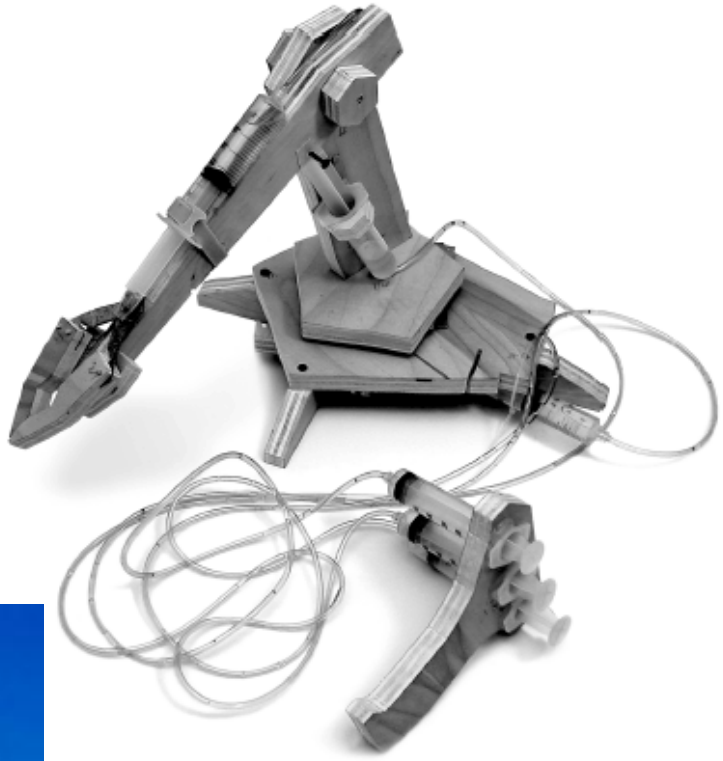
HYDRAULICS AND PNEUMATICS

Foundations of Technology

Assignment:

- Hydraulic Robot Arm

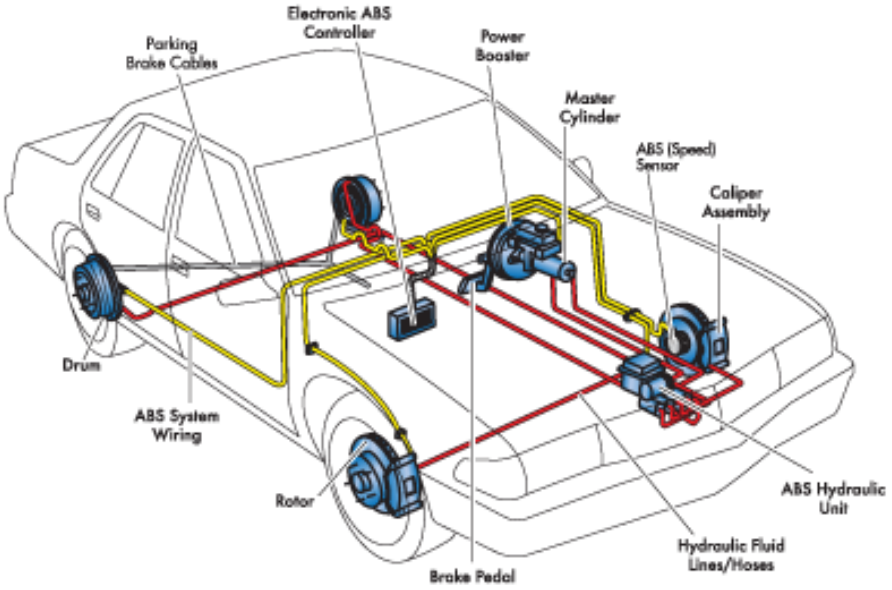


Hydraulics and Pneumatics:

- **Hydraulics:**
  - Hydraulics work on the principle of pressurized liquid forcing mechanical action.

- **Pneumatics:**
  - Pneumatics work on the principle of pressurized air forcing mechanical action.

Hydraulics:



Uses

- Industrial
- Agriculture
- Automotive
- Some Tools

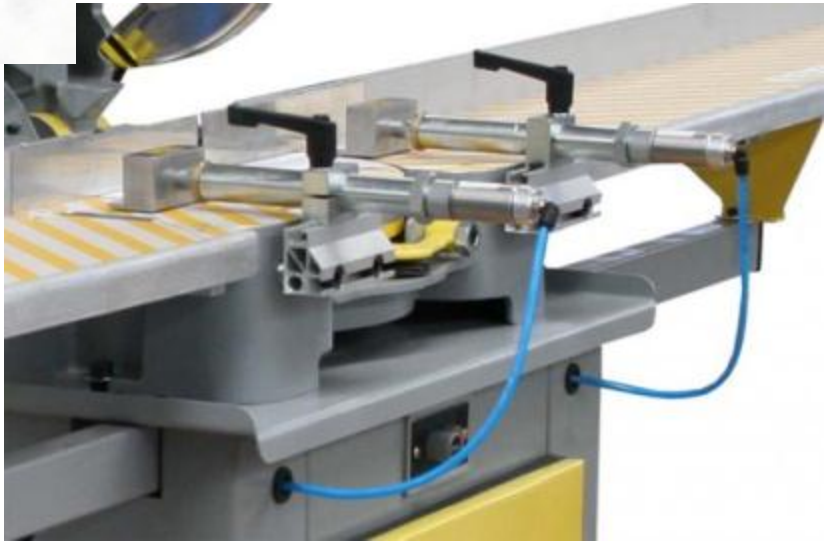
Anywhere heavy lifting or extreme pressures are necessary

Pneumatics:

Uses

- Medical
- Manufacturing
- Automation
- Suspensions

Anywhere that needs quick precise movement



Differences:

- **Hydraulics:**
  - Uses a form of hydraulic liquid
  - Slow motion
  - High Pressure
  - Heavy Applications
- **Pneumatics:**
  - Uses Compressed Air
  - Fast motion
  - Low Pressure
  - "Light" Applications

One similarity exists between the two systems: Any leak will cause the system to not work correctly or cease to function entirely.

Pascal's Law:

- Pressure remains the same in a closed fluid system.
- Pressure = Force / Area

Blaise Pascal

Calculating Pressure in a Fluid System:

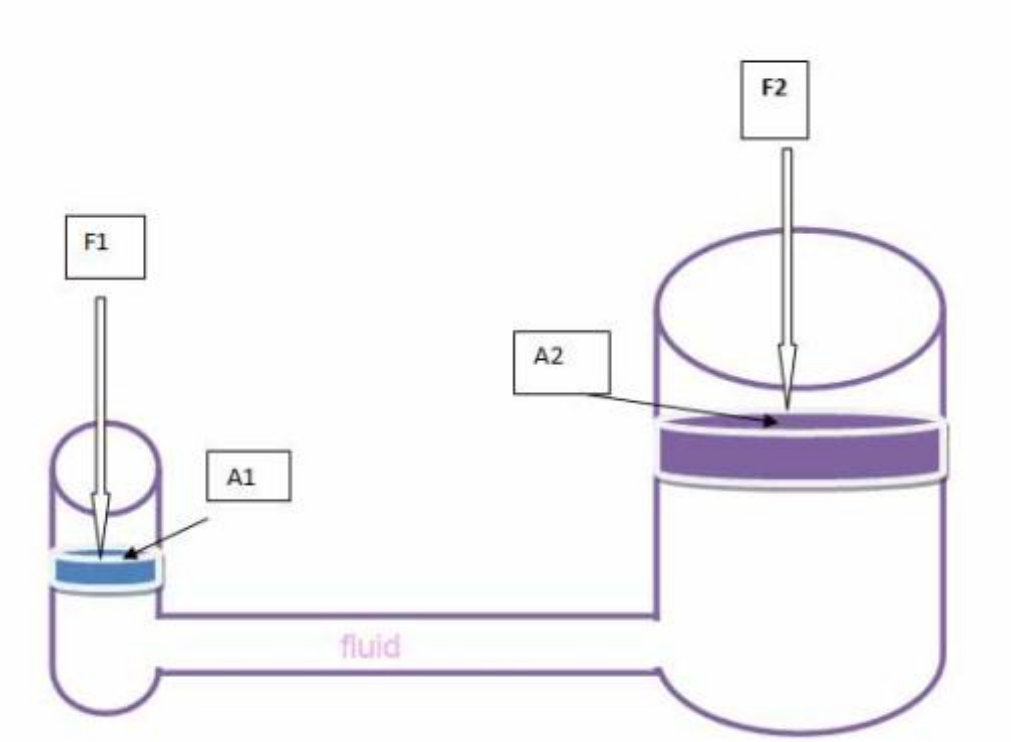
- Pressure
  - Metric Units = N/cm^2
  - Standard Units = psi
- Force
  - Metric Units = N
  - Standard Units = ftlb
- Area
  - Metric Units = cm^2
  - Standard Units = in^2
- Volume
  - Metric Units = cm^3
  - Standard Units = in^3

Let's Do Some Problems Together: #1

P1 =_____ N/cm^2

F1 = 5N

A1 = $1cm^2$

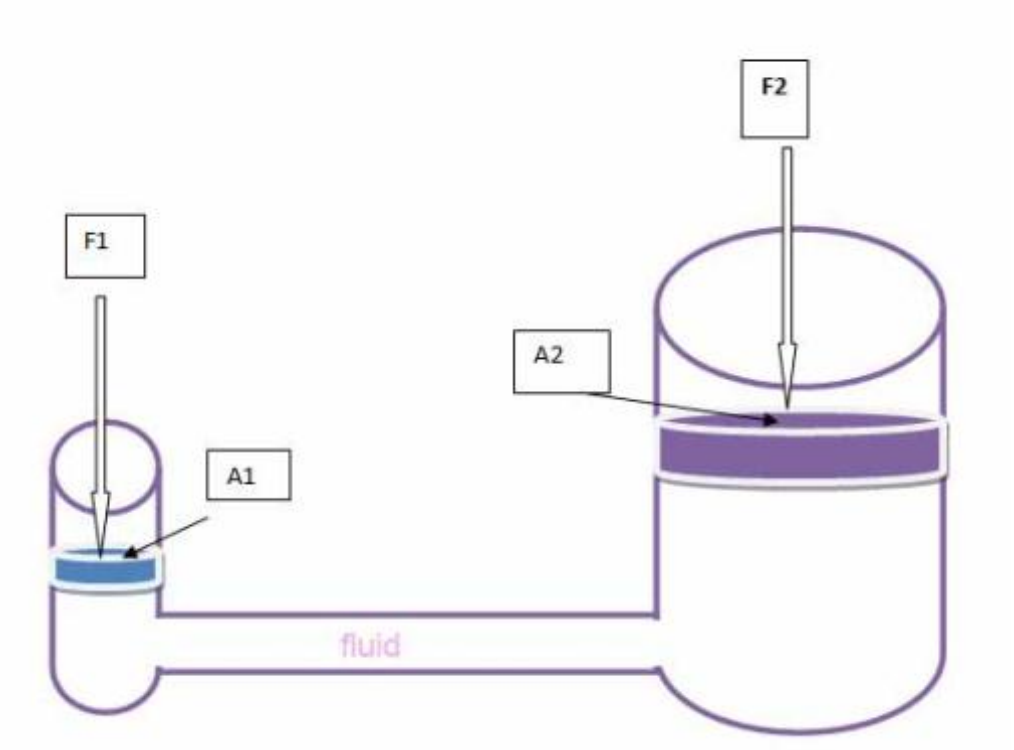


Let's Do Some Problems Together: #2

P1 =_____ N/cm^2

F1 = 10N

A1 = $3cm^2$

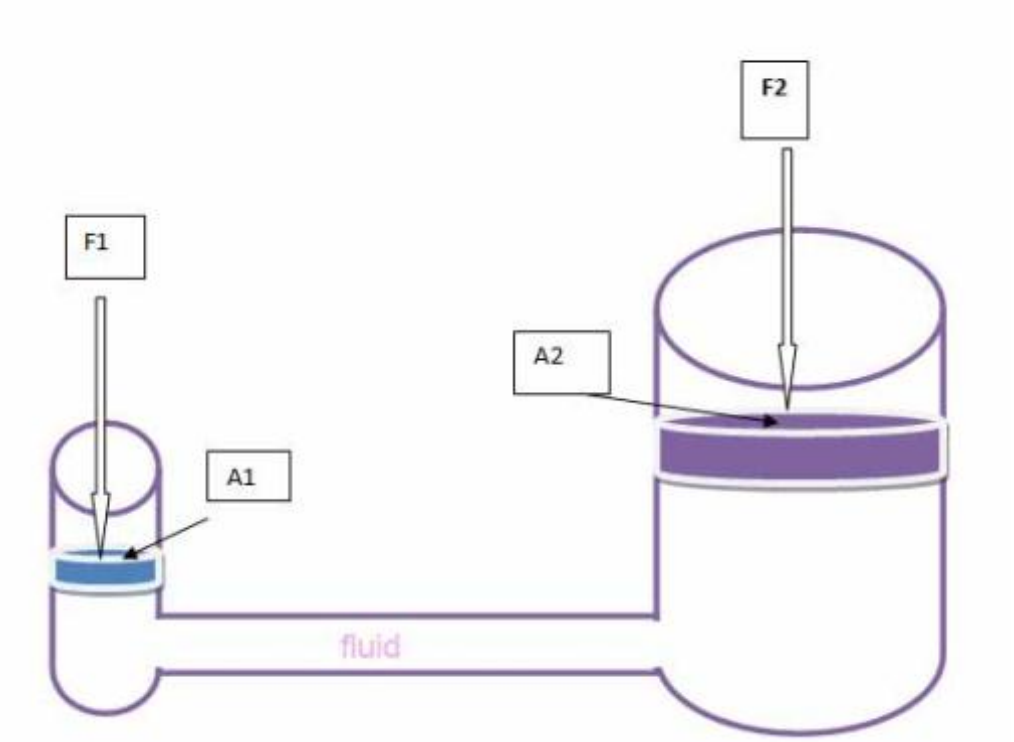


Let's Do Some Problems Together: #3

V1 = _____cm^3

A = $7cm^2$

H = 3.5cm

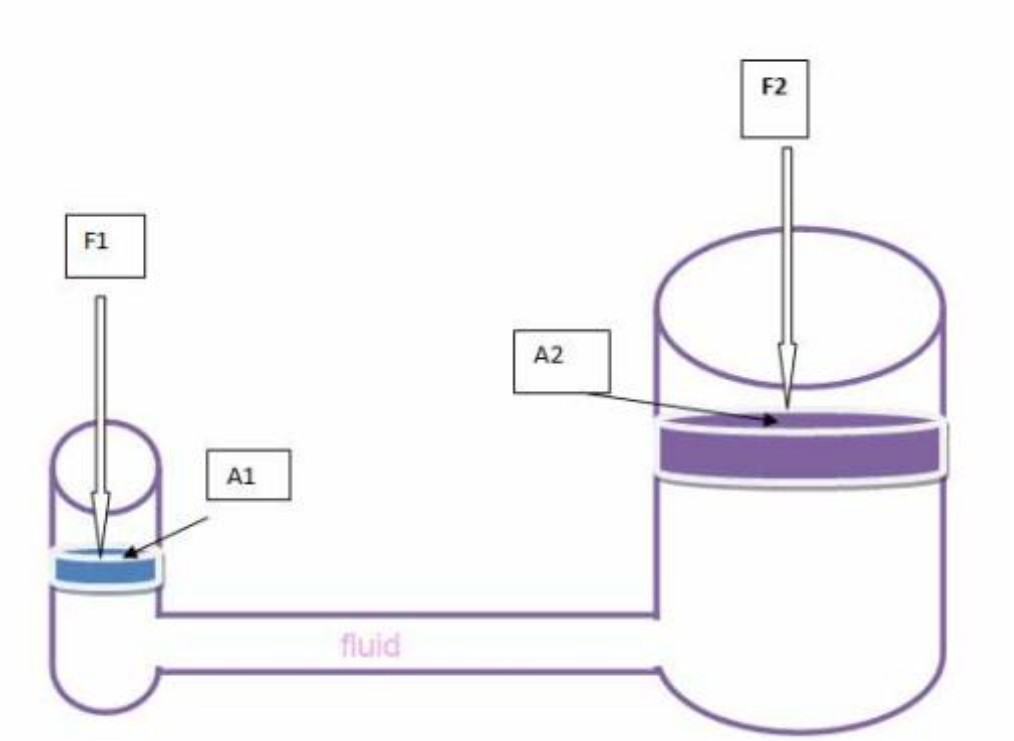


Let's Do Some Problems Together: #4

P1 =_____ N/cm^2

F1 = 12N
F2 =_____ N

$A1 = 3cm^2$
$A2 = 5.2cm^2$



1m=100cm, 1cm=0.01m

Let's Do Some Problems Together: #5

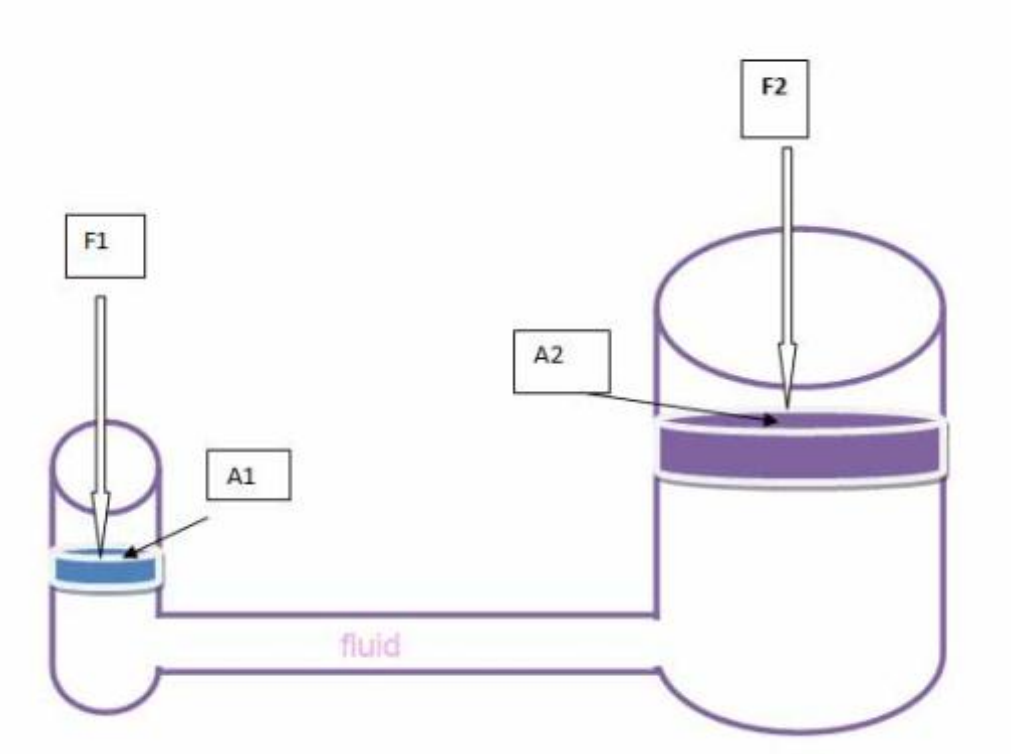
P1 =_____ N/cm^2

F1 = 10N
F2 =_____ N

A1 = $2cm^2$
A2 = $2.85cm^2$

V1 = _____ cm^3

H1 = 4cm
H2 =_____ cm



Let's Do Some Problems Together: #6

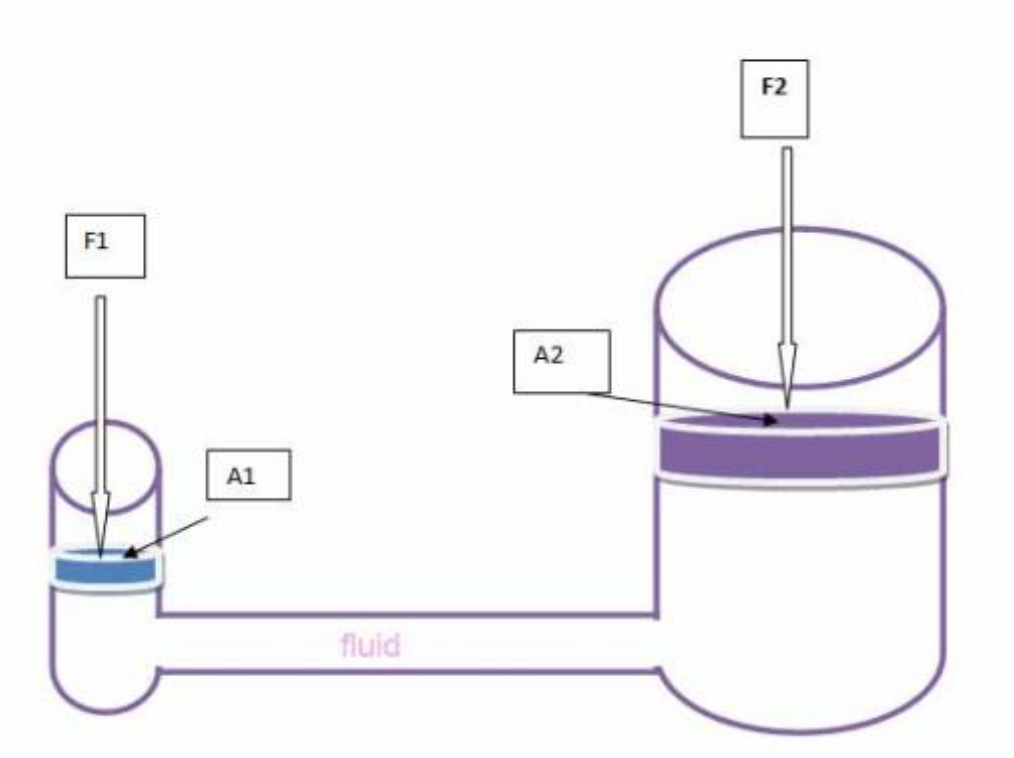
P2 =_____ N/cm^2

F1 =_____ N
F2 = 10N

A1 = $2cm^2$
A2 = $2.85cm^2$

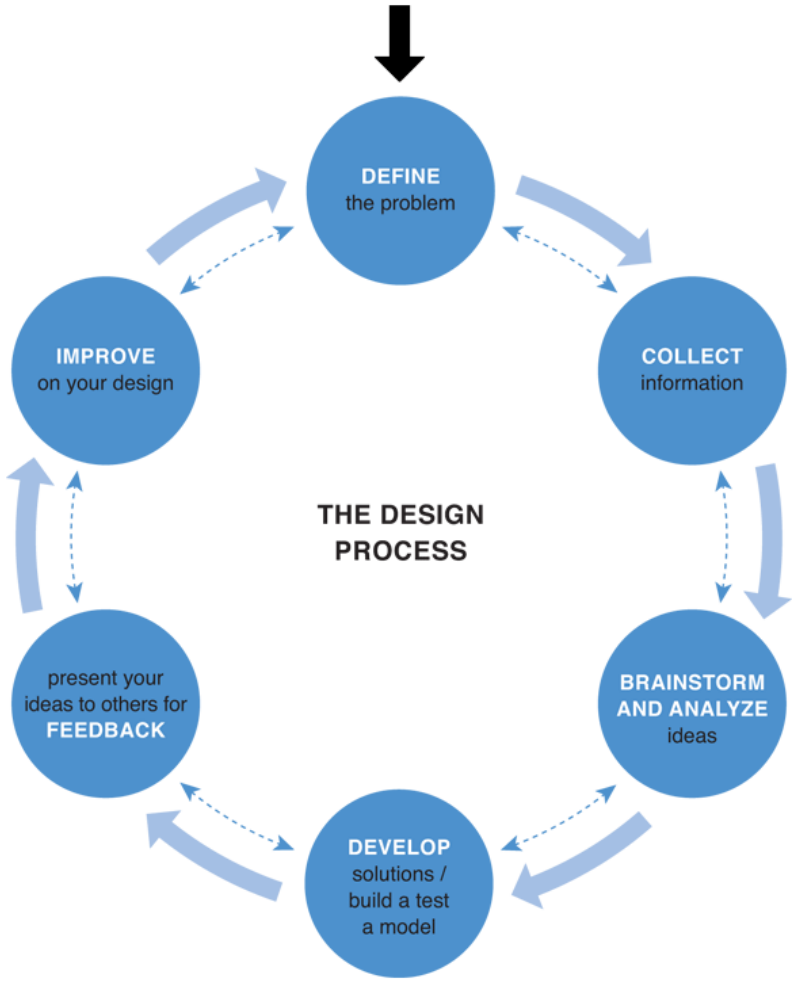
V2 = _____ cm^3

H1 =_____cm
H2 = 2cm



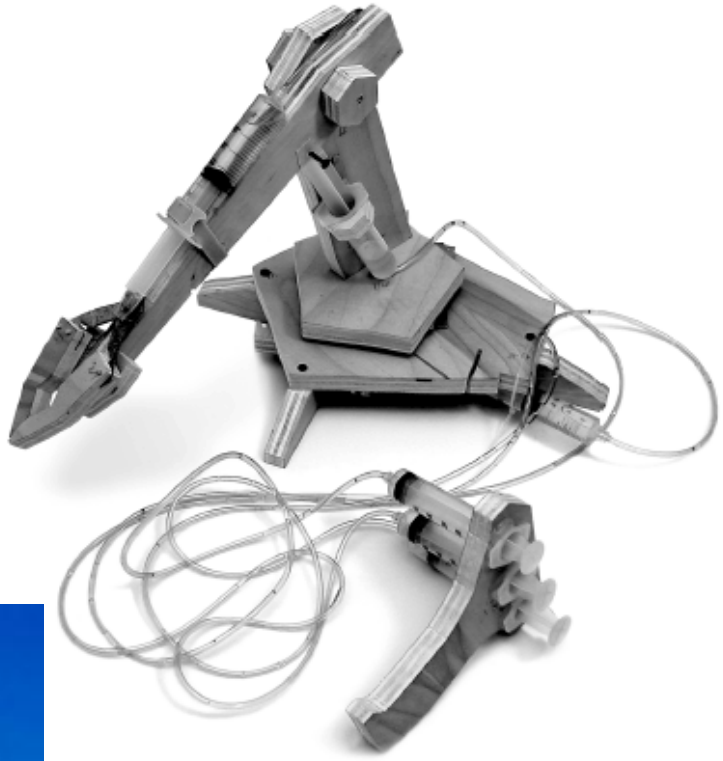
Design Problem Solving Process:

- 1: Define Problem
- 2: Collect Info./Research
- 3: Brainstorm and Analyze
- 4: Develop Solutions /Prototype
- 5: Feedback
- 6: Improve your Design



Assignment:

- Hydraulic Robot Arm



Goal:

- Design and build a hydraulic system in the form of a robotic arm.
- Learn problem solving skills.

- Dominate the challenges:
  - Battle - collecting more balls than your opponent.
  - Speed run - collect as many balls as possible in a 30 second time frame.

Materials:

- Syringes (10cc, 20cc) – 3 of each
- Plastic tubing (225cm)
- Eye hooks (aluminum/welding rod)
- Assorted wood, melamine, plastic, metal
- Assorted fasteners (nuts, bolts, screws)
- Small magnet (1 only)

Design Considerations/Problem Solving:

- Robot waist? Size? Angular Motion?
- Robot shoulder? Height? Where to attach syringes?
- Robot elbow? Length? Where to attach syringes?
- Multiple connection points on the various parts of the robot arm?
- What is the best location of the magnet?
- What is the best way to connect the magnet?
- What is the best configuration to connect the syringes (where should the small ones and the large ones be placed for maximum power and speed?)
- Should you choose an offensive or defensive strategy??

Rules of the Battle:

- Seven balls (with tacks) will be placed at random in the playing field.
- Each team will use their robot to gather as many balls as possible and place these balls in their home base area; using a magnet..
- The first team to gather the majority of the balls wins!
- Teams can gather more than one ball at a time if wanted.
- If you accidentally place a ball in the other team's home base, then the ball goes to the other team.
- Once balls have been placed in the home base area they cannot be stolen.
- Once play has started you cannot touch your or the other team's robot arm.
- You cannot intentionally destroy the other team's robot!!
- Battles do not stop for repairs or "blow outs"

- "No buying robotic kits or already made robots!"

Scoring:

- Battle Ball
  - First Place = 50 points
  - Second Place = 47 points
  - Third Place = 45 points
  - Competed valiantly = 43 points

- Speed
  - 10 points for every ball collected in a 30 second time period

Schedule and Expectations

Date:	Content:	Assignments:
3/23/15 – Monday	Hydraulics Lecture	
3/25/15 – Wednesday	Review Hydraulics Design Process	Hydraulics worksheet due
3/27/15 – Friday	Design Process	
3/31/15 – Tuesday	Project Work Time	
4/2/15 – Thursday	Sub – Alder at Conference	
4/13/15 – Monday	**Quiz – Liquid System** Project Work Time	Design process due
4/15/15 – Wednesday	Project Work Time	
4/17/15 – Friday	**Quiz – Design Process** Final Touches **Time Trial Competition**	Projects due
4/21/15 – Tuesday	**Battle Competition** Project clean-up	

Rubric / Expectations:

	Needs Work(0-10 pts)	Acceptable (11-15 pts)	Excellent (16-20 pts)
Design Process - (sketches, evidence of multiple brainstorming ideas, final drawing)	Few Sketches of brainstorming provided. Rough sketch of the final working model.	Several sketches of brainstorming ideas are provided but there is no documentation as to why ideas were used or not used. Neatly drawn with no detail.	Many sketches (3 minimum) of the brainstorming provided with accompanying documentation as to why ideas were used or not used in final product. Neatly drawn and detailed description, and/or dimensions
Construction of Project – (Creativity, Quality, Aesthetics)	Poor construction; lacks aesthetics. Bulky and/or weak. Lacks durability (breaks easily). Needs sanding, evidence of sloppy gluing, Robot waist, shoulder and elbow do not move smoothly and quickly.	Evidence of good construction, mostly aesthetically pleasing. Somewhat bulky and/or weak. Robot arm is mostly durable (has a weak component, need periodic fixing), has been sanded and glued but some evidence roughness and/or glue marks. Robot waist, shoulder and elbow periodically bind and do not move smoothly and quickly.	Evidence of quality construction and aesthetically pleasing Not bulky or too weak. Robot arm is durable (can be used repeatedly without breaking), has been sanded to look nice, has been well glued (no glue drips). Robot waist, shoulder and elbow move smoothly and quickly.

Project Work Time:

- Divide into groups of no more than 2:
  - I will adjust groups as needed to help ensure success
- Finish handout and turn in to class inbox
- Get started on research and design:
  - Sketching
  - Materials
  - Internet
  - Samples