OPTIMIZING USABILITY OF 3D PRINTERS IN THE CLASSROOM

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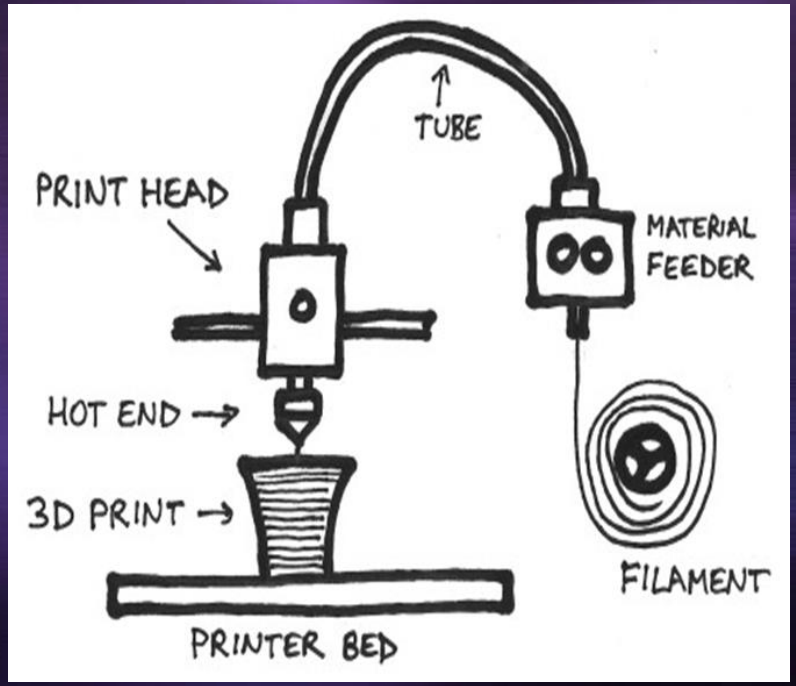
Agenda

- What is 3D printing?
- What Can You 3D print?
- Tools for Printing
- Available 3D Printers
- Software
- E3 Program Research- TAMU
- Lesson Plan Overview- Product Improvement
- Examples Projects & Other Resources

WHAT IS 3D PRINTING?

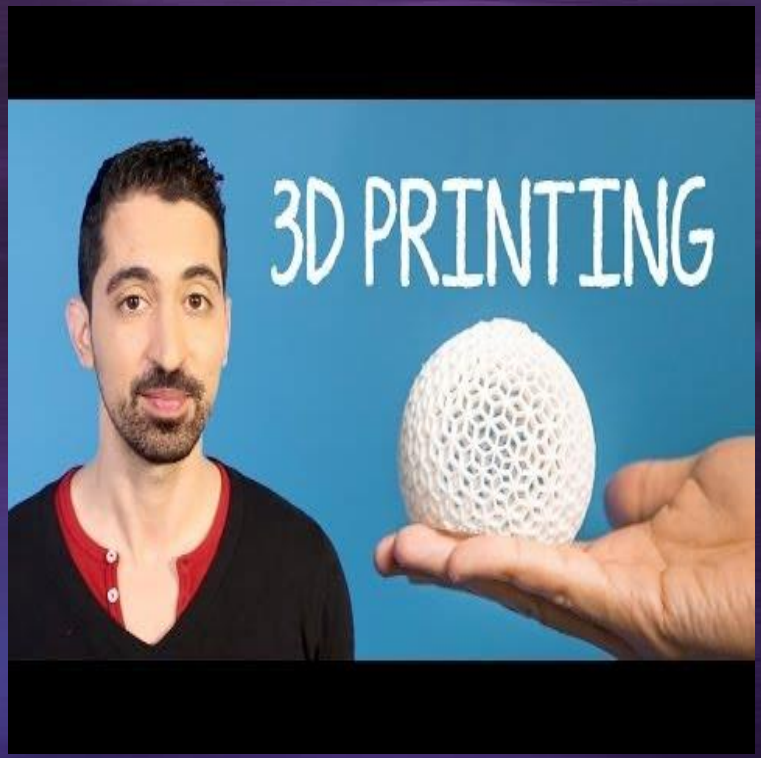
The Basics

- Process used in order to make a physical object out of a 3-dimensional digital model.
- Additive process that sets down successive layers horizontally to create the 3D object.



Explaining 3D Printing

3D Printing Explained



WHAT CAN YOU 3D PRINT?

Practical Objects

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ingiverse.com

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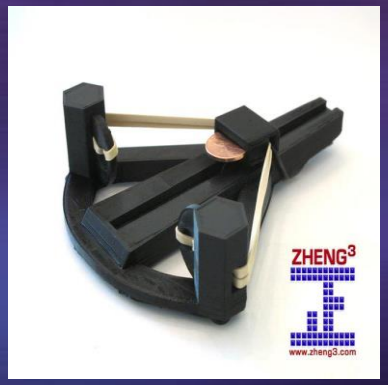
Any Entertainment-Oriented Object Imaginable

Along with objects that have practical use, there are a nearly infinite amount of toy-making possibilities. Along with toy creation, one is able to create customized parts for already existing toys such as legos and nerf guns.



Penny Shooter

Nerf Attachment

"Gnomedozer" snap model

Industry Use

This video shows the numerous movie projects which Legacy Effects has worked on, and how their extensive use of 3D printing has helped to create some famous models used in popular movies like Iron Man and Avatar.

This second video shows how 3D printing can be used to help in the field of dentistry. It's use extends to education, with models of damaged/out of place teeth created for students to assess and "treat".

TOOLS FOR PRINTING

Tape or Glue/Adhesive

These are used to help the 3-D model adhere to the plate while printing. This is essential for a 3-D printer because without it the model might shift while printing creating a rift in the model.

Scraper/Razor Blades

Once the object is printed, these tools are used to help safely remove the model from the base plate.

Finishing Hand Tools

Other tools that can be useful in 3-D printing are anything to do with cleaning up the finished model, such as files, sandpaper, and a blade of some sort.

AVAILABLE 3D PRINTERS

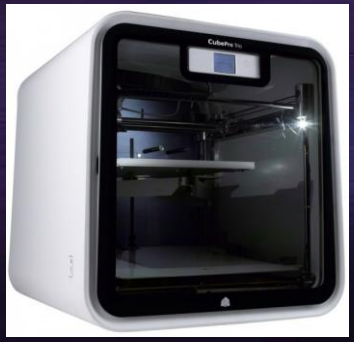
High Quality High Price

Formlabs Form 1+ $3299

- Pros
  - Extremely high quality
  - Prints in Resin
  - Prints with uv light rather than layering plastic thereby increasing quality
- Cons
  - Difficult to use
  - Material is expensive
  - Can be easily damaged
  - Print table is no larger than average
  - Material may begin to harden slightly if left unused for long periods

Cube Pro Trio $3000 - $5000

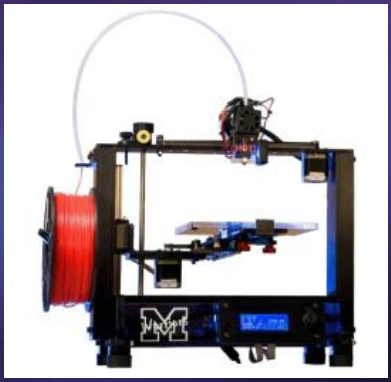
- Pros
  - Large Print bed
  - High quality prints
  - 3 Print heads allowing one to print in 3 different colors without the need to switch them manually
  - Easy to print objects
- Prints wirelessly and through usb
- Cons
  - dimensions cannot be edited from the machine
  - Spools cannot be refilled
  - Third party spools do not work



Reasonable Price, Solid Build

INVENT3D- $1500

- Pro
  - Developed specifically for students and the educational market
  - Can be operated independent from a computer with the included LCD
  - accepts 3rd party spools
  - Easy set up
  - Uses economical PLA bulk filament
- Cons
  - Open Frame means more noise
  - Plate leveling needs to be done often



Makerbot Replicator Desktop- $2745

- Pro
  - High resolution
  - Large bed
  - User Friendly
  - Relatively simple
  - Print wirelessly and through USB
- Cons
  - Loud
  - Extruder problems in the past

Budget Friendly Options

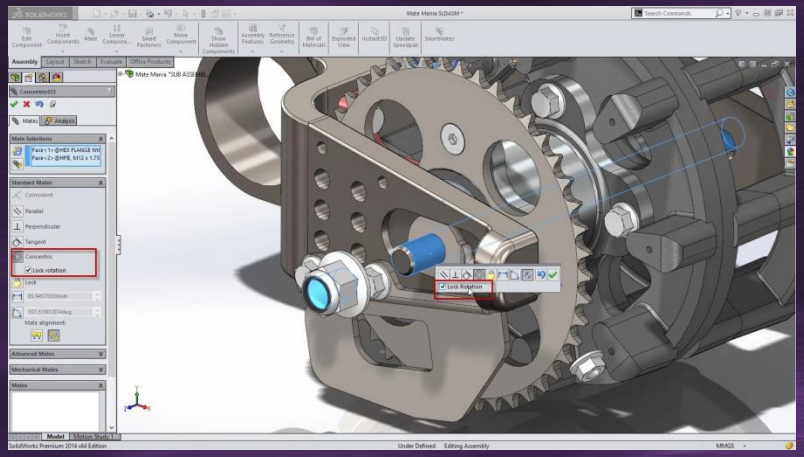
3D Systems Cube 3d Printer- $700

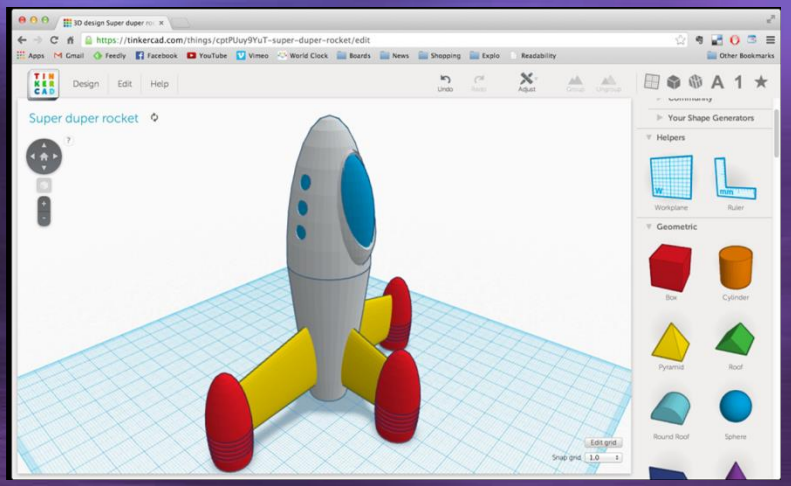
- Pros
  - Cheap
  - Easy to use
  - Prints in PLA and ABS
  - Prints via WIFI
- Cons
  - Poor build quality
  - Can only print on wifi
  - only one extruder head
  - Open Frame

XYZ printing Nobel 1.0- $1032

- Pros
  - UV printing uses resin
  - Feeds resin into machine on its own
  - Higher resolution than any layered filament
- Cons
  - Errors appear often with the auto feeding mechanism
  - Uses chemicals which can be very harmful to exposed skin as well as the lungs
  - Difficult to tell how much resin is in the chamber

SOFTWARE





Software for 3D Printing

CAD Software

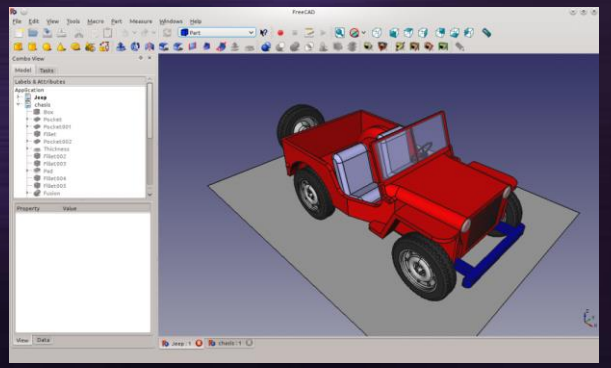
-Every printer is compatible with models made with any software as long as they can be converted into a .stl format.

Paid Subscriptions (free for students)

-Solidworks- $1,295 per year (used for technical objects and assemblies)
-Inventor- $1,890 per year (used for technical objects and assemblies)
-Maya- $1,470 per year (used for animations and freehand models no assemblies)

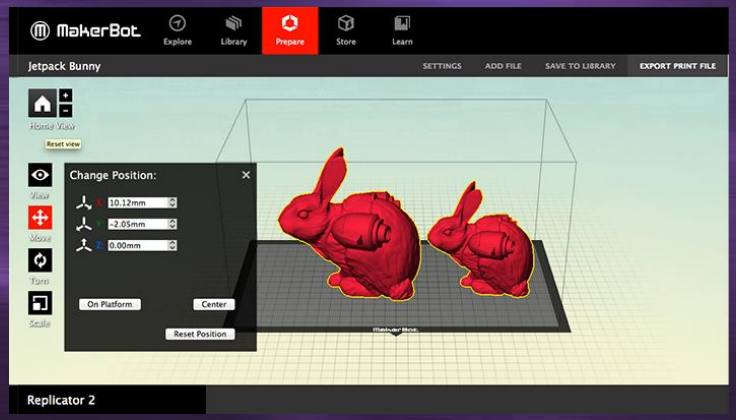
Free CAD Software

-Tinkercad- Online
-Freecad- Downloadable



G-Code Software

G-code software allows a .stl file to be turned into instructions for the 3D printer.



Open Source

-Simplify3D-$150

-Printrun-free

-Slic3r- free

Software for Common Printers (free with printer)

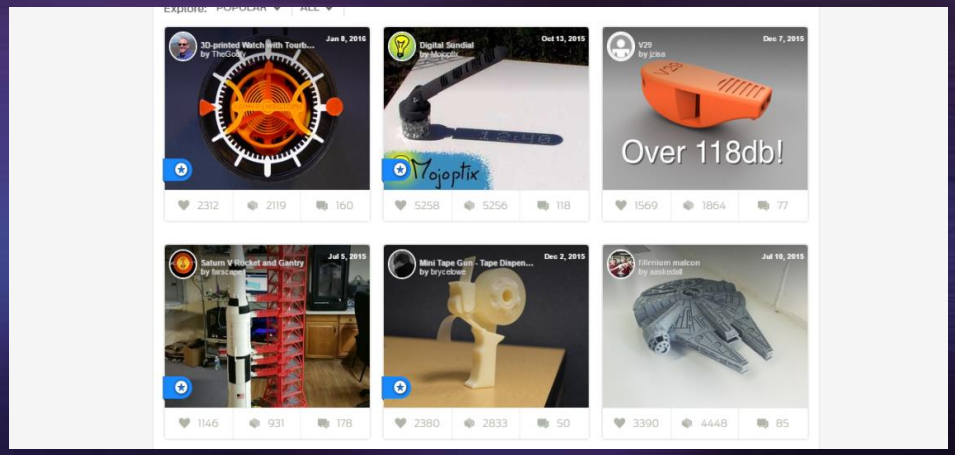
-Makerbot desktop

-Cube pro desktop

-Preform

Other Programs

- http://www.interop3d.com/apps/ -Allows you to convert a wide variety of parts into a .stl format.
- Thingiverse- Allows you to find other 3D models created and posted by others that can then be downloaded.



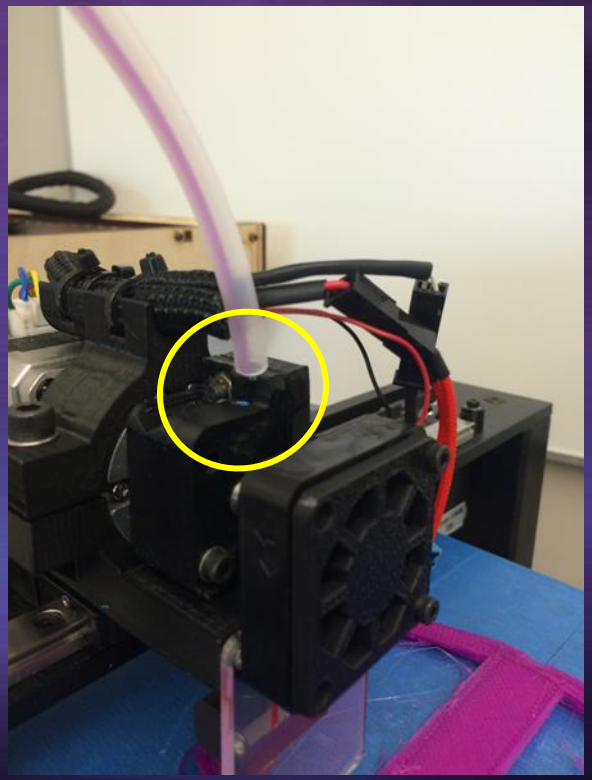
E3 PROGRAM RESEARCH

Research Overview

- Research Objective: Improving the functionality, usability, and performance of the printers by redesigning printer components.
- Experiments: Test printing with standard file type, temperature, and filament settings
- Qualitative Data:
  - Print Quality
  - Special Material Performance

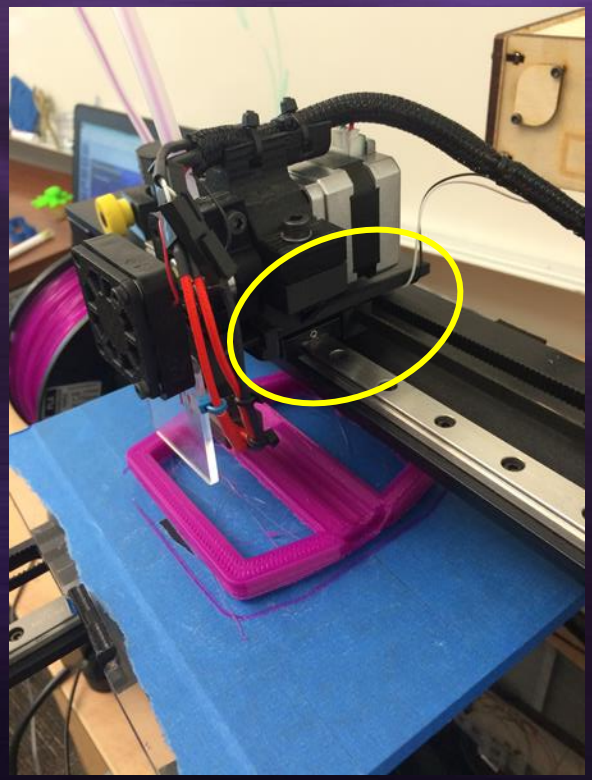
Product Improvement

Filament Feed Bracket



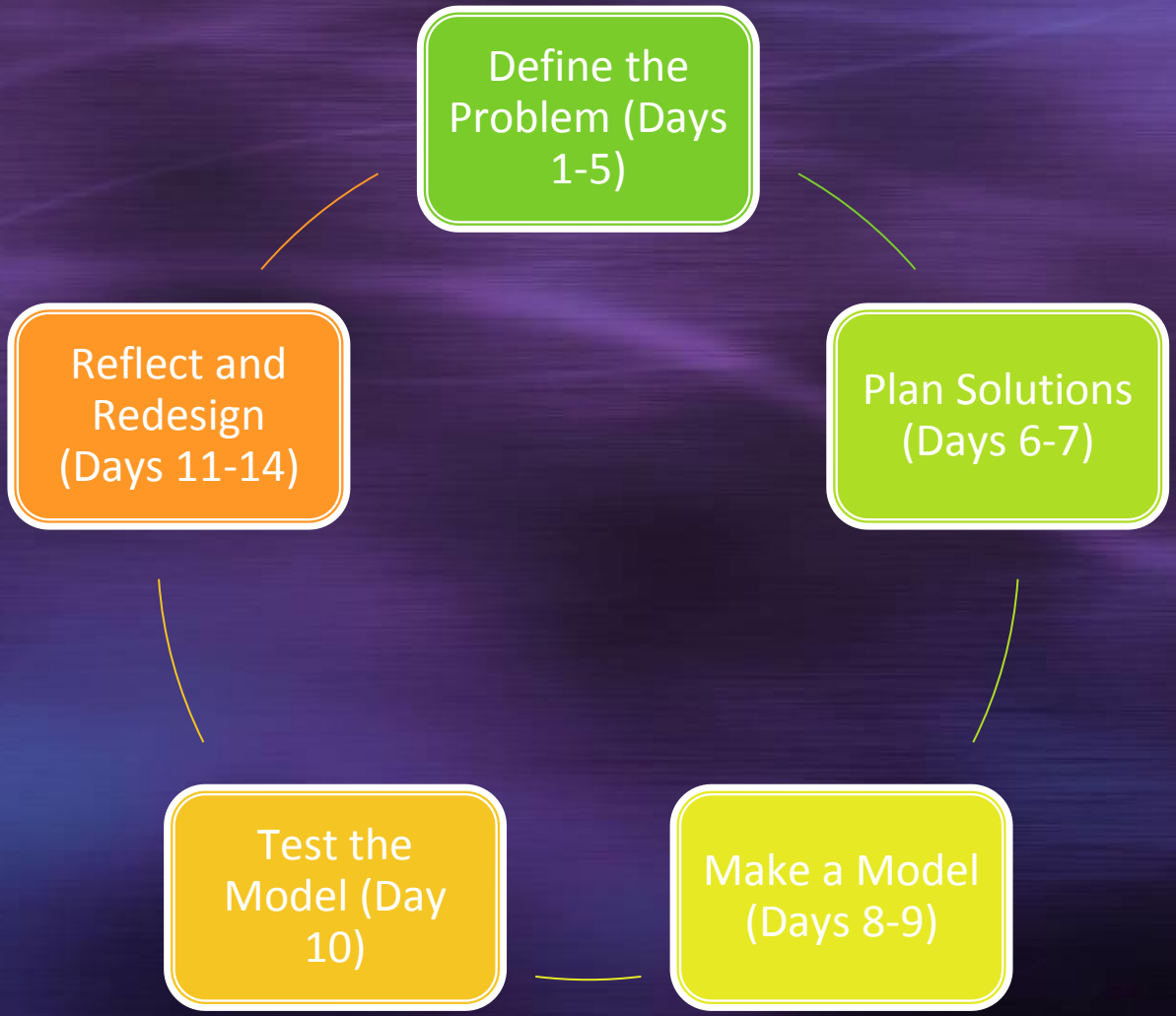
Spool Hanger

Motor Mount



PRODUCT IMPROVEMENT LESSON PLAN

Lesson Plan Overview- Product Improvement

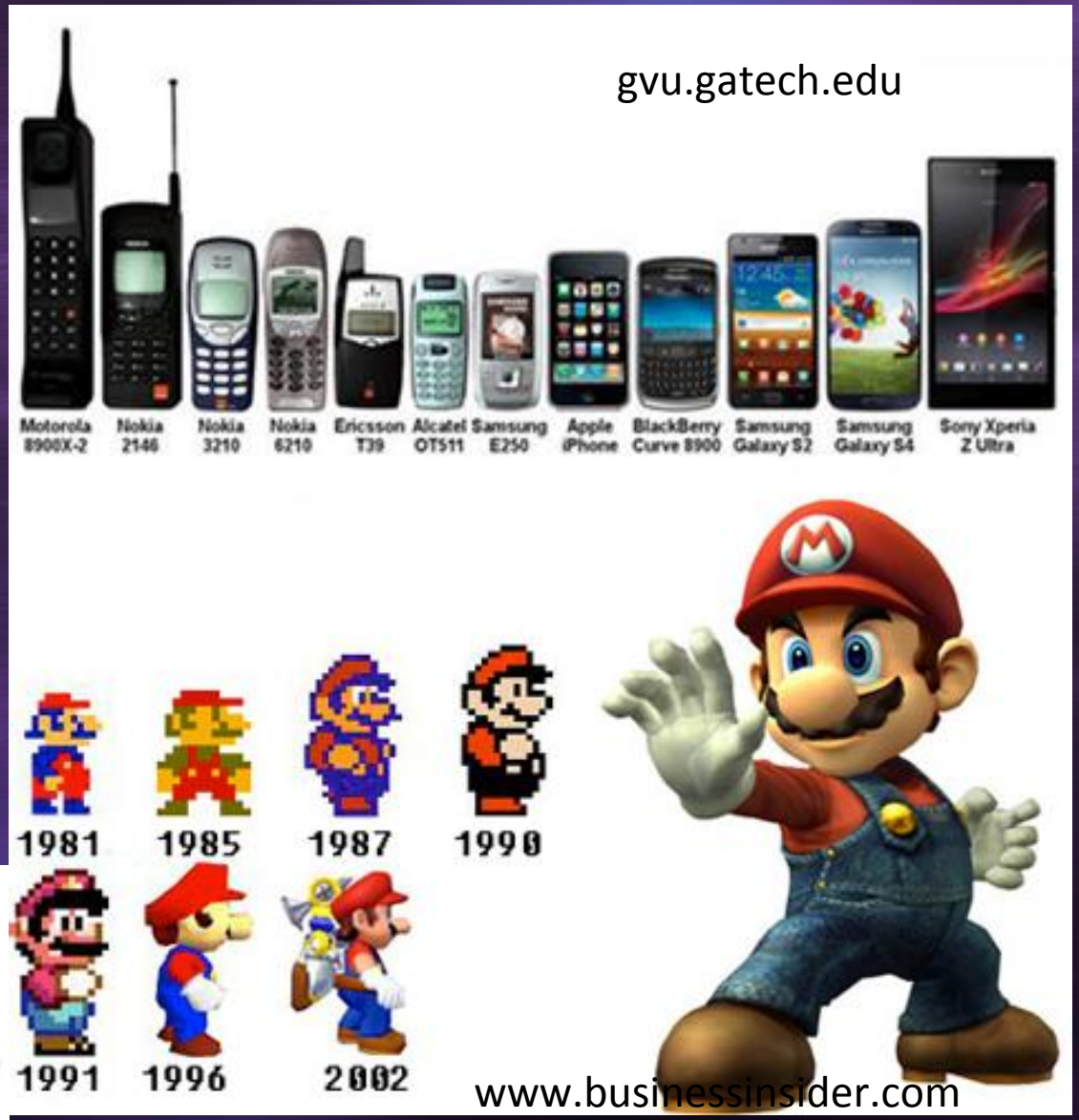


TEKS- Concepts of Engineering and Technology; 6, 9, 10

- identify and describe the fundamental processes needed for a project, including design and prototype development;
- use problem-solving techniques to develop technological solutions;
- use consistent units for all measurements and computations; and
- assess risks and benefits of a design solution.
- apply design concepts to problems in physical and mechanical systems; and
- apply the design process in a team;
- maintain an engineering notebook for the project;
- develop and test the model for the project; and
- present the project using clear and concise communication skills.

Day 2

- Product Evolution
- Reverse Engineering
  - Documentation
  - Discovery
  - Investigation
  - Product Improvement

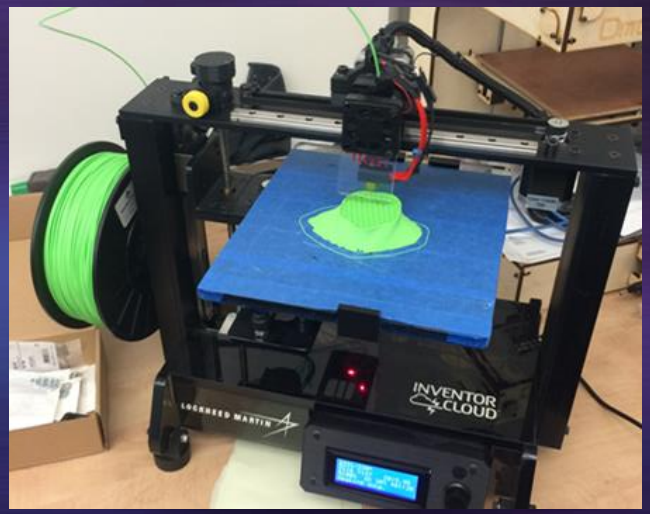


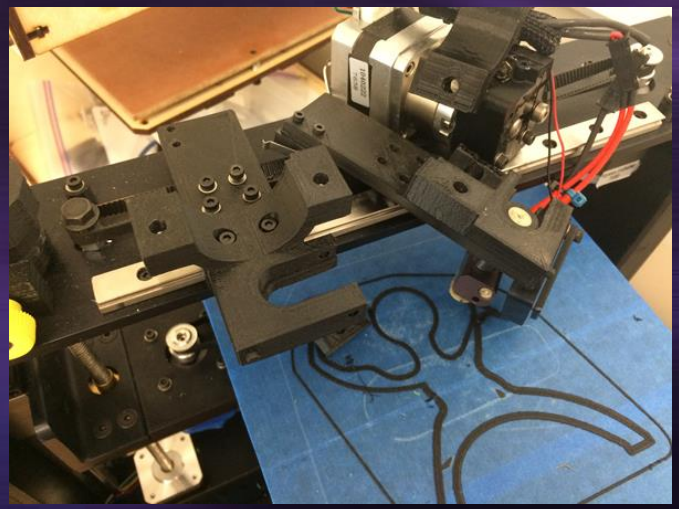
Days 3-5

- Each day will focus on visual, structural, and functional analysis.
- We will evaluate a products:
  - Spork
  - Earbud case
  - Invent3D Printer
  - Packaging - How can we reduce packaging size which cuts the cost of materials and speed up the packaging process?

Days 8-9

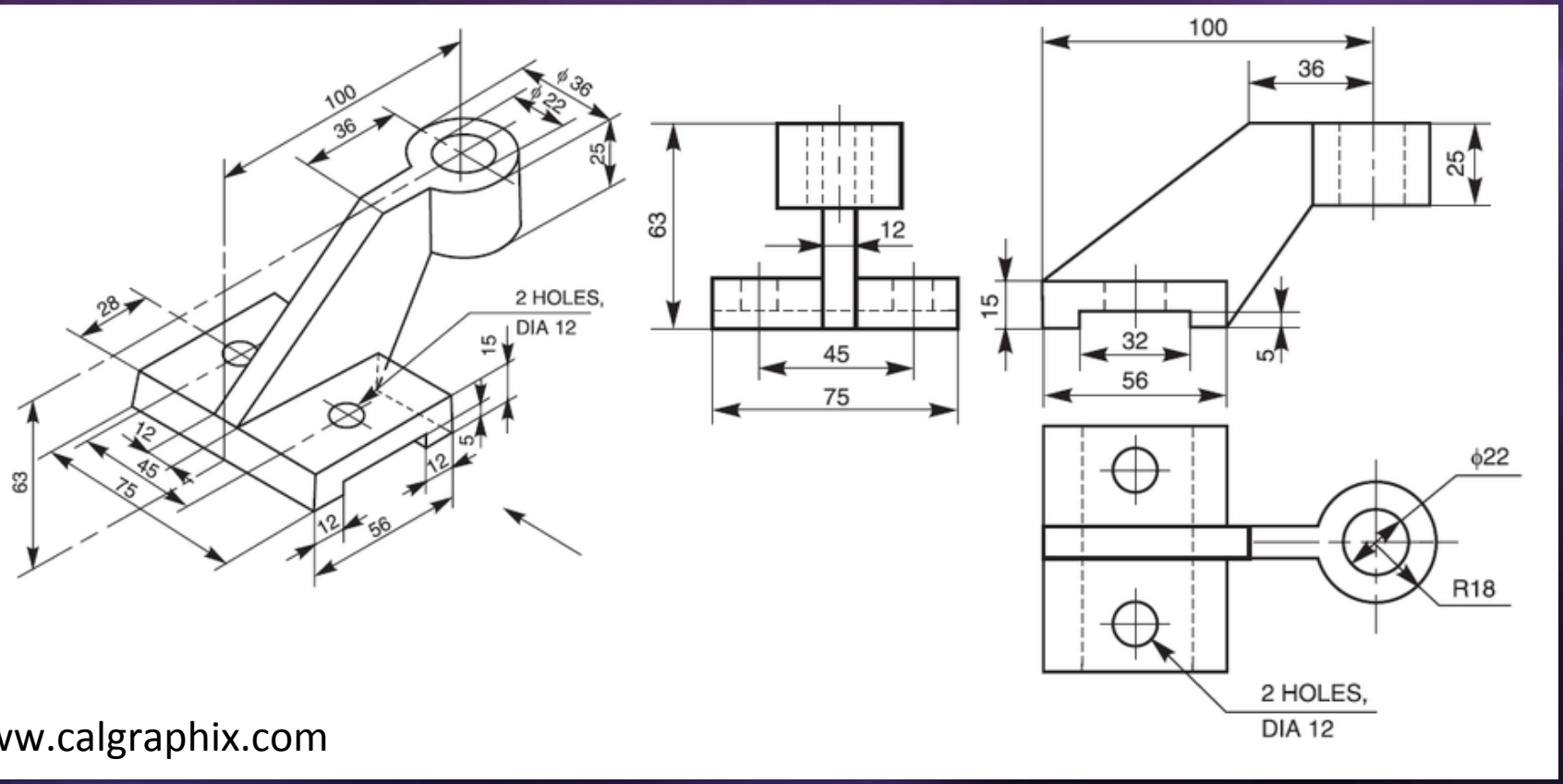
- Choose a design idea and then model it in CAD
- Print a prototype of your design in the 3D printer
- Discuss ways to make the print come out most efficiently and with good quality





Day 11-12

- Create part drawings and a presentation on the design process and test results.



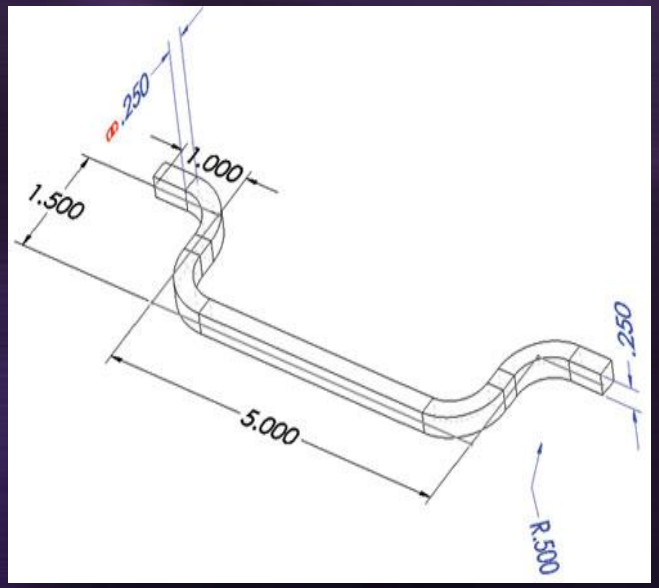
www.calgraphix.com

EXAMPLE PROJECTS

Lesson Plans

- Lesson plan ideas can vary dramatically. Depending on financial and time constraints, many options are available. Creating an object freely is always an option, but then problems such as appropriateness and practicality become important.

- One idea is to have students create a keychain of their choice. This would be a small project that would print quickly and not use much filament, plus it would have a sense of achievement with doing something that a larger project might not offer due to frustration.



Lesson Plans

- Thingiverse hosts a print competition every two months or so. They specify a prompt and then people submit their design ideas.
- https://www.thingiverse.com/challenges

- Professional educational curriculums are available online as well. SeeMeCNC has a 3D printing guide for teachers and educators.
- https://docs.google.com/document/d/1fzFSsgQon7SlSW358gD3rN3KAvU8UWvK5tZ8eNzuepg/edit?pli=1

Lesson Plans

- Entire documents are available to help guide the teachers in their pursuit of educational conquest.
  - https://docs.google.com/document/d/1fzFSsgQon7SlSW358gD3rN3KAvU8UWvK5tZ8eNzuepg/edit?pli=1
- Stratasys has a full lesson plan already laid out for educators as well. They set up the course to take approximately one full semester.
  - http://www.stratasys.com/industries/education/educators/curriculum/introduction-to-3d-printing
  - http://video.stratasys.com/services/player/bcpid2346945686001?bckey=AQ~~,AAABZHZNdKk~,FM7H3b6my7a8DLyTJUyXKv_NA3MSXGi-&bctid=4332418971001

QUESTIONS?

Acknowledgements

- Dr. Justin Yates
- Katharine Leysath
- TiffanI Cortez
- Stephanie Willox
- Teresa Monterrosa
- Dr. Saniyyah Thomas
- Tila Hidalgo
- E3 Program