3D Printing: Education through “Replication”

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Why 3D printing?

• 3D printing, a.k.a. additive manufacturing, is making three-dimensional objects from digital designs, sometimes called CAD designs.

• The hype is big now that 3D printing materials and tools are more affordable but it has been around since the 80’s.

• 3D printing allows for students, of all ages, to design something through “replication” or from their own imagination. Almost any type of material can be used in 3D printing.
  • These factors make 3D printing a technique that combines STEM and creativity –something many academic programs for kids and young adults are looking for.
Basic Outline for STEM Education Through 3D Printing

• Have students create a “tech plan” that covers
• Who their audience will be
• What they want to make
• When will they start and complete the 6 steps of production
  1. Create tech plan
  2. Design using CAD tools
  3. Analyze for errors
  4. Print the design
  5. Test the design
  6. Post design and finish product
• Why this design (scope of project)
• How will they complete all 6 steps
Who is using 3D printing?

• I show this portion of the slide deck to students to get their imaginations charged up.
• I reserve the x.pose dress slide for ages 14 and up because it is a bit more risqué than the other examples.
Ecologists are using it to make artificial flowers to study the spread of pollen – helping agricultural engineers (University of Washington)

Bioengineers are using it to make bioprinted organs (prototype)
The sugar lab is creating 3D editable geometric sugar shapes.

The print2Taste Emerges with Bocusini Food Printer; others include the PancakeBot and Papabubble which make 3D printed pancakes and lollipops.

Watch the video: [https://youtu.be/7INqWBz7DEI](https://youtu.be/7INqWBz7DEI)
Disney’s New Huggable Fabric 3D Animals

Check out Printing Teddy Bears [Here](https://youtu.be/8jErWRddFYs)

Watch the video at: [https://youtu.be/Ounmxq3PgMo](https://youtu.be/Ounmxq3PgMo)

Watch the video at: [https://youtu.be/8jErWRddFYs](https://youtu.be/8jErWRddFYs)
3D Prototype casts, when connected to ultrasound equipment, help heal bones faster, no yucky smell, and the cast can be printed and designed for the individual.
The x.pose dress project uses a 3D smart material printed dress to expose how much data people share unknowingly.

Check it out: [https://player.vimeo.com/video/977036](https://player.vimeo.com/video/977036)
And so much more!
3D printing options for the classroom and library
The Total Package:

- A few curricula include:
  - Wind-up Racers from 3DIY
  - Shapeways
  - SolidWorks
  - SAE/SquareOne Educational Network
    - Additive Manufacturing Competition
      - [http://www.squareonenetwork.org/professional-development/](http://www.squareonenetwork.org/professional-development/)
      - [http://f1inschools.sae.org/](http://f1inschools.sae.org/)
  - Pitsco 3D Printing-Vehicle Engineering
  - Leapfrog 3D printing for education
  - PrintBot Learn
  - 13DCreatives
  - Stratasys
## CAD tools

### Free (for educators)
- **AUTODESK 123D**
- **TINKERCAD**
- 3DTin
- Blender
- FreeCAD
- OpenCAD
- SCULPTRIS
- SketchUp
- 3D Model To Print

### Commercial
- **3DS MAX**
- **AUTOCAD (free-ish)**
- **CINEMA 4D**
- LightWave
- Autodesk Maya
- Photoshop CC
- Rhinoceros
- Zbrush
- SolidWorks
### Pre-Made CAD Designs

- Most CAD tools also offer the ability to upload/download pre-made CAD designs
  - **Thingiverse**
  - **GrabCAD**
  - **Google 3D Warehouse**
  - **3D Content Central**
  - **TraceParts**
  - **YouMagine**
  - **My Mini Facctory** (provides learning-centered pre-designs)
- More can be found here.
- Coming soon….Legos!

### Other options

- There are many 3D print shops and libraries willing to print your design if you send it to them.
- **3D printing Apps**
  Libraries are using their 3D printers as a small revenue stream (unless grant-funded)
Other 3D printing topics to look into

• Contests!
  • SAE (partnered with GM, Ford, Kia etc.) and ASME (sponsored by NASA) both offer competitions.
  • Printbot Learn projects
• Square One offers grants!
• ALA 3D printing and public policy doc
3D Printers

• Commercial printers are getting more affordable.
• Some of the “Total Package” options include a 3D printer or help you make your own 3D printer.

• Lots of folks getting in on 3D printers:
  • Playdoh!
  • Legos!
How can you incorporate 3D printing and STEM educational programs in the library?

By using this guy
Kid-Friendly 101 Project: Make a Lego 3D Doodler

- Using only a hot glue gun and 112 Legos students can make their own 3D doodler (simplified version of a 3D printer) to get started in the 3D printing world.
  - **Instructions**
  - Assemble Lego 3D Doodler- takes between 1-4 hours depending on student ability
  - Students can use colored 3mm biodegradable filament instead of hot glue sticks for different designs.
  - Choose keychain design from Thingiverse or a clipart outline-type image.
  - Go back through the tech plans and share reflections and designs.
  - I would suggest groups of 3-4 but have seen 5-6 work with experienced instructors.

Check out the video: [http://rebrickable.com/mocs/vmIn8r/lego-3d-printer-extruder](http://rebrickable.com/mocs/vmIn8r/lego-3d-printer-extruder)
Examples of student work
Students at work at the SAE 2015 3D printing contest