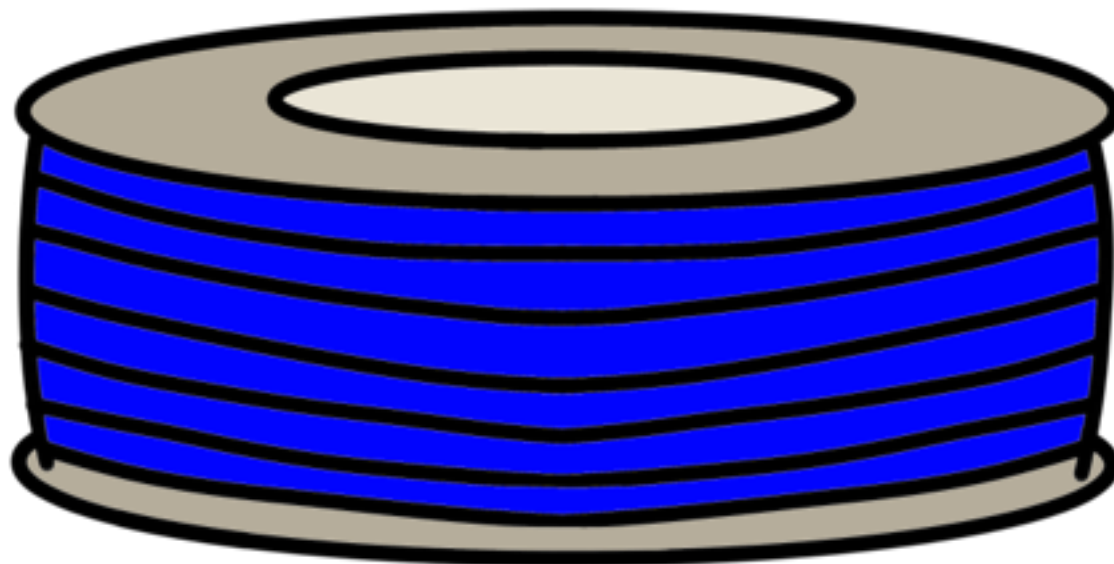




Using 3D Printing in the Science Classroom

Dr. Leslie Suters
Tennessee Tech University



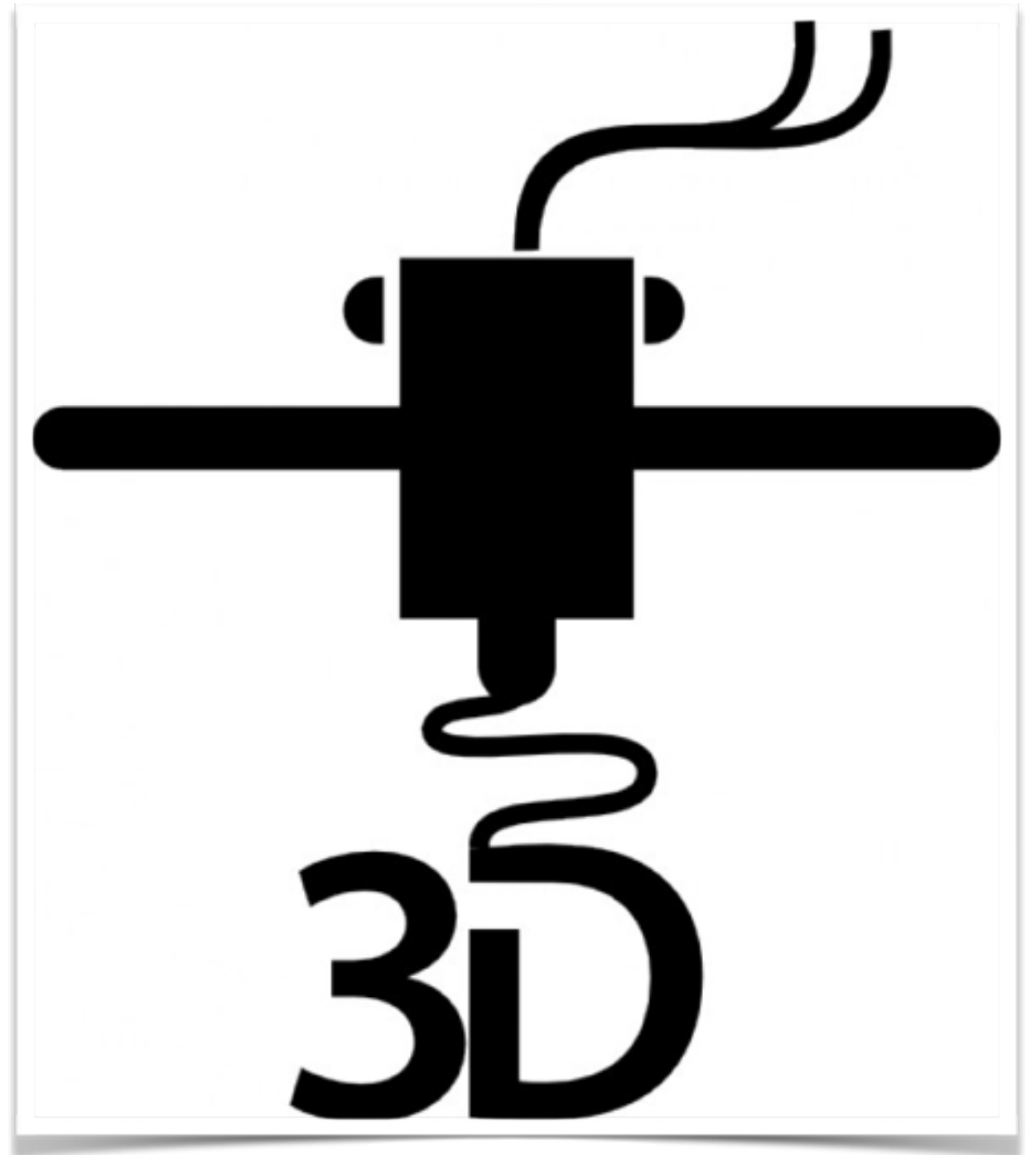
What is 3D Printing?

- ❖ Process in which solid 3D objects are created, one layer of material after another, from a single digital file.
 - ❖ Use a 3D modeling program to create an original object
 - ❖ Software: Google Sketchup, Tinkercad (cloud-based)
 - ❖ iPad Apps - Autodesk Tinkerplay, Blockify
 - ❖ Download a modifiable 3D file - (*most often STL- STeroLithography - format*)
 - ❖ MakerBot Thingiverse, Instructables, YouMagine, TurboSquid
 - ❖ 3D scanner

Why Use 3D Printing?

- ❖ These tools enable students to think creatively as they construct models using STEM, engineering design, computer programming, and collaborative teamwork.
- ❖ Collaborative learning spaces where teacher and students are equal learners in the process. Failure is part of process.

Edudemic (Slack, 2014)



What do You Need to get started?

- ❖ Begin with modeling tools (build prototypes)
 - ❖ Legos
 - ❖ Clay / Play-Dough
 - ❖ Pipe Cleaners
 - ❖ Jello
- ❖ 3D printer or 3D pen (more affordable and use the same technology)
- ❖ Filament - plastic
 - ❖ PLA - PolyLactic Acid (made from renewable resources)
 - ❖ ABS - Acrylonitrile Butadiene Styrene (shatterproof)
- ❖ Masking tape
- ❖ Chisel to remove your creation...
- ❖ Time to troubleshoot!!!
 - ❖ Search YouTube for tutorials



What can you do in the classroom?

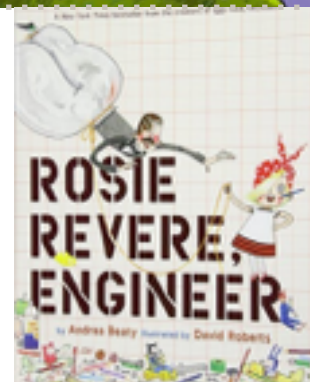
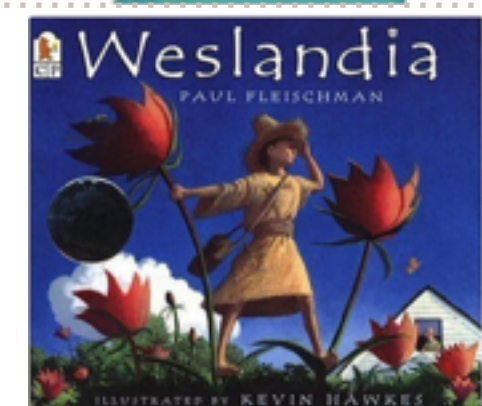
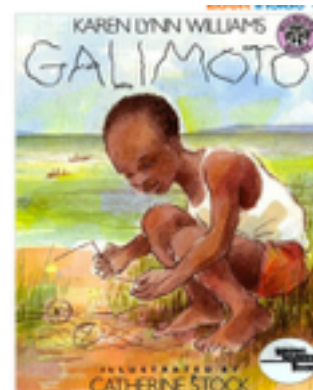
- ❖ Allows students to create physical objects that relate to their curriculum.
- ❖ Body parts such as a femur, landforms, caterpillars, robot parts, math manipulatives
- ❖ Math is embedded - proportional reasoning
- ❖ Social studies - design buildings, technology artifacts, etc. from history

Literacy Connections

- ❖ Reading - fiction & nonfiction texts
 - ❖ Informational text
 - ❖ *Kids get real helping hands from 3-D printers* (Newsela)
 - ❖ *Cuttlefish, an ocean shape-shifter, inspires new 3D printer textures* (Newsela)
 - ❖ *7-year old girl gets new hand from 3D printer* (Tween Tribune)
 - ❖ Fiction - Inventions, creativity
 - ❖ Students can be encouraged to read online about 3D printing and look for things to print
- ❖ Writing - about creations
- ❖ Public speaking skills & discourse enhanced as students explain work

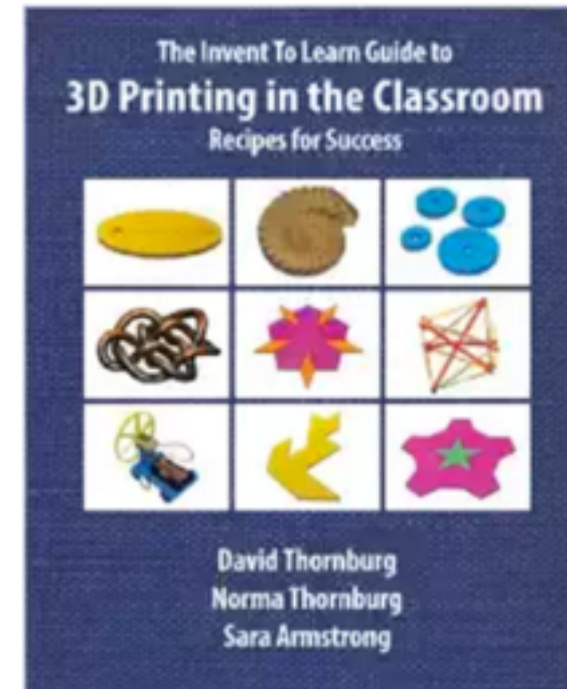
Recommended Children's Books

❖ Connect to Inventing & 3D Printing



Examples of Curriculum

- ❖ **Solving Problems with 3D Printing - \$5 Teachers Pay Teachers**
 - ❖ PreK-1st grade
 - ❖ Independent Learning Center Approach
 - ❖ Post “Problem”, students brainstorm, draw solution & sculpt solution
- ❖ **City X Curriculum - FREE**
 - ❖ Designed for students 8-12 years old
 - ❖ Creative Problem-solving using 3D technologies and the design process
 - ❖ Toolkit - instructor guide, printable guide, Common Core Alignment, videos
- ❖ **BrainPop - 3D Printing Lesson Plan - print your own Moby - FREE**
 - ❖ Grades 3-12
 - ❖ Read article about 3D printing, brainstorm & sketch things they’d like to print



iPad Apps

- ❖ iPad apps allow for an easier interface (than software such as Sketchup) to allow young users to design their creations. Many work with blocks similar to Minecraft.
- ❖ *Options: Wireless print, export STL (or other formats)*

Blockify
\$3.99



Makers
Empire



MakerBot
Printshop



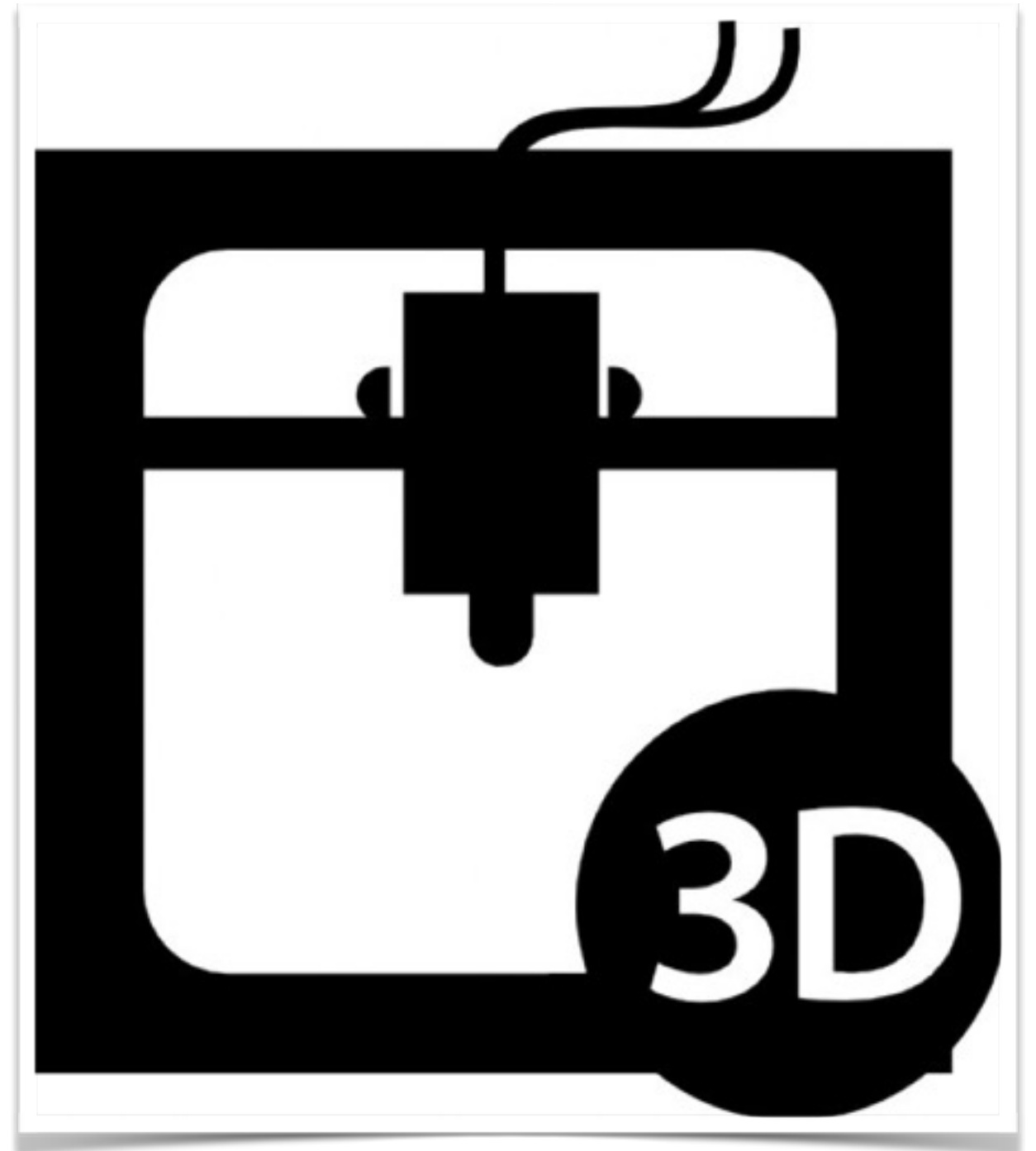
ThingMaker
Design



AUTODESK®
TINKERPLAY

Technical Tips

- ❖ Watch YouTube videos
 - ❖ how to load filament
 - ❖ how to operate machine
- ❖ Call/contact the manufacturer
- ❖ Keep hands-off the printer nozzle
- ❖ Keep a basket of printed items near the printer
- ❖ Play with resolution
 - ❖ layers
 - ❖ fill density
 - ❖ wall thickness
- ❖ Always attend to the printer - check in often
- ❖ Order variety of filament colors
- ❖ Invest in two nozzles



Pedagogical Tips

- ❖ Organize printing
 - ❖ how will students submit work?
 - ❖ How will you give feedback?
 - ❖ How will students revise?
 - ❖ How will you organize prints efficiently?
- ❖ Let students work in teams
- ❖ Start with pre made items
- ❖ Use boxes to keep organized
- ❖ Let students use software that is most comfortable to them
- ❖ Plan longer-term projects
- ❖ Learn together!

Vicki Davis - Edutopia, 2015



Resources - Curriculum Ideas

- ❖ **Problem Solving with 3D theme - PreK-1 Stations**

- ❖ <https://www.teacherspayteachers.com/Product/Problem-Solving-with-3-D-Printing-Theme-1680183>

- ❖ **Print Your own Moby Lesson Plan**

- ❖ <https://educators.brainpop.com/lesson-plan/3d-printing-lesson-plan-make-moby/?bp-topic=3d-printing>

- ❖ **Mini Maker Notebook**

- ❖ <http://designmaketeach.com/2013/05/23/mini-maker-notebook-v1/>

- ❖ **City X Project**

- ❖ <http://www.cityxproject.com/>

- ❖ **Other Lesson Plan Sites**

- ❖ <http://www.3duniverse.org/tag/3d-printing-lesson-plans/>

- ❖ <https://docs.google.com/document/d/1fzFSsgQon7SlSW358gD3rN3KAvU8UWvK5tZ8eNzuepg/edit?pli=1>

- ❖ <https://sites.google.com/a/sabinepass.net/education-in-3d/lesson-plans>

Resources - Informational Text Articles

❖ Tween Tribune

- ❖ <http://www.tweentribune.com/article/tween56/7-year-old-girl-gets-new-hand-3-d-printer/>

❖ Newsela

- ❖ <https://newsela.com/articles/3D-limbs/id/5466/>
- ❖ <https://newsela.com/articles/cuttlefish-camouflage/id/10908/>

Resources - Articles

- ❖ <http://www.freotech4teachers.com/2015/06/3d-printers-in-elementary-school.html#.Vvz8SGQrLUo>
- ❖ <http://www.schrockguide.net/3d-printing.html>
- ❖ <http://corkboardconnections.blogspot.com/2014/10/3d-printers.html>
- ❖ <https://thejournal.com/Articles/2013/12/11/3D-Printing-in-the-Classroom-5-Tips-for-Bringing-New-Dimensions-to-Your-Students-Experiences.aspx?Page=1>
- ❖ <https://www.makersempire.com/blog/5-year-olds-design-and-3d-print-hungry-caterpillar-at-north-adelaide-primary-school/>
- ❖ <http://www.fractuslearning.com/2014/07/10/3d-printing-elementary/>
- ❖ <http://www.edutopia.org/blog/jaw-dropping-classroom-3d-printer-todd-finley>
- ❖ Using Minecraft: 3D printing in education (can export STL files of creations from Minecraft to 3D print)
 - ❖ <https://www.youtube.com/watch?v=KwyvyBS0ag8>