WAY BEYOND THE ROCKTOPUS

3D Printing and the Natural Resources Classroom

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Overview: What’s in store this session

- Brief summary of what 3D printing is
- How 3D printing works
- How 3D printing is used in courses at CSU
- Examples of courses using the technology
- How to get started using 3D printing
- Resources to expand your knowledge
- Questions?
3D printing in its many forms

https://www.3dhubs.com/what-is-3d-printing
3D printing in its many forms

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Fused Deposition Modeling (FDM)

- FDM – ‘Glue Gun on Steroids’
- Least expensive and most ubiquitous method
- Most applicable for general education purposes
- More commonly available in k-12 schools
- More & more Public & University Libraries are offering time on them
Fused Deposition Modeling (FDM)
A FDM printer in action:
Beyond the Rocktopus: 3D printing and the Classroom – myriad applications

- Engineering and Design: Rapid Prototyping
- Manipulatives for classroom use
- Modeling things normally hard to see or touch
- Modeling things precisely from imaging data
- Your imagination is the limit
Case Studies: CSU courses utilizing 3D printing technologies

- Proteins: LIFE210, LIFE212
- ‘Ninja-Flex’ Proteins: BC404
- Topographies: NR220, GEOL121
- CityScapes: Creative Works Project
Proteins: LIFE210 and LIFE212

Lysosome–In ABS plastic
Proteins: LIFE210 and LIFE212
Proteins: LIFE210 and LIFE212

Proteosome assembly kit with magnets for LIFE210
Proteins: LIFE210 and LIFE212

Proteosome assembly kit with magnets for LIFE210
Flexy Proteins: BC404 and LIFE210

Lysosome in ‘Ninja Flex’ filament
Flexy Proteins: BC404 and LIFE210

Lysosome in ‘Ninja Flex’ filament
Flexy Proteins: BC404 and LIFE210

Lysosyme in ‘Ninja Flex’ filament
Flexy Proteins: BC404 and LIFE210

Dual Extrusion with Dissolvable Support
Flexy Proteins: BC404 and LIFE210

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BC404 students print protein models Fall 2016
Biomechanics: Tendons in a finger
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Topographies: GEOL 121

Arthur’s Rock: Topographic Profile Lab
Topographies: GEOL 121

Arthur’s Rock: Topographic Profile Lab
Topographies: CSU Mountain Campus at Pingree Park – NR220

Four 11” x 6” pieces to form a 22” x 12” model
Topographies: CSU Mountain Campus at Pingree Park
Topographies: CSU Mountain Campus at Pingree Park
Topographies: CSU Mountain Campus at Pingree Park
Civil Engineering: CSU lagoon
Civil Engineering: CSU lagoon
Print NASA’s wrench used by astronauts

https://nasa3d.arc.nasa.gov/detail/wrench-mis
View & print Smithsonian artifacts

https://3d.si.edu/
Building a custom 3D printer: A table full of parts... 5/15
Building a custom 3D printer: First Print... 8/15. ~ 40 hours labor
Building a custom 3D printer: Second print

Lulzbot Forum thread chronicling the build experience: https://forum.lulzbot.com/viewtopic.php?f=16&t=2263
Pingree full extant – 22” x 14”
Pingree full extant – 22” x 11”
Pingree Final North East and North prints
Onodrim home at TILT
CityScapes: CU Boulder

LiDAR data as source files for printing
CityScapes: CU Boulder

LiDAR data as source files for printing
Questions?
‘Ok, great. Where do I find things to print?’

- Online repositories of printable files:
  - Thingiverse.com
  - NIH 3D Print Exchange

- Online sources of files to be converted:
  - USGS National Map
  - USGS Earth Explorer

- Think 3D files that may be convertible:
  - CAD data, MRI data, LiDAR data

- Draw it!: Tinkercad, Onshape, Blender
‘Ok, great. *Where* do I print?’

- **Online Services:** [Shapeways.com](http://www.shapeways.com)
- **Local Maker Spaces or other Local Services**
- **On Campus Services:** [CSU Idea2Product lab](http://www.csuidea2product.com), [Morgan Library](http://www.morganlibrary.com)
- **Buy your own:** [Lulzbot.com](http://www.lulzbot.com)
- **Build your own:** [RepRap Project](http://www.reprap.org)
Further Reading

- Case Studies: 3D printing and Education
- Infographic: Simple uses of 3D printing in Ed.
- Book: Makerbot in the Classroom
- Potential Student Projects: Autodesk
- Good Resource Site: Uses, printers, software
- ‘3D Printing Revolution’: Penn State
- Transdisciplinary Partnerships: U of Wisc
- Thingiverse: 3D printable file library
- Idea2Product 3D Make Lab: CSU
Questions?

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