Remember...

- Wednesdays 7:30-9:30 E5 Wizards in Hicks 212
- 9/9: Lab 1 due – submitted on moodle page
- 9/10: Mouse Escape – 4:15 p.m.
  - Arrive about 4:05 in front of Hicks for Ball Drop (if you are able to come). Choose one person to describe project: from 1 to 3 minutes.
  - Engineering Department Picnic starts at about 4:30 in front of Trotter
- 9/14: Mouse Escape Report due – submitted on moodle
- 9/17: Lab 2 due – submitted to moodle
- Shop class (not required – only if you are interested). You should have received an email about it.
The Big Picture

The next 3 weeks we will be exploring CAD (Computer Aided Design) with SolidWorks.
You will:

1. Design a part and have it printed in plastic.
2. Design a part and simulate stresses on it. We will build a model and test the accuracy of your predictions. This part will be part of a robot you will build
3. Design an assembly of moving parts.

Today we’ll talk about some manufacturing techniques, and get a brief introduction to SolidWorks.
Making and Designing Parts

- Today we will discuss how parts are made, and how we can design them.
- We won’t be doing much in terms of making parts, but if you are really interested take the shop course.
- Design of parts is largely done with CAD (Computer Aided Design) software. We will use a software tool called SolidWorks to do this.
Making parts (1)

- Subtractive Prototyping (Start with stock, and remove)
- Manual vs. CNC (Computer Numerically Controlled)
- Manual Milling machine: Cutter spins [video](http://www.youtube.com/watch?v=CVnSq2fDfGU)
- CNC Milling machine:
  - 3 axis (smaller): [video](http://www.youtube.com/watch?v=LdrFHBUUKEx)
  - 4 axis: [video](http://www.youtube.com/watch?v=j6ce8varBbo)
  - 5 axis: [video](http://www.youtube.com/watch?v=RSvgvNyHEYU)
- CNC Lathe: stock material spins [video](http://www.youtube.com/watch?v=ghF7njMgZgs)
- Water Jet: [video](http://www.youtube.com/watch?v=crgujRcyhhE)
- Laser cutter
Other techniques

- Drawing
- Forging
- Stamping
- Cutting / Sawing
- Casting
  - Molding
  - Lost wax process
- Joining pieces (welding, soldering, gluing, bolting, nailing, riveting)
- ...
Brazing

Making parts (2)

- Additive prototyping (Build up part one layer at a time).
- Visible Human project does reverse. Human body one slice at a time.

From the NIH Visible Human Project®

3D Printers (additive prototyping)

**Powder Deposition**

1. Print carriage spreads a layer of powder from the feed box to cover the surface of the build piston.

2. Print heads spray binder solution onto loose powder, "printing“ first cross-sectional view. Remaining loose powder supports part as it is being printed.

3. After cross-section is printed, build piston is lowered slightly, a new layer of powder spread over its surface and the next cross sectional view is printed.

4. The process is repeated until the build is complete.

From: [http://www.rapidprototyping.co.nz/desc.htm](http://www.rapidprototyping.co.nz/desc.htm)

Also… sintering.
3D Printers (additive prototyping)
Fused Deposition Modeling

1. Print carriage lays a melted filament on a single layer (like a hot-glue gun)
2. Layer cools and hardens.
3. The process is repeated until the build is complete.

http://www.youtube.com/watch?NR=1&feature=endscreen&v=yKHMmKqdl68/desc.htm
Designing parts - SolidWorks

- Creating parts with SolidWorks makes the process a very methodical one (as opposed to drawing by hand).
- Keep in mind that parts of the drawing can have explicit relationships that makes reusing/rescaling the part easier.
- Examples of SolidWorks designed parts.
- SolidWorks demo...