Research Library 3-D Printer Program

Master Class: Science of 3-D Printing
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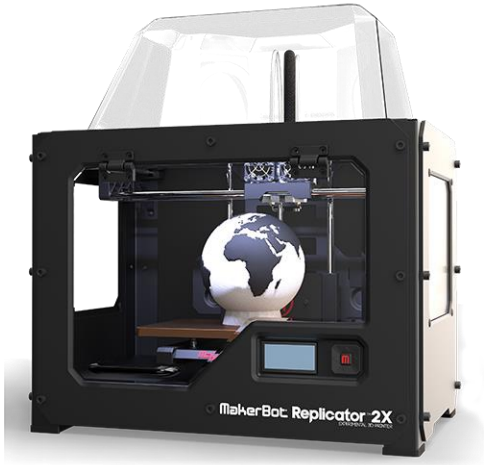
- Non-regulatory Federal agency made up of about 3,000 science and technology researchers
- NIST promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology
- The Information Services Office supports and enhances research activities of the NIST scientific community through a comprehensive program of technical learning and knowledge management

Library's 3-D Program

(3) MakerBot Replicator 2



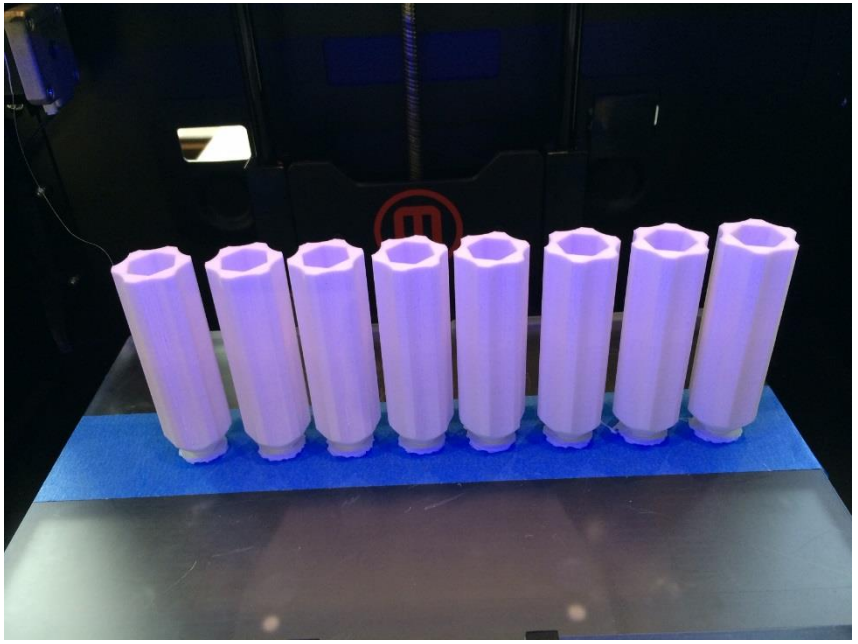
(1) MakerBot Replicator 2X

(1) MakerBot Digitizer

3-D Printer Research Impact #1

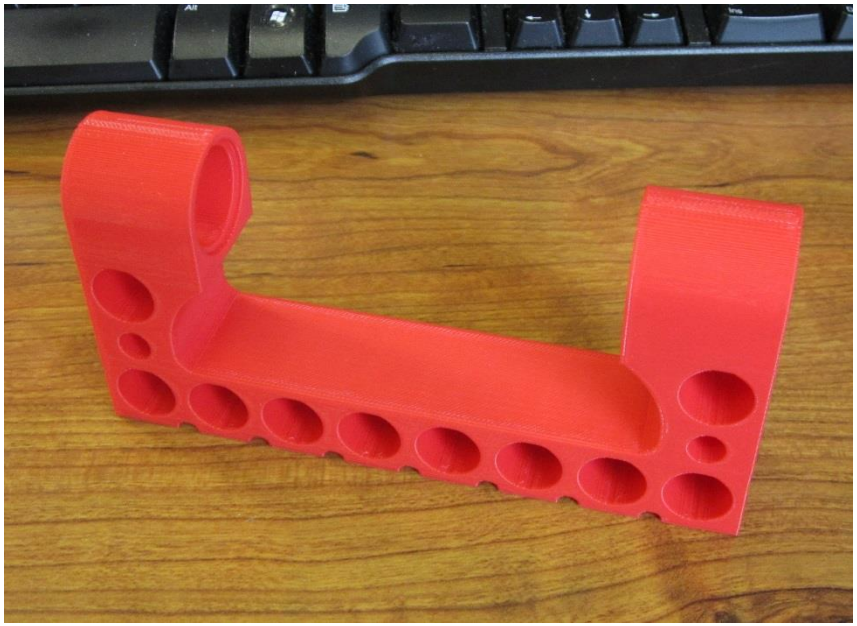
Centrifuge adapter within 48 hours

- NIST-sponsored measurement round robin
- Adapter for miniature protein sample vial to fit a standard 50ml centrifuge tube
- Critical need found only 48 hours before shipping test kits
- *"…the NIST Library 3-D printing facility has saved my projects at least $10K and helped us avoid inestimable delay."*



3-D Printer Research Impact #2

Custom scanning apparatus



- Developing new method for forensic bullet evaluation
- New means to secure bullet for scanning needed
- Customer learned 3-D modeling and eventually obtained own printer
- Made significant changes to method through 3-D printed iterations

Library Brings Together the 3-D Printing Community

- Orientation focuses on the bare necessities for using the printer – start a journey of learning from their and others' experiences
- Library is central resource for sharing experiences
- Library provides expert assistance to new 3-D printer owners

3-D Printing Materials

Poly-Lactic Acid (PLA)

Why You Should Use It

- Most common non-commercial 3-D printing material
- Simple printing – needs only heated extrusion nozzle
- Most consistent printing of common filaments
- Corn-based – very mild, sweet odor while printing

Pitfalls

- Difficult to print small features, strings between features (video)
- Printed objects can melt/deform in hot temperatures (picture)
- Printed objects can be brittle

Poly-Lactic Acid (PLA)

The Science of the Material

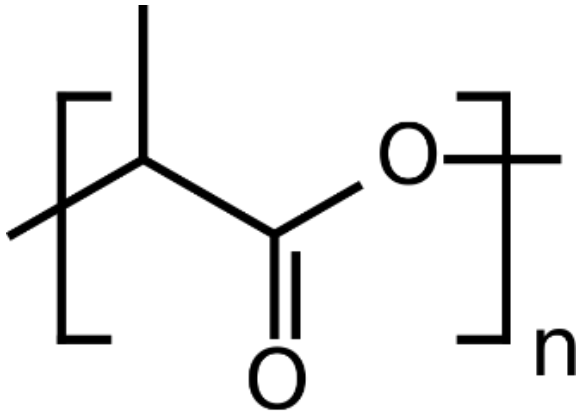
- Derived from renewable corn, soon sustainable sources
- Biodegradable
- Biocompatible/bioabsorbable
- Hygroscopic

<u>Mechanical Properties</u>

- Glass Transition Temperature: 60 °C (140 °F)
- Tensile Strength: 56.6 MPa
- Elastic Modulus: 3,368 MPa

Commercial Uses

- Food packaging, table and dishware
- Medical implants
- Agriculture
- Automotive parts



Acrylonitrile Butadiene Styrene (ABS)

Why You Should Use It

- 2nd-most common non-commercial 3-D printing material
- Long history of use in non-commercial and commercial 3-D printing
- Can print small features easily
- Can machine printed parts
- Heat-resistant
- Can make glossy, smooth objects with common acetone (picture)

Pitfalls

- Requires heated print bed, controlled print enclosure, or special treatment to print without warping and cracking (picture)
- Petroleum-derived – moderate, acrid odor while printing

Acrylonitrile Butadiene Styrene (ABS)

The Science of the Material

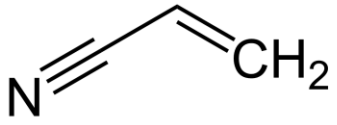
- Acrylonitrile and styrene polymers in polybutadiene rubber
- Can be recycled (limited)
- Properties can be adjusted by changing component ratios

Mechanical Properties

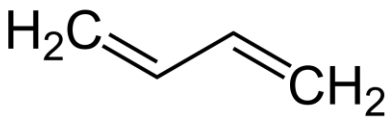
- Glass Transition Temperature: 105 °C (221 °F)
- Tensile Strength: 28.5 MPa
- Elastic Modulus: 1,807 MPa

Commercial Uses

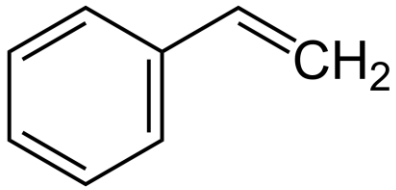
- LEGO building blocks
- Housewares
- Pipes
- Computer casings
- Automotive parts



acrylonitrile



1,3-butadiene



styrene

Up-and-Coming Materials

Typical Consumer 3-D Printers

Nylon

High-strength, durable, and chemical-resistant

Wood

Wood particles embedded in PLA – can sand, stain

Flexible PLA

Elastic and abrasion-resistant (pic)

Metal

Metal particles embedded in PLA – can polish

PET

Clear, strong, heat-resistant, and recyclable (picture)

Conductive

Print circuits or batteries

Other 3-D Printers

Photopolymer

Clear, smooth finish, used in SLA

Paper

Fine detail, color flexibility (pic)

Contact Information

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