3D models of physical objects with our NextEngine 3D scanner and software.

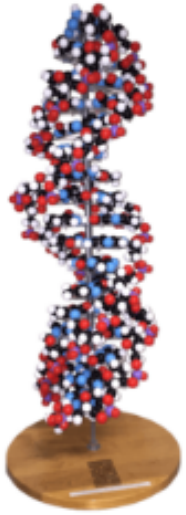
Handheld 3D Scanner

Try 3D scanning with an object of your choice! You can scan an object as small as a book or as big as a person. Yes, you can save the resulting 3D model and 3D print it!

What You Can Use at the Innovation Space

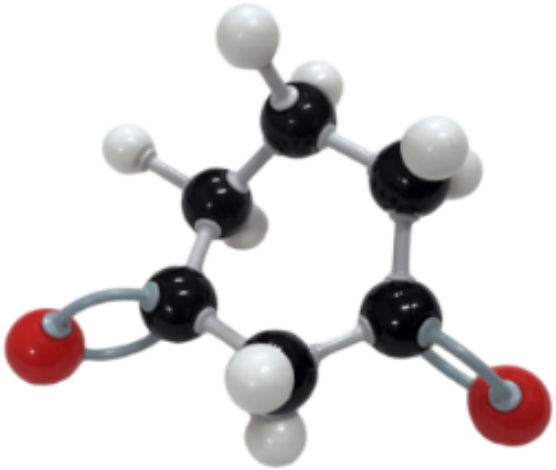
DNA Model

Come play with the human DNA model. Assemble and disassemble while learning about the DNA structure! Check out the assembly instruction.



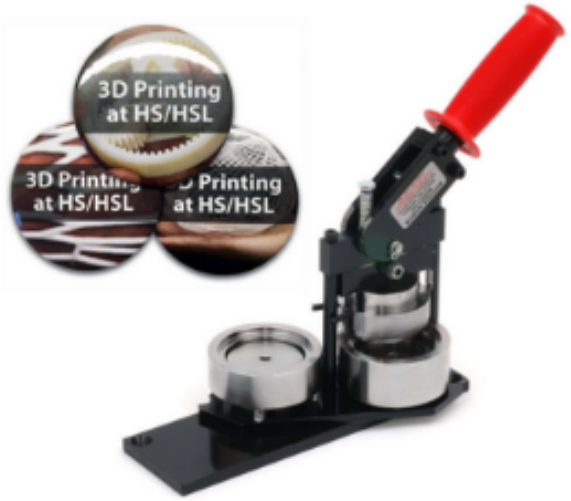
Molecule Model

Explore the chemical structure of molecules! You can build methane, ethane, benzene, acetone, and more.



Button Maker

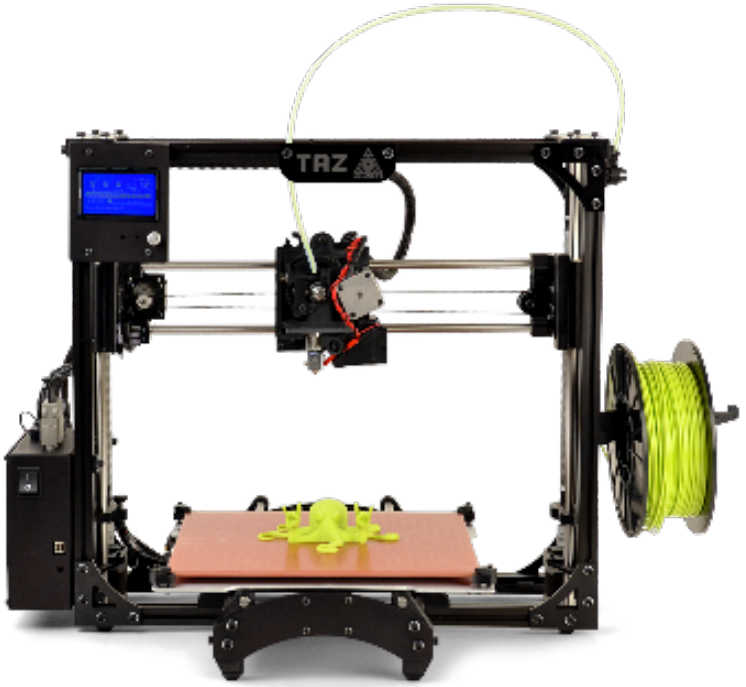
Button making is easy - if you have the right button making equipment! This 3" button making system will include everything you need to make high-quality 3" buttons.



Taz 5

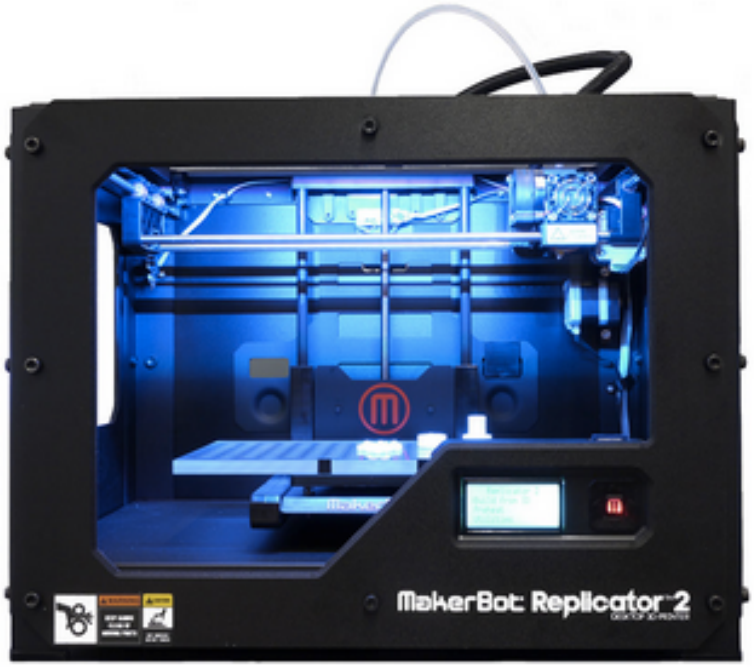
- Detailed instruction here:

http://guides.hshsl.umaryland.edu/ispace/taz5



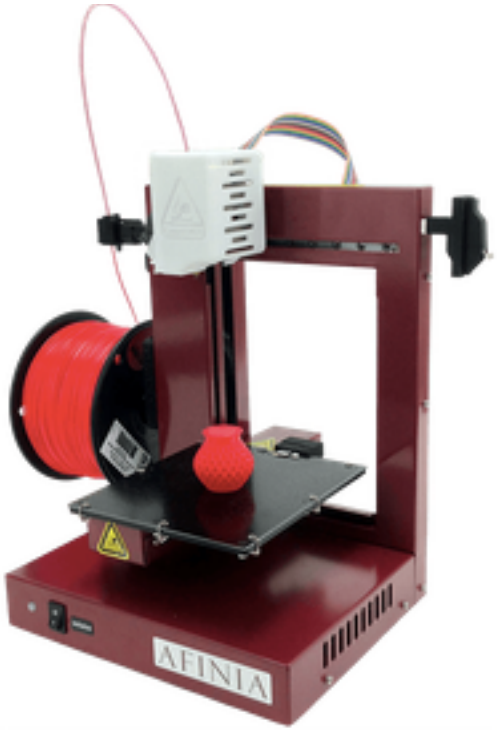
Replicator 2X

- Detailed instruction here: http://guides.hshsl.umaryland.edu/c.php?g=163717&p=1598497



Afinia H480

- Detailed instruction here: http://guides.hshsl.umaryland.edu/c.php?g=163717&p=1598500



Live 3D Print Web Cam

3D Printing Process Checklist

- http://guides.hshsl.umaryland.edu/c.php?g=163717&p=1075333

3D Printing and 3D Scanning at the Innovation Space

Get hands-on learning experience with 3D printing and 3D scanning!

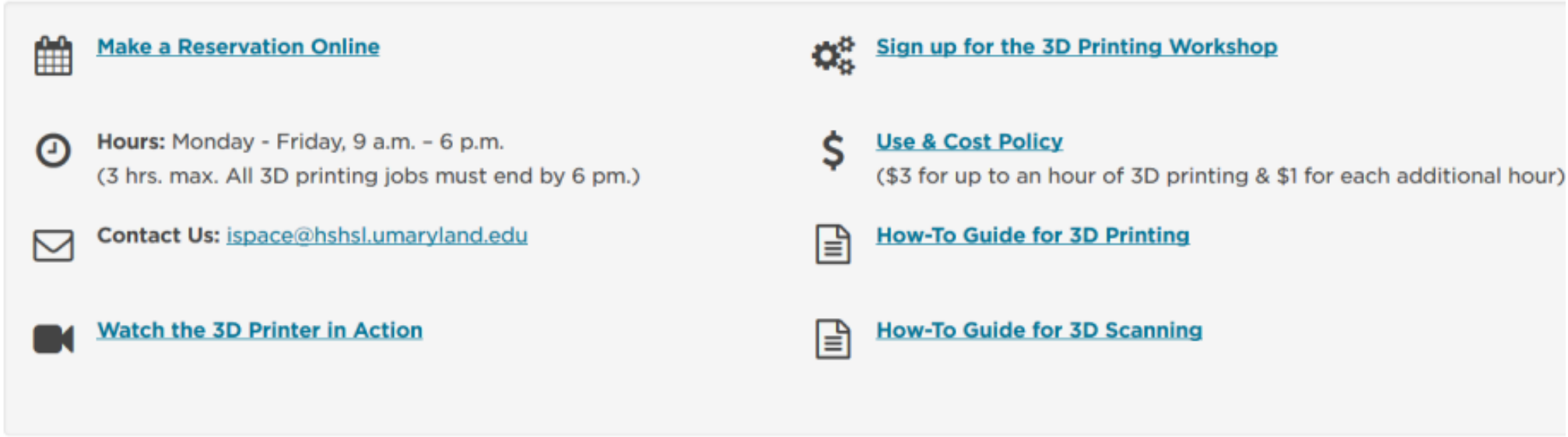
5. 3D Printing Process Checklist

You must 'Prepare and Repair Your 3D Model as a .STL file' before starting a 3D print job.

1. Check with the CATS staff if the maintenance has been recently performed.
2. For the successful 3D printing, the platform needs to be leveled properly, and both the platform and the extruder need to be clean.
3. You may apply or replace the blue painter's tape on the plate to remove the printed object more easily.
4. Make sure you have enough filament on the spool.

After this workshop,

- Make a reservation for orientation/use! http://cal.hshsl.umaryland.edu/booking/ispace.



- Prototype, create, collaborate!

Contact Us!

- E-mail ispace@hshsl.umaryland.edu
- HS/HSL Innovation Space: http://www.hshsl.umaryland.edu/services/ispace/
- 3D Printing/3D Scanning How-To Guide http://guides.hshsl.umaryland.edu/ispace

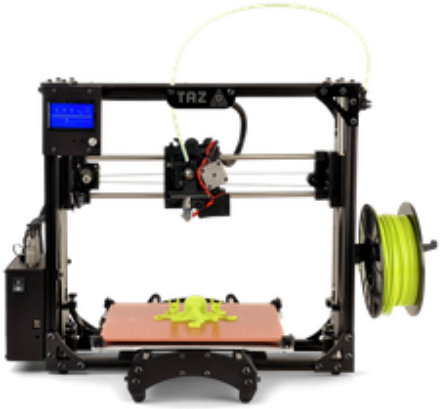
3D Printing at the Innovation Space

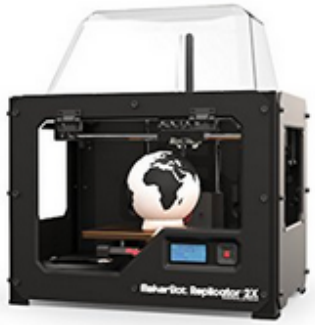
Search this Guide | Search

How-To Guide for 3D Printing http://guides.hshsl.umaryland.edu/ispace/

3D Printers at HS/HSL

Lulzbot Taz 5, MakerBot Replicator 2X and Afinia H480 are available. All three of them utilize the Fused deposition modeling method,





3D Printer Models

- Lulzbot Taz 5
  - Quick Start Guide [PDF]
  - User Manual [PDF]
  - Cura Lulzbot Edition Manual [PDF]
- MakerBot Replicator 2X