BOISE STATE UNIVERSITY

IDoTEACH

Integrating Engineering and Making in Research Methods

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Overview

- Introduction to Engineering and Engineering Design
- 3D Printing and the Boise State University MakerLab
- Developing an Engineering 5E Lesson
- Future Ideas
- Group Discussion

The Marshmallow Challenge

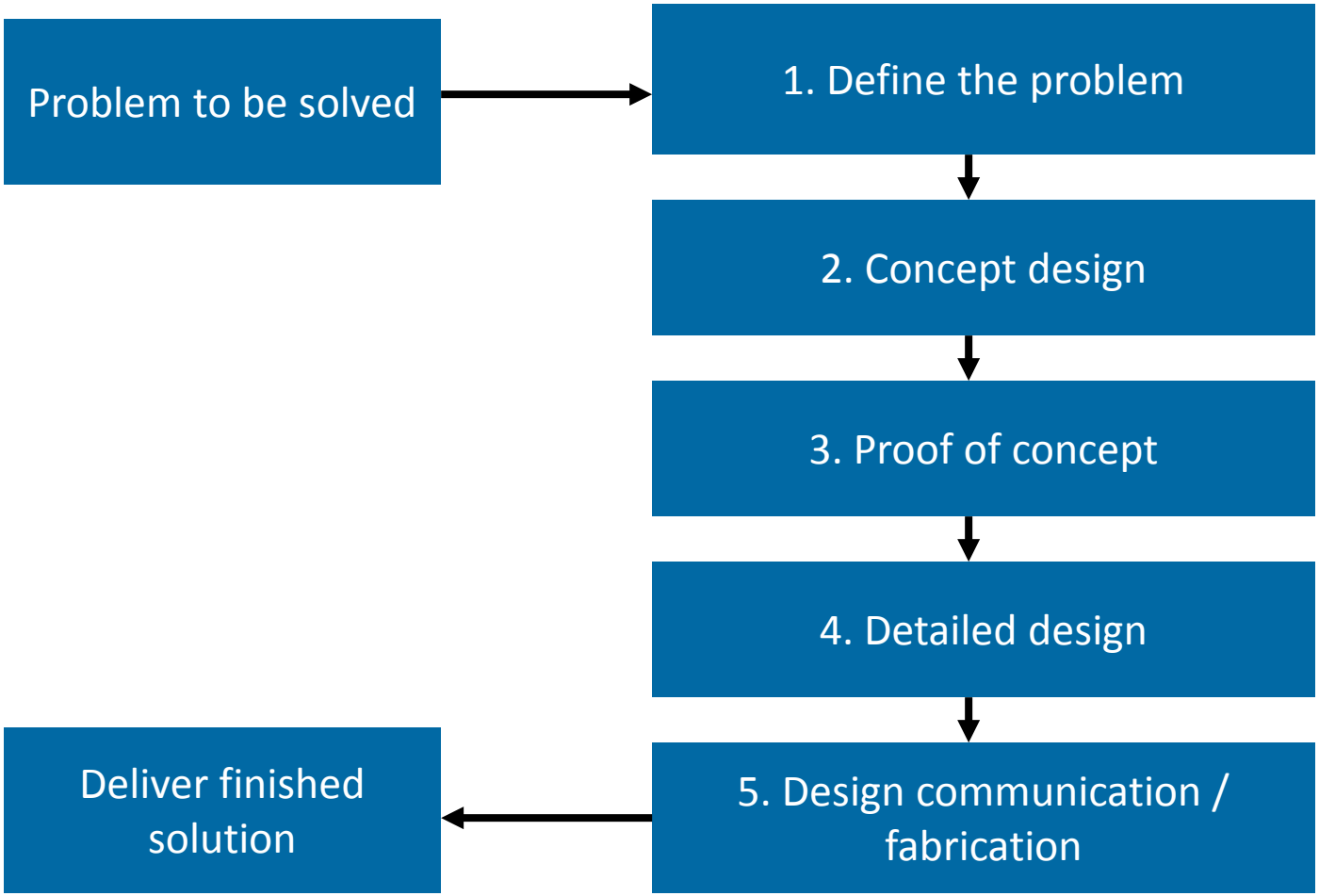
The Marshmallow Challenge

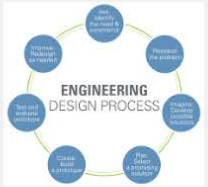
- Using
  - Spaghetti
  - Tape
  - String
- In 18 minutes, build the tallest freestanding structure that can support a marshmallow
- Debrief
  - Talk about process
  - Compare to others' experiences with the marshmallow challenge

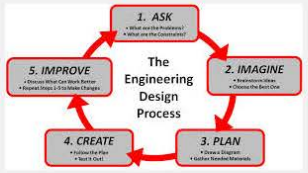
The Marshmallow Challenge

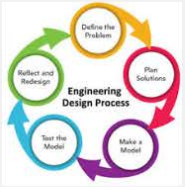
- Pros:
  - Engaging, high energy
  - Quick introduction to design
- Cons:
  - Potentially reinforces misconception of engineers as builders
  - Lacks relevance
- Discussion:
  - What activities have you used to introduce engineering to university and/or K-12 students?

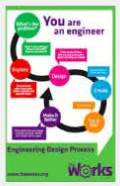
A model of the engineering design process

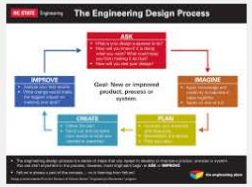


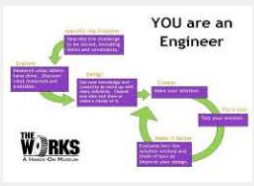



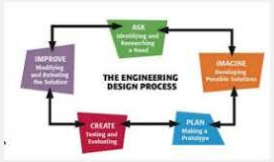



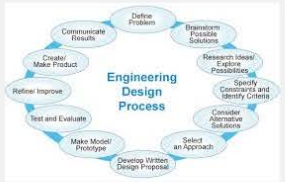




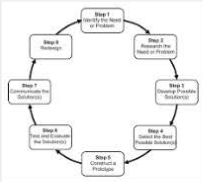


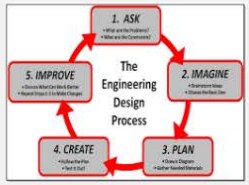



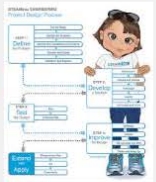


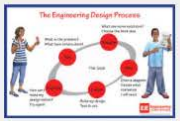


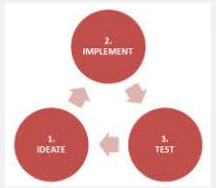


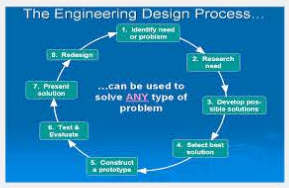


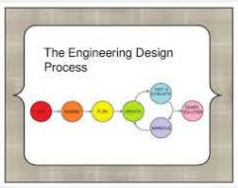


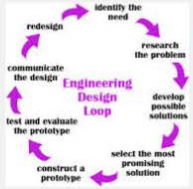


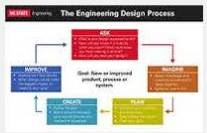



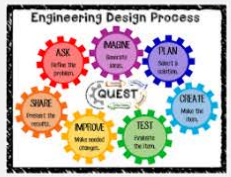


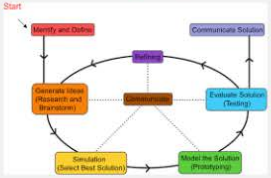












IDEO's Deep Dive

Documentary of a product design firm (IDEO) developing a solution to a design problem (rethinking the shopping cart)

Pros

- Provides a comprehensive view of an engineering design process
- IDEO is a recognized leader in this field
- Condenses an engineering design activity into a 22 minute television show episode

Cons

- Contrived problem
  - Client is ABC's Nightline, a news show
  - Somewhat dated (1998)
- Product Design vs. Engineering Design
- Problematic presentation of who gets to be an engineer
  - Mostly male
  - Not very diverse
  - Engineers = Silicon Valley Geek Culture

Discussion questions

- What are other ways to introduce engineering design ***as it is done by engineers***?
- Is this important?

3D Design and Printing and the MakerLab

- 1 Class Period
- Led by a library faculty member
- Overview of the MakerLab
  - http://makerlab.boisestate.edu
- Introduction to TinkerCad and Thingiverse
- Introduction to 3D Printing

MakerLab Vision

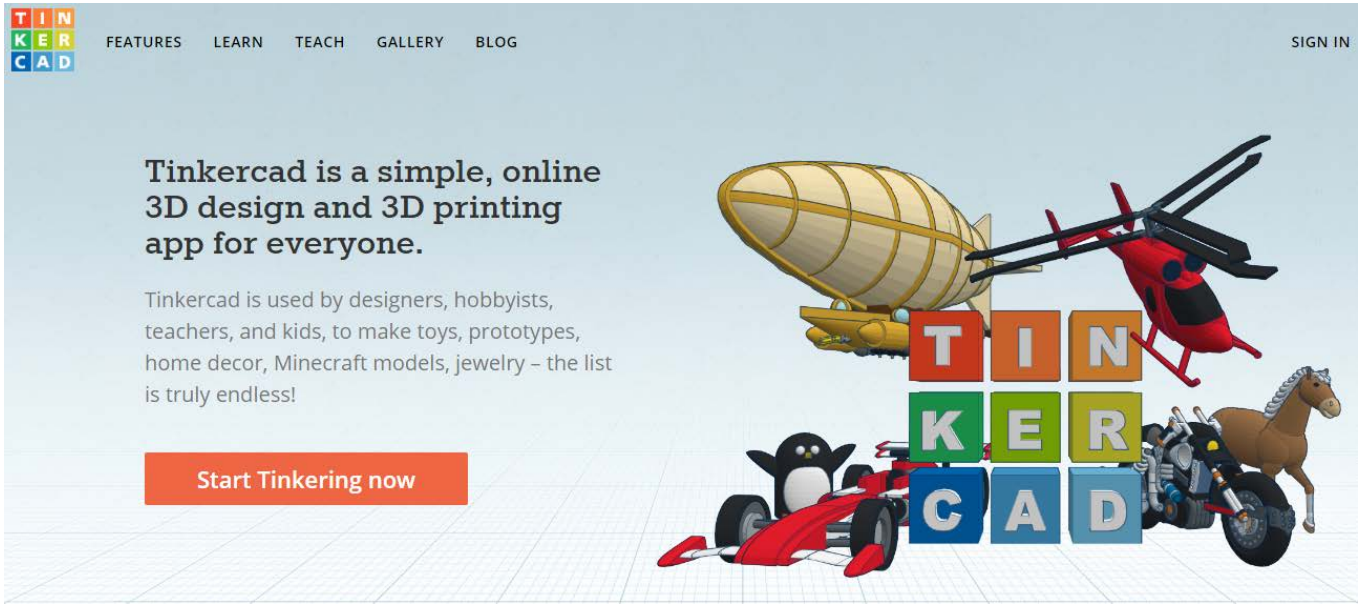
The makerspace is a radically inclusive community with a clear pipeline to fabrication resources allowing students to design ideas, objects, and dreams

Tinkercad is basic Autodesk software that allows basic modeling features for 3D design.

Anyone can create a free account.

Students and educators can download Autodesk Inventor for free, and other products from this company.

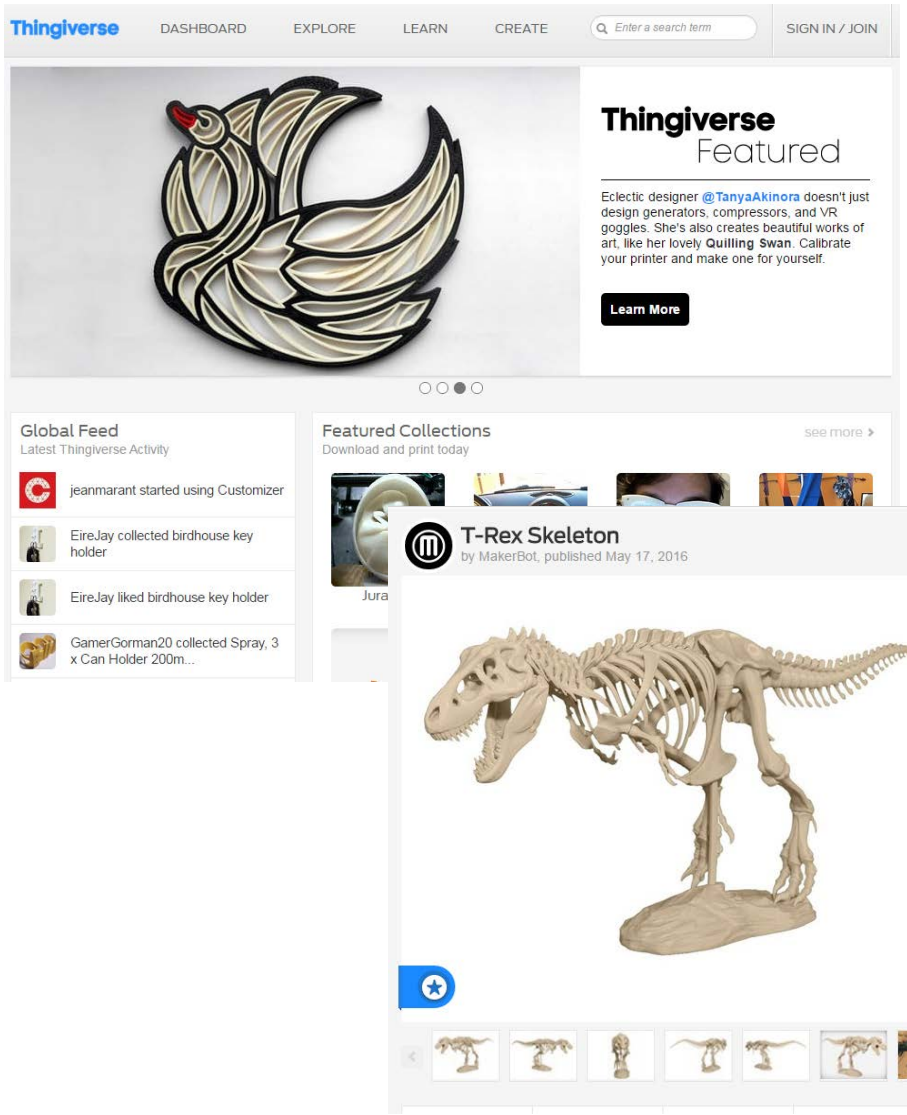
This works seamlessly with Thingiverse to upload and modify files.



Thingiverse is an open repository managed by MakerBot to host, share, and allow download of 3D things.

Many students import a preexisting file and modify it in Tinkercad.

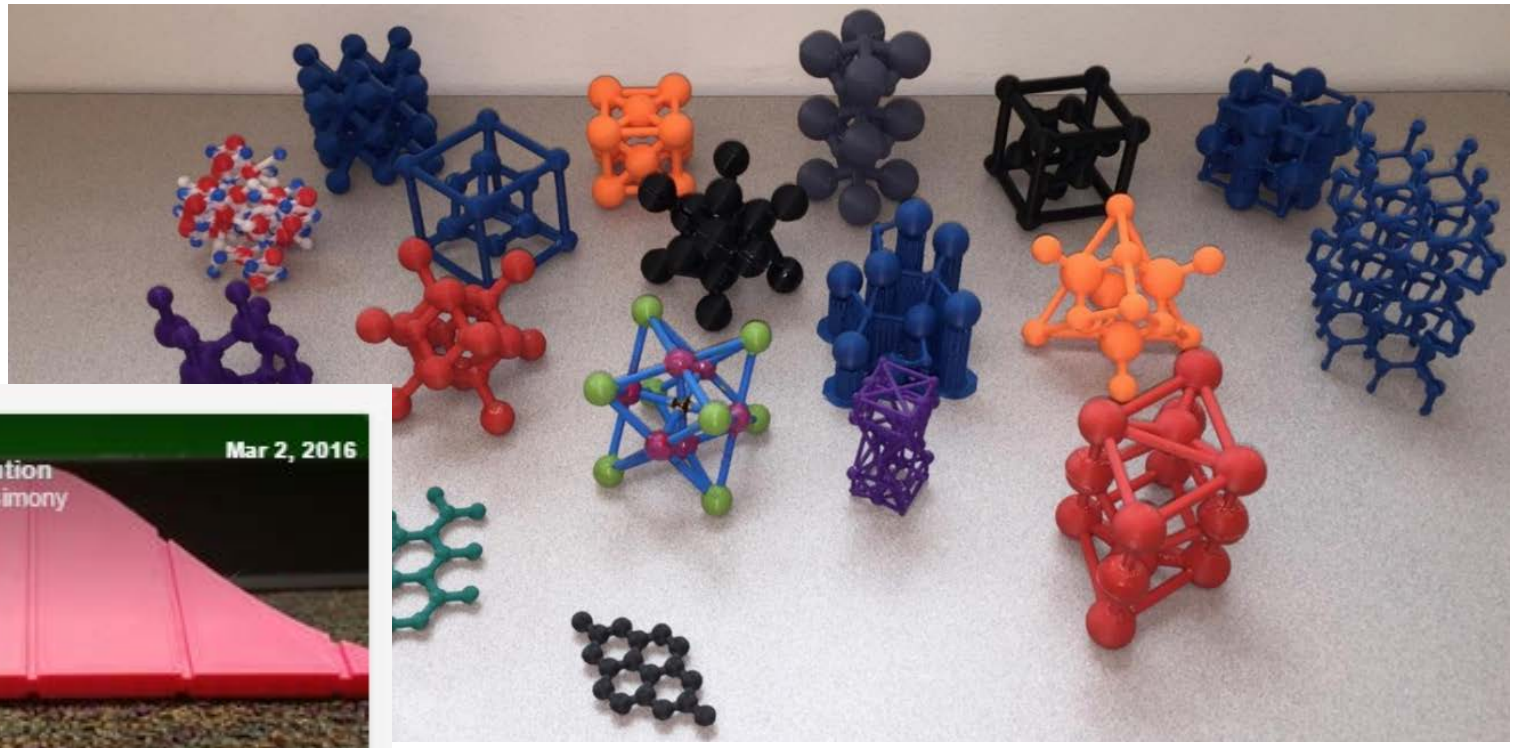
Many manipulatives exist here for classroom use.



3D Printing @ the Library

- Library maintains multiple 3D printers for student use
- Students design objects, get trained on the 3D printers, and print their designs
- 3D printing has a learning curve associated it, but facilitates creating tangible objects without requiring a lot of experience
- It's free!

Student Examples



Discussion

- How can you envision utilizing 3D printing in the preparation of future STEM teachers?
- Think, discuss with your neighbors, then we'll share out

The Engineering 5E Lesson

- The 5E Lesson Format:
  - Engage
  - Explore
  - Explain
  - Elaborate
  - Evaluate
- Integrate
  - Content Area
  - Engineering Design
  - 3D Printing

Examples of Student Lessons

- Creating terrain maps to understand water flow and drainages (Geosciences)
- Printing models of skeletal joints to understand physiology (Biology)
- 3D Printing Musical Instruments (Physics)

Where are we headed next?

- Increase access to 3D printers
  - Using 3D printers to develop manipulatives for the classroom
- Introduce other Engineering/Maker technologies to our students
  - Arduino, Programming, Robotics, ?
- Dedicate more time to engineering
  - Have students complete an engineering design project

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THANK YOU