

# DIGITAL FABRICATION IN THE CLASSROOM

Josh Ajima - @DesignMakeTeach  
DesignMakeTeach.com

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## Bell Ringer

What digital fabrication tools do you have  
in your learning environment?

What do you hope to take away from this  
session?

### Share

-with the person next to you and/or

<https://padlet.com/designmaketeach/t2zuwskecktu>



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## Goal

Use real-world tools including vinyl  
cutters, 3D printers, laser cutters,  
and CNC mills to solve authentic,  
challenging problems in the  
classroom.

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## HANDOUTS & CONTACT INFO

[DesignMakeTeach.com/TCEA](https://DesignMakeTeach.com/TCEA)



### Josh Ajima

@DesignMakeTeach

[DesignMakeTeach.com](https://DesignMakeTeach.com)

[youtube.com/designmaketeach](https://youtube.com/designmaketeach)

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## FEATURED PRESENTER



**Digital Fabrication in the Classroom**  
Mon, February 5th, 8:00 AM – 11:00 AM, 9C

**Scaling Up the Makerspace**  
Mon, February 5th, 3:30 PM – 4:30 PM, Ballroom E

**The Maker Mindset**  
Tue, February 6th, 9:45 AM – 10:45 AM, Ballroom F

**Making with Head, Hands, and Heart**  
Tue, February 6th, 11:30 AM – 1:00 PM, 6B

**The Makerspace Chromebook**  
Wed, February 7th, 8:00 AM – 11:00 AM, 10A

**3D Printing Projects That Matter**  
Wed, February 7th, 3:30 PM – 5:00 PM, 9A

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## EDUCATOR



Josh Ajima - DesignMakeTeach.com

**Instructional Facilitator for Technology**  
-Dominion High School & Loudoun Academy of Science, Sterling, Virginia (2003-present)

**Director of Instructional Technology**  
-Clarke County Public Schools (1998-2003)

**Teacher: Chemistry, 7th Life Science, 8th Physical Science, Cisco Networking**  
-Clarke County Public Schools (1996-1998)

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## MAKER



**Make Magazine Review Team**  
2014 & 2015

**Featured: Thingiverse, Pinshape, Adafruit**

**World Maker Faire NY: Best in Class Ribbon**

**Outsider Art Fair NY: Tower Design Competition - 2nd Place**

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## MAKER EDUCATOR



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**US Department of Education's CTE Makeover Challenge Winner**

**Stanford FabLearn Fellow**

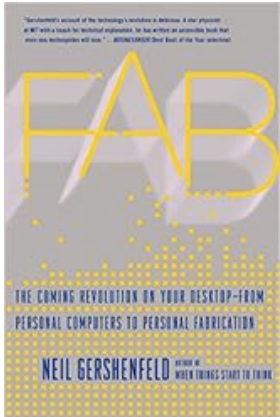
**Formlabs 3D Design Awards -Top Educational Model**

**Construct3D 2017 - K12 Program Chair**

**VSTE Innovative Educator of the Year**

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## MY MAKER JOURNEY



Neil Gershenfeld: MIT Center for Bits and Atoms

- 2005 NSBA Conference
- How to Make (almost) Anything
- Personal Fabrication
- FabLabs

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## UNIVERSAL DESIGN FOR LEARNING

- Multiple Means of Engagement
- Multiple Means of Representation
- Multiple Means of Action & Expression



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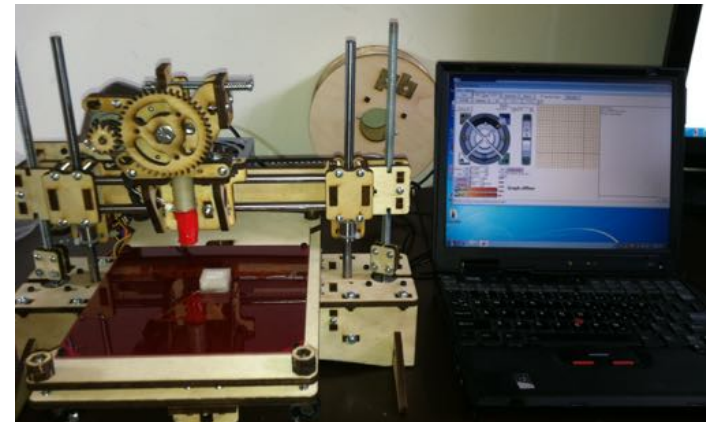
## A MAKER EDUCATION MODEL



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## PERSONAL INVESTMENT



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#### 4 KEY ELEMENTS

##### SIGNIFICANT **CONTENT** & IMPORTANT **COMPETENCIES**

Through *One to the World* work, students develop as knowledgeable critical thinkers, communicators, collaborators, creators, and contributors. *One to the World* work ties directly to our curriculum.

##### AUTHENTIC CHALLENGING PROBLEMS in **THE WORLD**

*One to the World* student work is framed by an authentic, challenging problem. The work features real-world context, tasks and tools or impact.

##### PUBLIC PRODUCT *for* **THE WORLD**

Students make their work public by displaying and/or presenting it to people beyond the classroom. Students create and share products, performances, services, and exhibitions of work relating to authentic problems and tasks in the world.

##### CONNECTED with **THE WORLD**

Students improve the quality of their work and amplify the impact of their work through three types of connections:

- connections to valuable tools and information;
- connections to others with whom they collaborate; and
- connections with an audience beyond the teacher.

When appropriate, students use technology to make these connections with the world.

Revised July 2015. The concepts and phrasing of the 4 key elements draws from the "Essential Project Design Elements" of Gold Standard Project Based Learning from the Buck Institute for Education. Alan November was an early user of the phrase, "One to the World."

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## Design, Make, Market

### Idea to Product in the Classroom

**CHALLENGE:** Create a design for a new product.

**DESIGN:** Use marker to create a design in thick **bold** lines in the box to the right. (Tip: Think silhouette.)

**MAKE:** Take a photo of drawing. Crop photo to show only design. Convert photo to SVG at [picsvg.com](https://picsvg.com). (Tip: Try Filters Ready #3.) Download SVG or copy URL and submit at [DesignMakeTeach.com/demo](https://DesignMakeTeach.com/demo).

**MARKET:** Publish photo of your design via social media with #TCEA & @DesignMakeTeach

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# What tools do your students use in your classroom?

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# HAND MACHINE

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# Why digital fabrication tools?

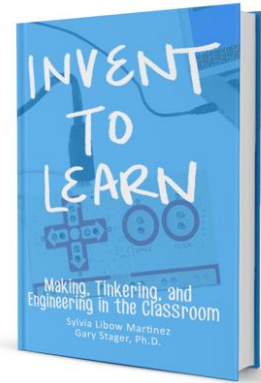


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## 3 GAME CHANGERS

[InventToLearn.com/resources](http://InventToLearn.com/resources)

- Physical Computing
- Programming
- Fabrication



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# PRODUCERS

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# CONSUMERS

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# MAKERS

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# TAKERS

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**ENTERPRISE**  

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**CONSUMER**

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**INDUSTRIAL**  

---

**MAKER**

22

**ADDITIVE**  

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**SUBTRACTIVE**

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**DIGITAL FABRICATION IS HARD**

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## DIGITAL FABRICATION TOOLS

**2D Printer/Plotter**  
**Embroidery Machine**  
**Cutting Plotter/Vinyl Cutter**  
**3D Printer**  
**Laser Cutter**  
**CNC**

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## OTHER CATEGORY

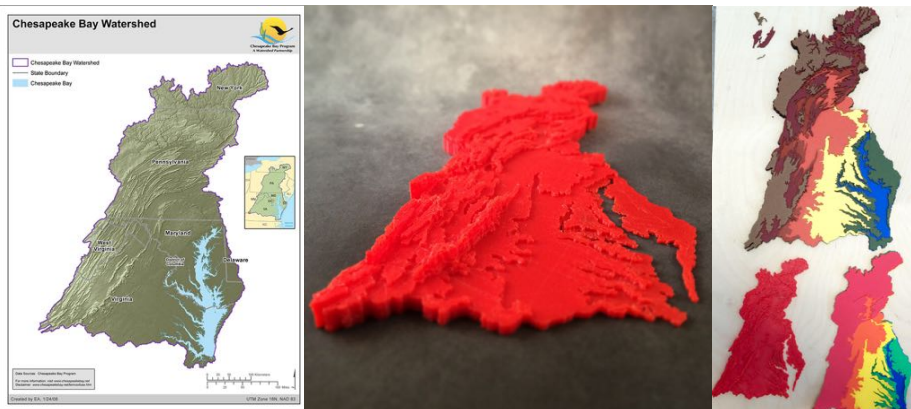
**Plasma Cutter**  
**Water Jet: Wazer**  
**Robotic Router: OnShape**  
**3D Laser Printer: GlowForge**

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## CHESAPEAKE BAY WATERSHED

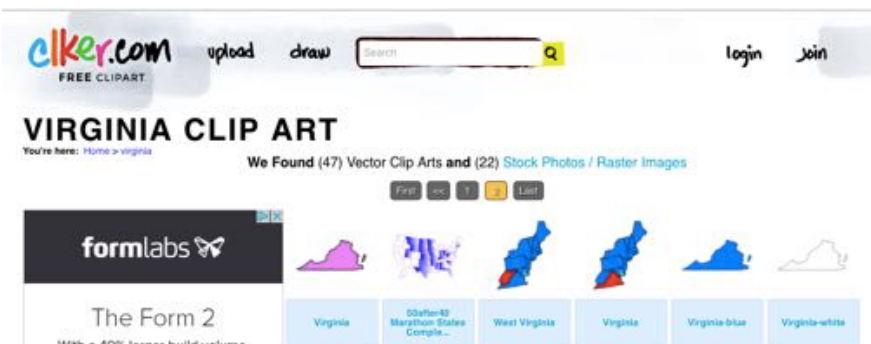
thingiverse.com/thing:908712



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## CLKER.COM - VECTOR CLIPART



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## WIKIMEDIA - VECTOR GRAPHICS

File:Map of Virginia highlighting  
Virginia Beach City.svg



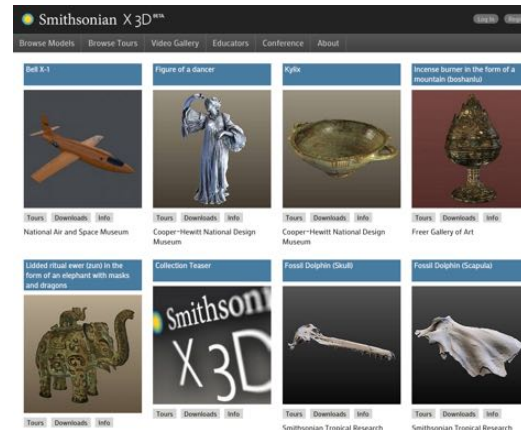
Size of this PNG preview of this SVG file: 800 × 347 pixels. Other resolutions: 320 × 139 pixels | 640 × 278 pixels | 1,024 × 444 pixels | 1,290 × 555 pixels | 7,486 × 3,247 pixels.  
Original file (SVG file, nominally 7,486 × 3,247 pixels, file size: 223 KB)

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## SMITHSONIAN X 3D

3d.si.edu



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## NASA 3D RESOURCES

nasa3d.arc.nasa.gov

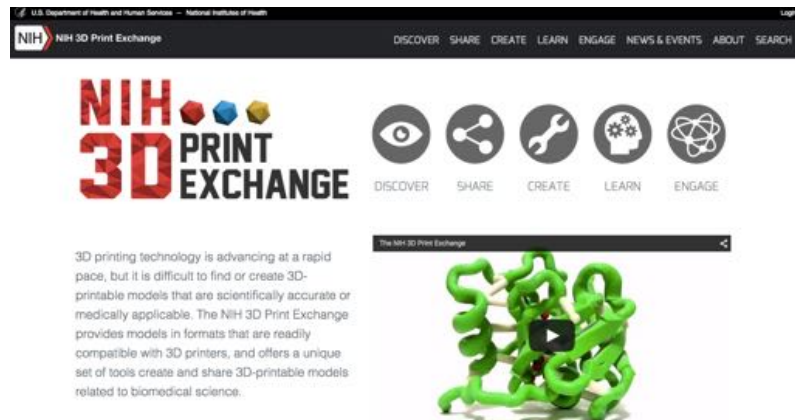


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## NIH 3D PRINT EXCHANGE

3dprint.nih.gov/

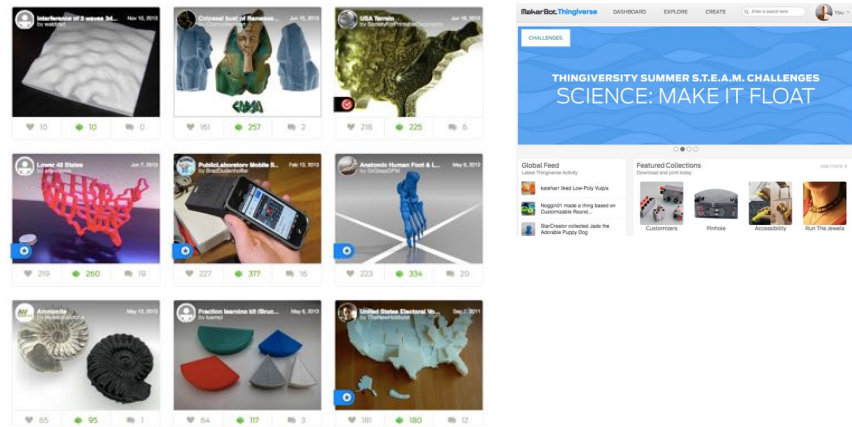


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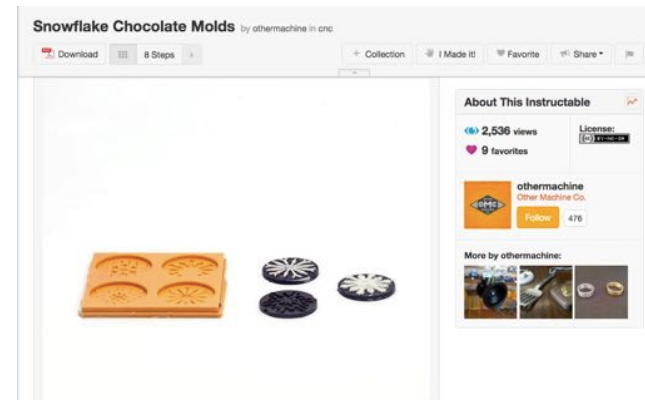
## THINGIVERSE.COM



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## INSTRUCTABLES.COM



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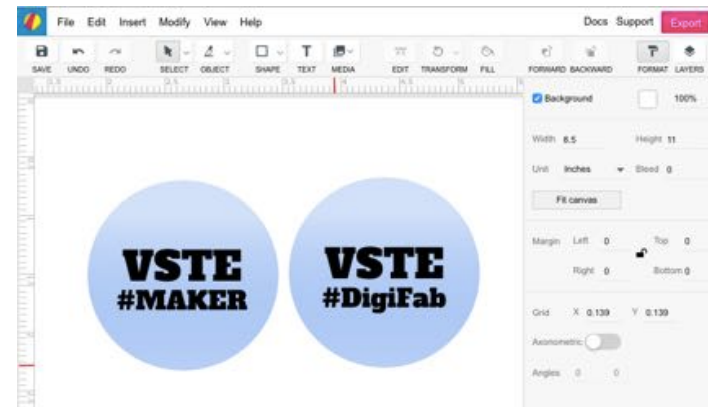
## MAKE MAGAZINE



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## DESIGNER.IO - 2D DESIGN



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## TINKERCAD.COM - 3D DESIGN



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## CUSTOMIZATION

<http://www.thingiverse.com/thing:305087>



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## MORPHI - IOS

[morphiapp.com](http://morphiapp.com)



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## 123D CATCH

[123dapp.com/catch](http://123dapp.com/catch)



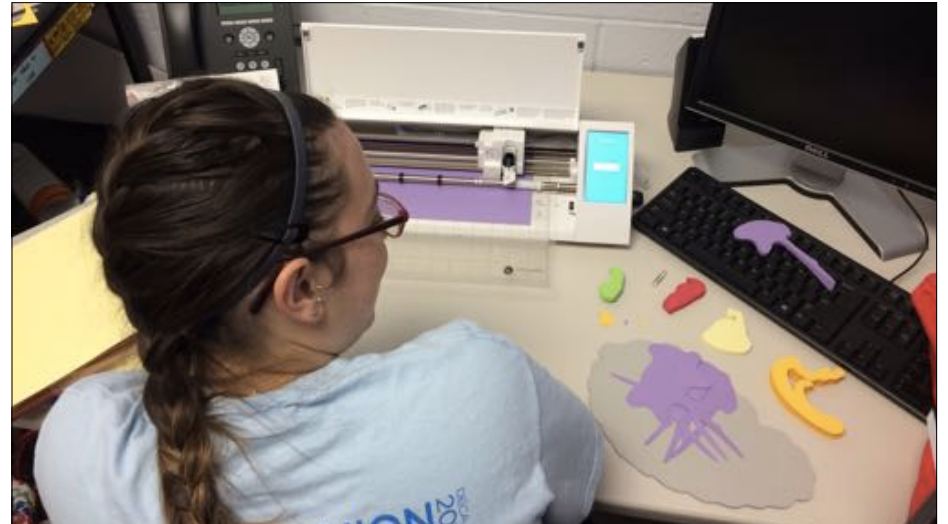
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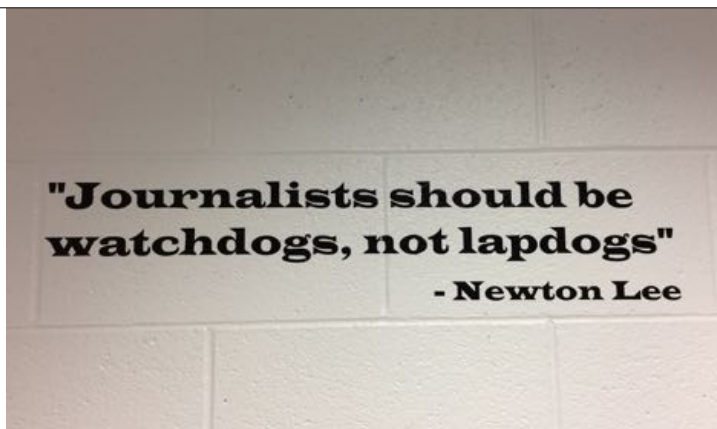


**Buttons: CTE Careers & US History Quarters**

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**Checkout the new quote in the newspaper room  
Vinyl for the win.**

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**Stickers for new FIELD HOCKEY team.  
Go Titans!!! #DHSMakerspace**

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Learning to make our own stickers = More profit  
Marketing teachers are pumped! #CTEMakeover

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CTE students are designing their own products 😎

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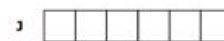
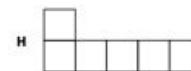
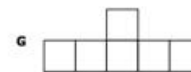
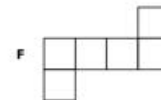


Creating public products using real-world tools 🌐  
#OTTW #LCPS16

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## NETS OF A CUBE

36 Which of these nets would form a cube when folded?



VIRGINIA STANDARDS OF LEARNING  
Spring 2010 Released Test

END OF COURSE  
GEOMETRY

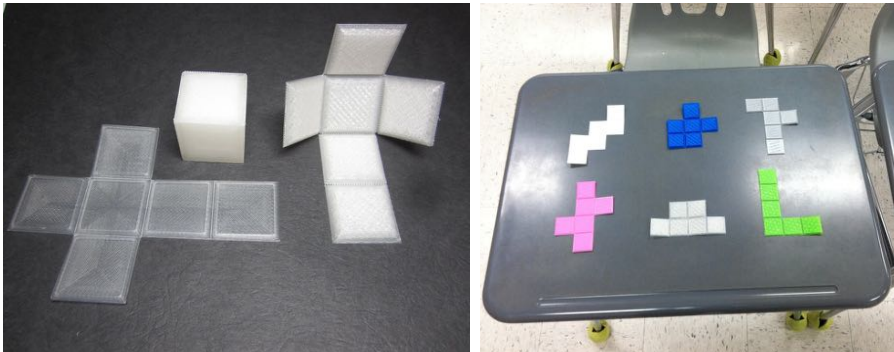
Form M0110, CORE 1

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## NETS OF A CUBE

thingiverse.com/thing:75093

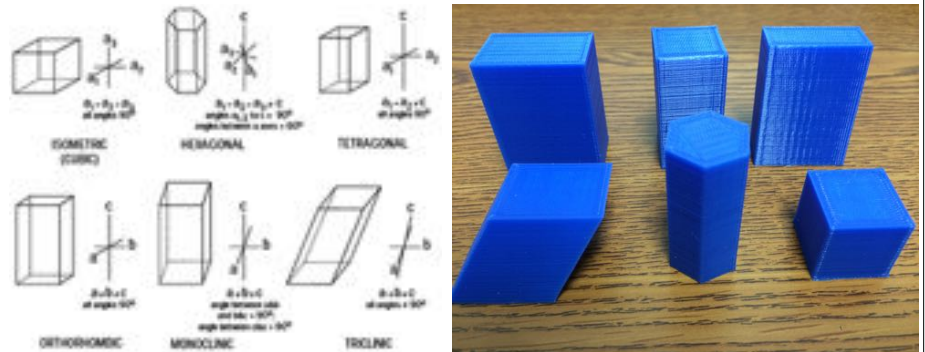


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## THE SIX CRYSTAL FAMILIES

thingiverse.com/thing:169569

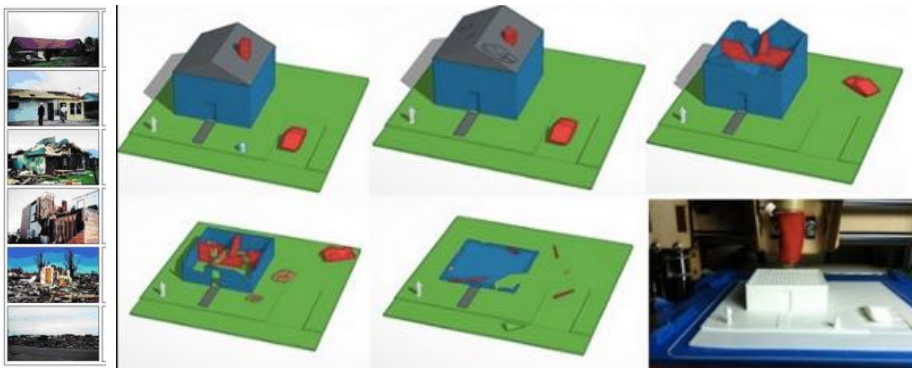


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## FUJITA SCALE MODELING

thingiverse.com/thing:298534

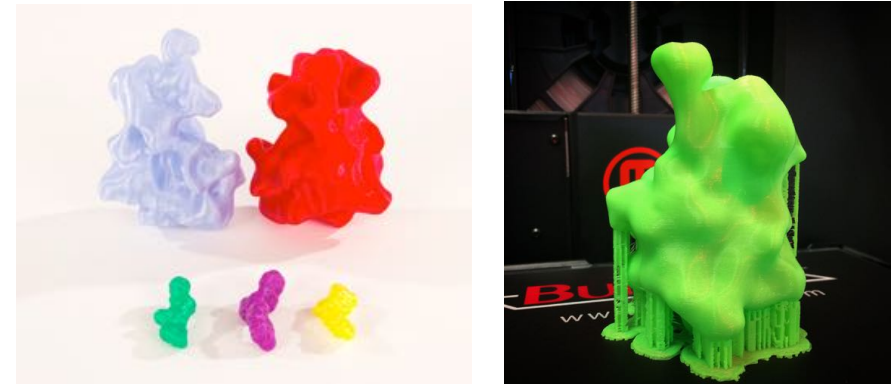


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## HHMI'S BIOINTERACTIVE.ORG 2013 HOLIDAY LECTURES ON SCIENCE MODELS

thingiverse.com/thing:222545



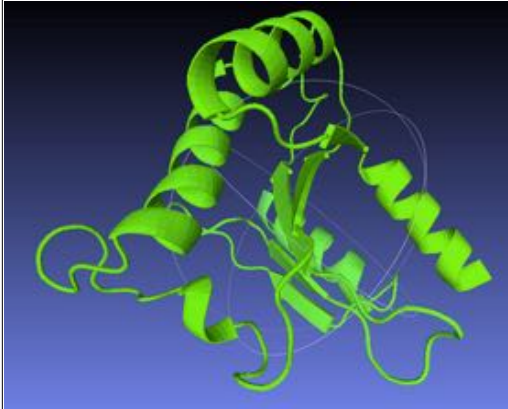
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## PROTEIN MODEL

Student Designed Model

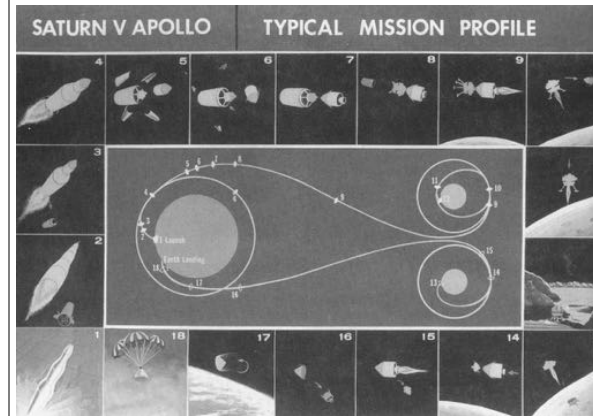


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## APOLLO MISSION

[thingiverse.com/thing:15098](http://thingiverse.com/thing:15098)



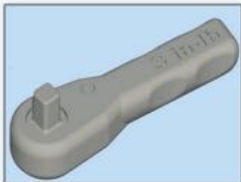
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## SPACE WRENCH

[nasa3d.arc.nasa.gov/detail/wrench-mis](http://nasa3d.arc.nasa.gov/detail/wrench-mis)

### Wrench



#### Description

**Author/Origin:** Made In Space, Inc.(MIS)/NASA  
**Relevant Mission:** Wrench  
**Date Added:** January 14, 2015  
**Keywords:** 3D Model, Wrench

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.

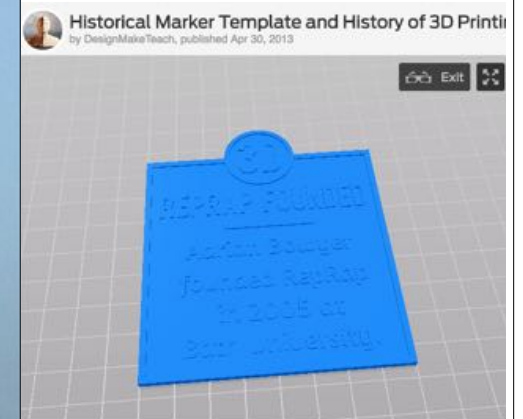
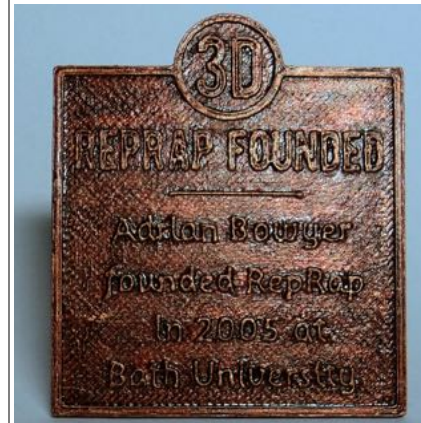


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## HISTORICAL MARKER TEMPLATE

<http://www.thingiverse.com/thing:81412>



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## HISTORY & CULTURE

[thingiverse.com/thing:305087](http://www.thingiverse.com/thing:305087)



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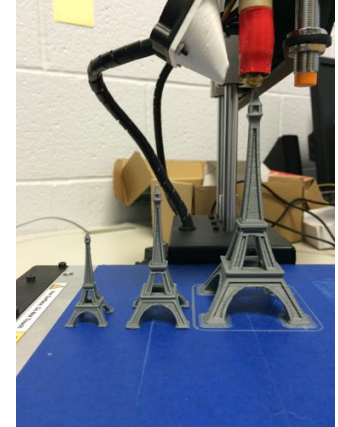
## WORLD LANGUAGES

Famous Paris Buildings by LeFabShop



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<http://www.thingiverse.com/thing:311002>



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## TACTILE WRITING PROMPT

<http://www.thingiverse.com/thing:90193>

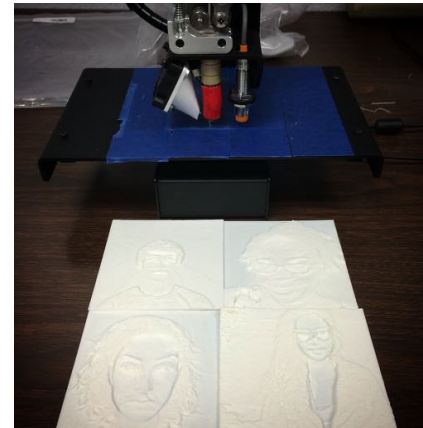


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## ART

3dp.rock/lithophane



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## ART



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## SERVICE LEARNING

Cyborg Beast by JorgeZuniga



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## 3D PRINTING INFILL PATTERNS

High School Research Student



Top to bottom, left to right: Honeycomb, Concentric, Line, Rectilinear, Hilbert Curve, Archimedean Chords, Octogram Spiral

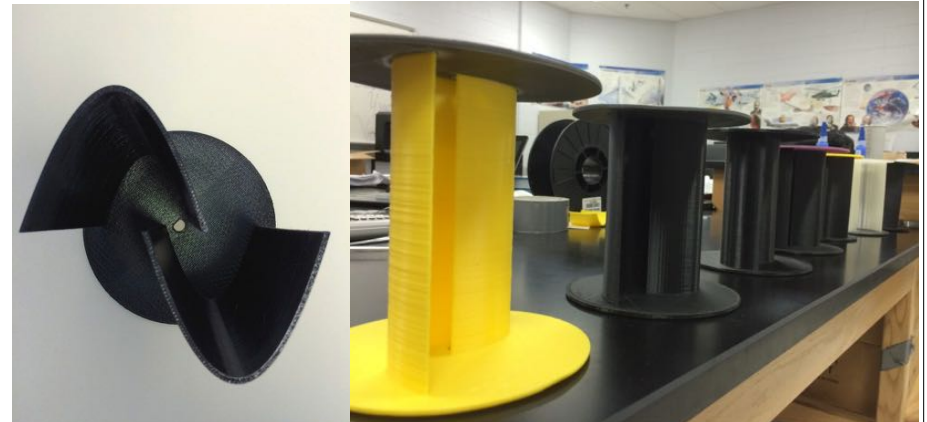
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- 3D printers have been emerging in commercial markets for the last 30 years (Canessa, Fonda, & Zennaro, 2013)
- Most common type uses Fused Deposition Modeling (Flaherty, 2009)
- Uses thermoplastics like poly (lactic acid)
- Fatigue testing has been conducted in the past (Moore & Williams, 2012)

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## VERTICAL WIND TURBINE

Collaboration with Singapore



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## SPINAL DISC RESEARCH

High School Research Student

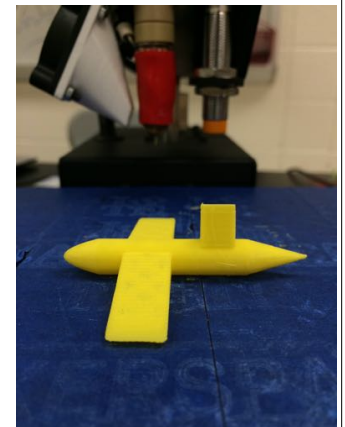
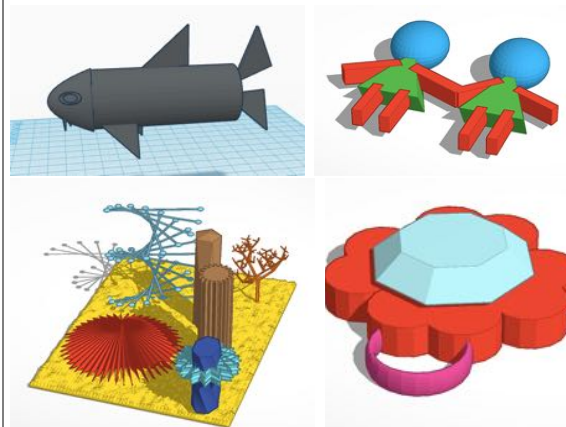


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## STUDENT DESIGNERS

tinkercad.com



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## 3D GUMBALL GALLERY

Student models courtesy Wendy Ahart

**River Bend  
Middle School Makers**



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## 3D GUMBALL GALLERY



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## CULTURE

thingiverse.com/DesignMakeTeach/collections/hispanic-latino-heritage-and-culture

0 results for "hispanic":  
No things were found that match

0 results for "latina":  
No things were found that match

5 results for "latino":



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## SHARING

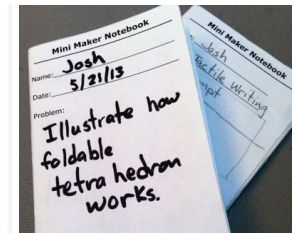
http://www.thingiverse.com/thing:93186



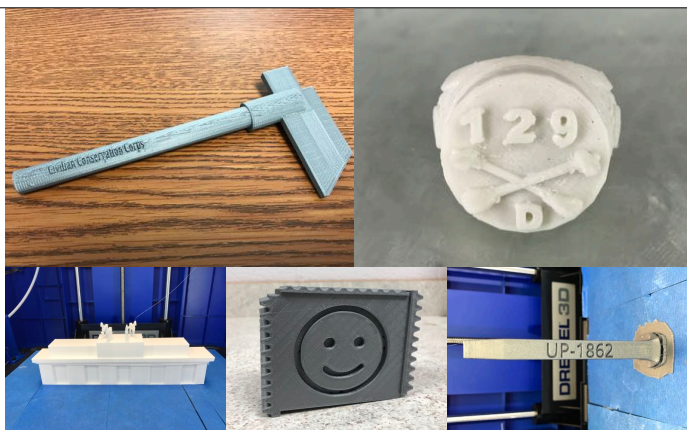
By Thing

Thing	Views	Downloads	Likes	Collects	Watches	Comments	Makes	Reprints
MOM Gimbal - Print in Place	17452	4187	303	345	6	18	30	7
MOM Card	406	241	5	9	0	0	1	0

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3D Printed Mystery Artifacts in US History

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Making Linoleum Stamps in Art w/ Othermill

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WHAT WILL YOU MAKE?

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## Challenge

**Design & publish a model/project  
for use in the classroom. Tweet  
URL of model/project #TCEA  
@DesignMakeTeach**

**(Tinkercad → Thingiverse?)**

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## Closure

**Create a 90 sec video describing  
your classroom digital fabrication  
model/project and what you are  
taking away from this session.**

**<https://flipgrid.com/60c2ea>**

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## HANDOUTS & CONTACT INFO

**[DesignMakeTeach.com/TCEA](https://DesignMakeTeach.com/TCEA)**



**Josh Ajima**

**@DesignMakeTeach**

**[DesignMakeTeach.com](https://DesignMakeTeach.com)**

**[youtube.com/designmaketeach](https://youtube.com/designmaketeach)**

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