



Flint Regional Science & Engineering Fair

Inspiration, Invention, Innovation

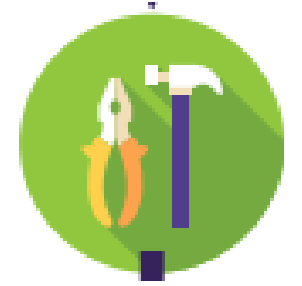


TOPIC 6: DESIGNING



Design – We will....

Prototype and Develop Solution Part 1 - Design



- **Project design**
 - Draw a model
 - State how your project will work
- **Plan Implementation**
 - Decide on materials and tools needed
 - Gather needed material and tools
 - What skills are needed?
 - Do you have them?
 - If not, decide who can help? Ask them for help.
- **By the end of this step, you will have:**
 - You will have a clear plan for moving forward on building your project.

Design

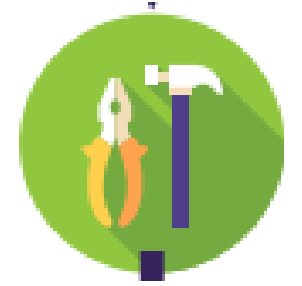
Prototype and Develop Solution Part 1 - Design



<https://www.youtube.com/watch?v=0pmYZRiTQ3g>

Design

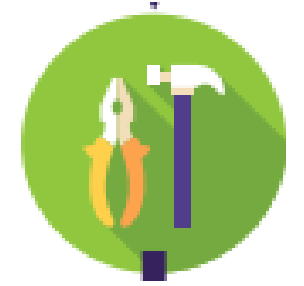
Prototype and Develop Solution Part 1 - Design



- What problem is the designer trying to solve?
- How did the inventor begin designing the prototype?
- What other steps in the engineering process (that we already did) did you notice in the video?

Design

Prototype and Develop Solution Part 1 - Design

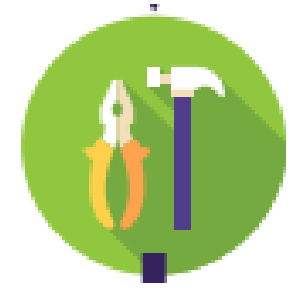


This is where the fun starts!

- Be very careful to pay attention to the work in all previous steps!
 - Make sure you are solving your original problem
 - Pay attention to your criteria for success and constraints
- Sometimes it helps to take apart an object to gain a better understanding of its design and inner working. This can help when figuring out the best way to design your invention.

Design – Simple Machines

Prototype and Develop Solution Part 1 - Design

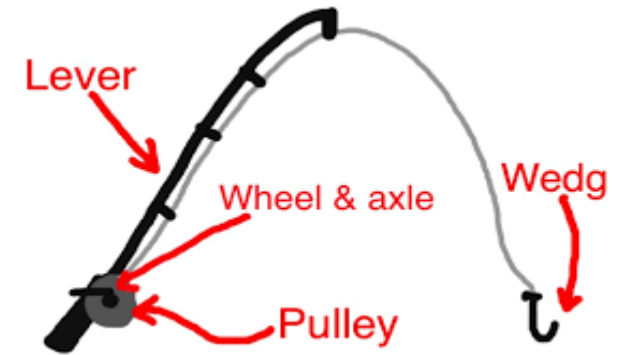
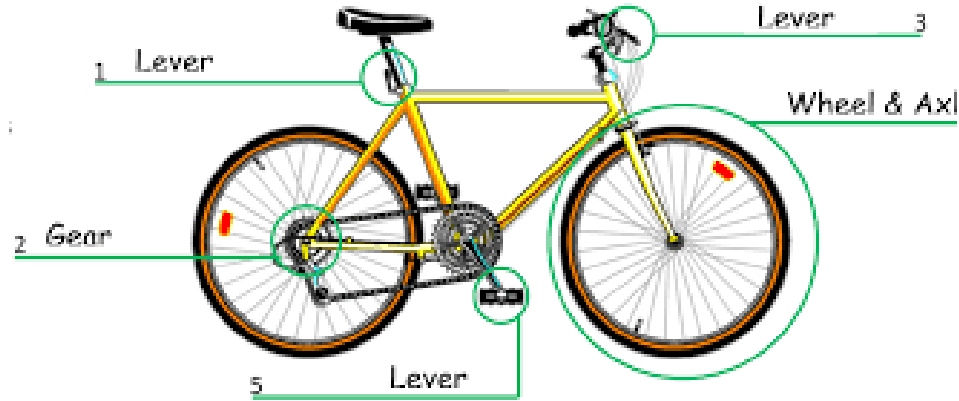
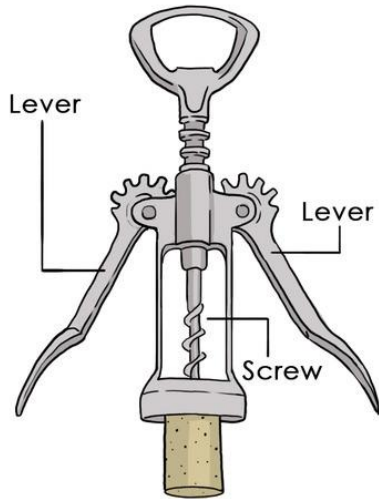
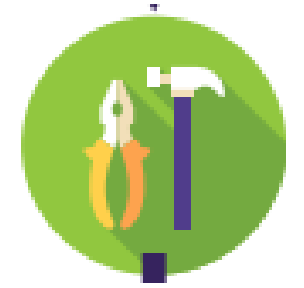


The purpose of most simple machines is **to reduce the effort (force) required to perform a simple task.**



Design – Compound Machines

Prototype and Develop Solution Part 1 - Design



Simple machines

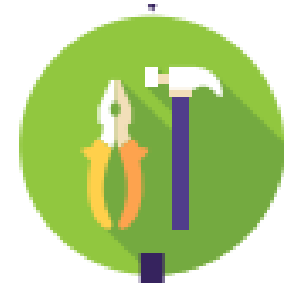
1. lever
2. wheel and axel
3. gear
4. wedge



NOTE: A gear is a wheel and axel with teeth, often found in series.

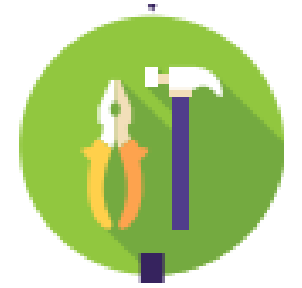
Design – Compound Machines

Prototype and Develop Solution Part 1 - Design



Design - Model

**Prototype and
Develop Solution**
Part 1 - Design

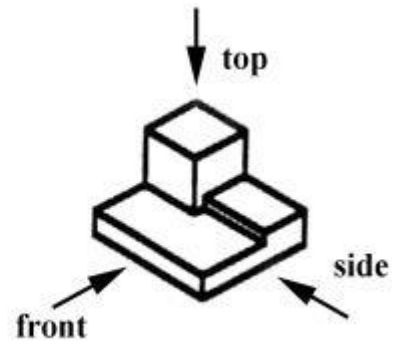
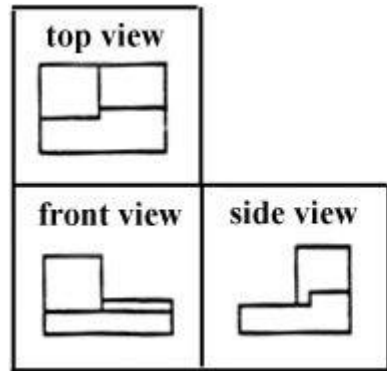
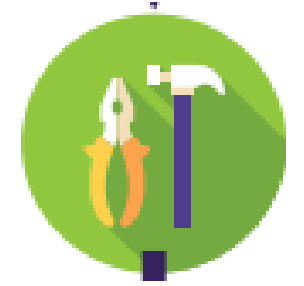


Suppose you want to build a bird house.

- Draw a model of that bird house.

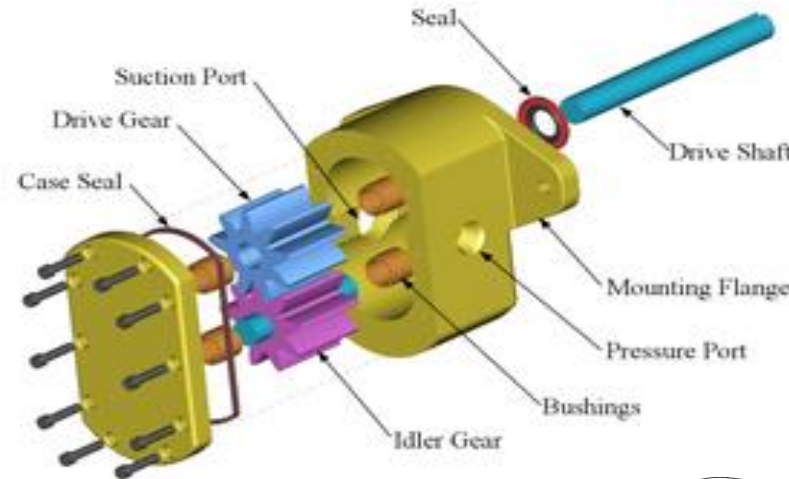
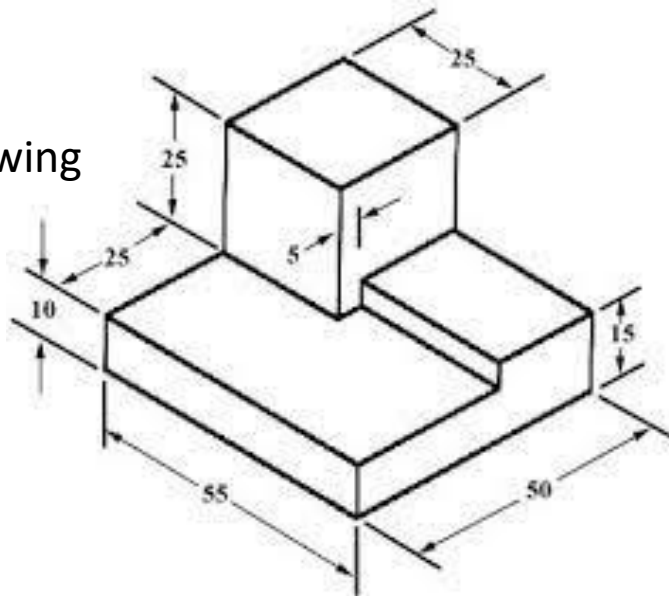
Design - Draw a Model

Prototype and Develop Solution Part 1 - Design

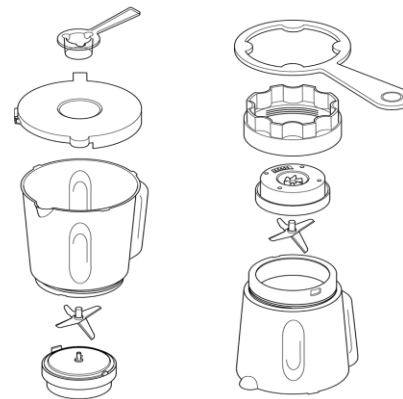


View Drawing

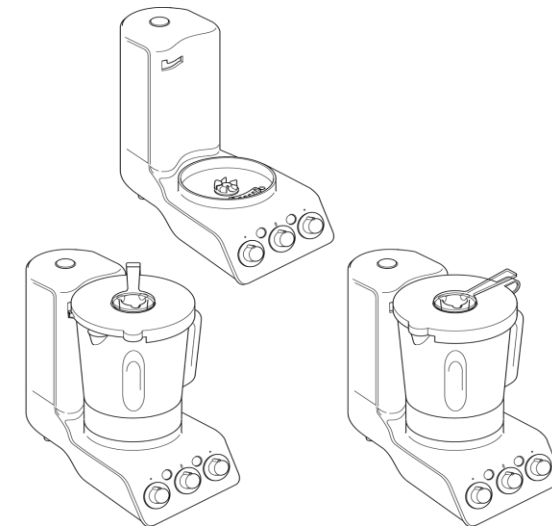
Scale Drawing



Explode the View

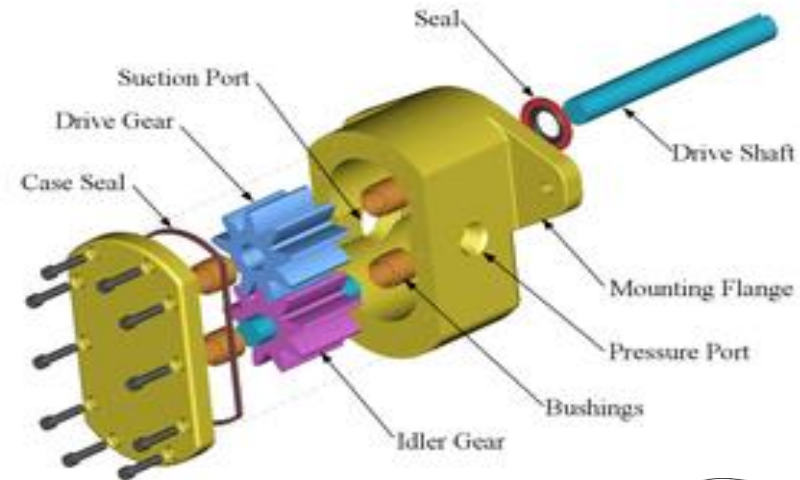
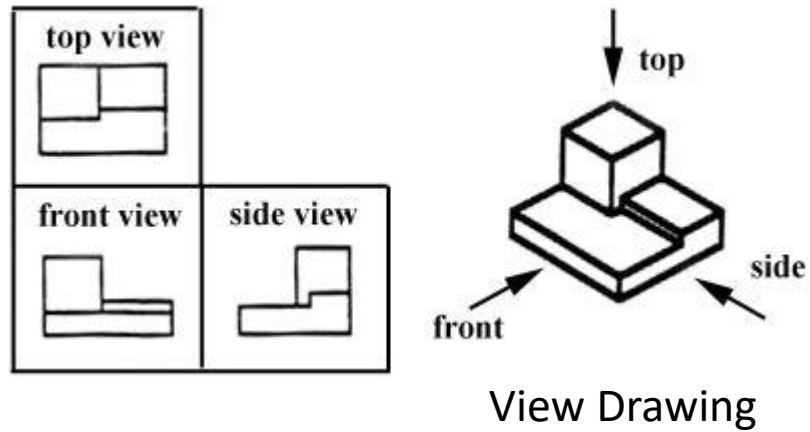
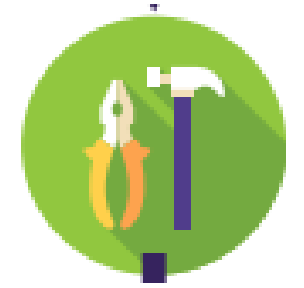


Sketch

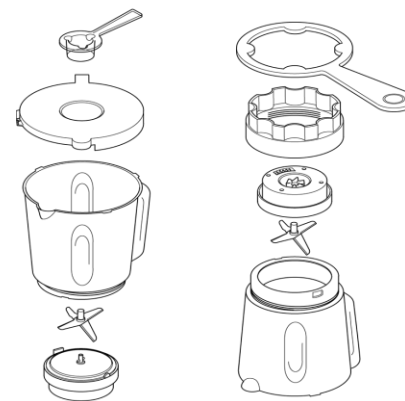
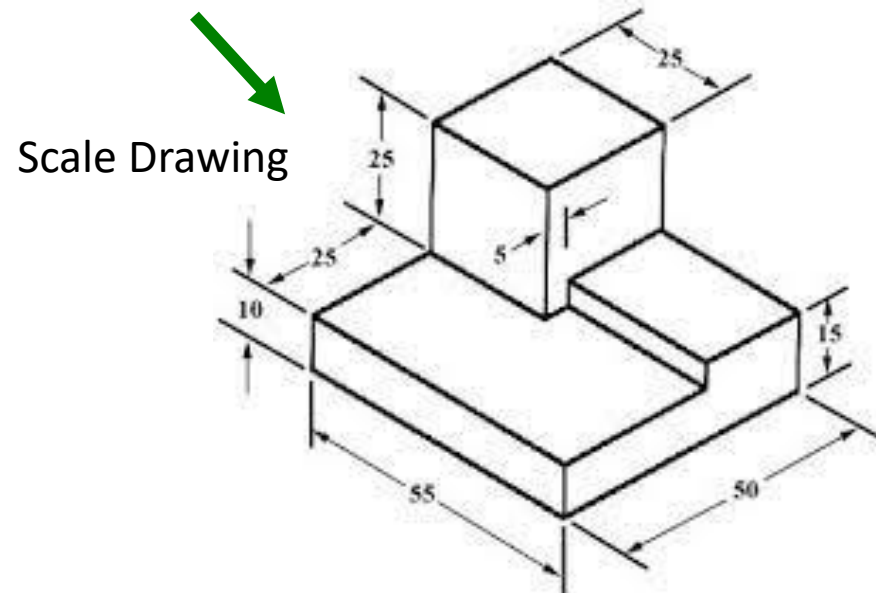


Design - Draw a Model

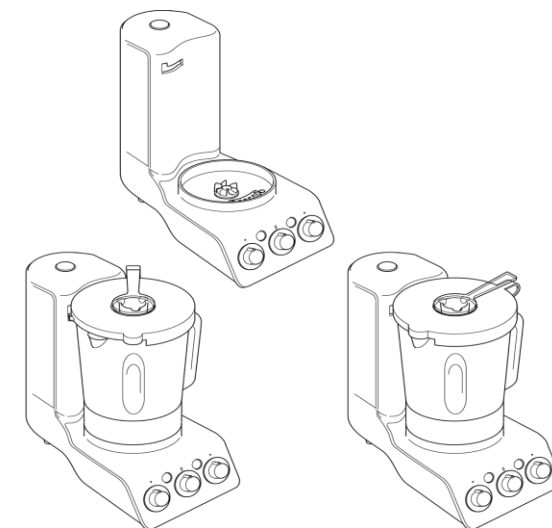
Prototype and Develop Solution Part 1 - Design



Explode the View

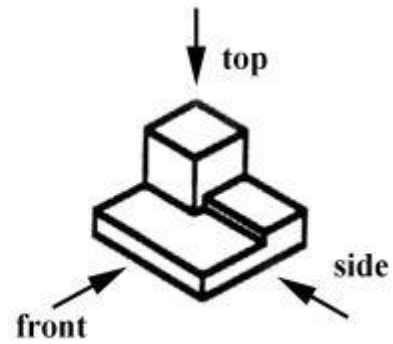
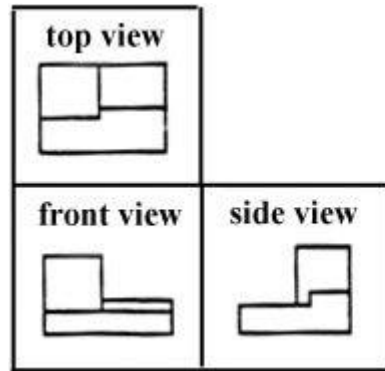
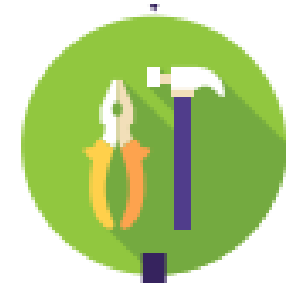


Sketch



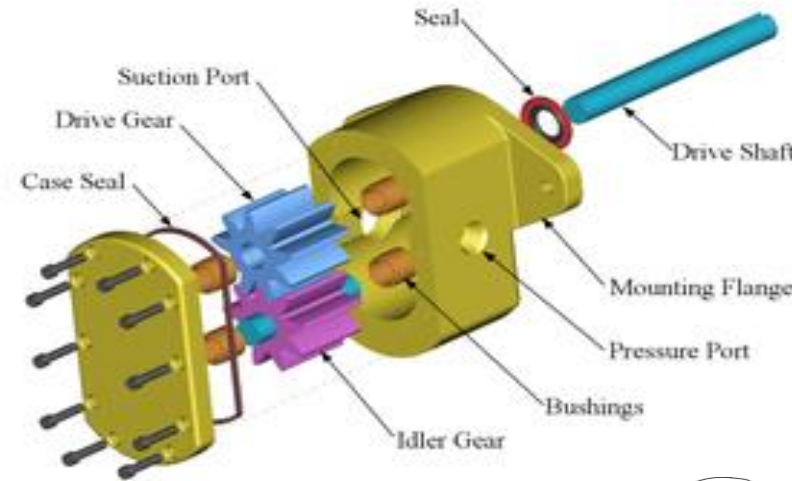
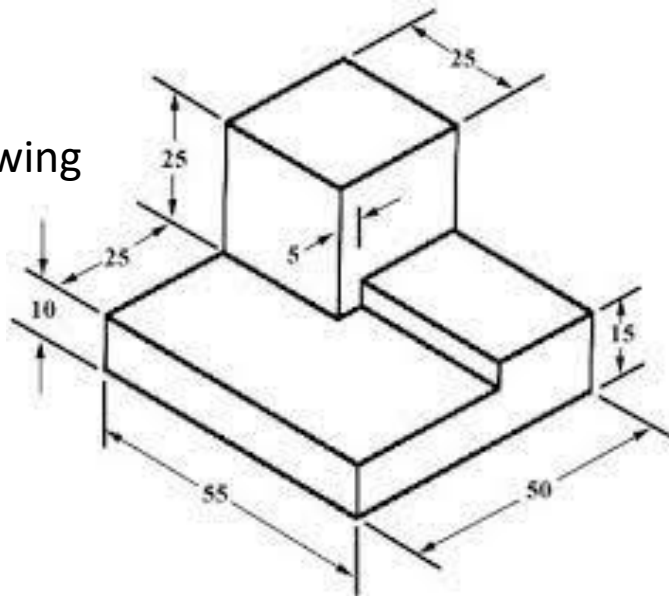
Design - Draw a Model

Prototype and Develop Solution Part 1 - Design

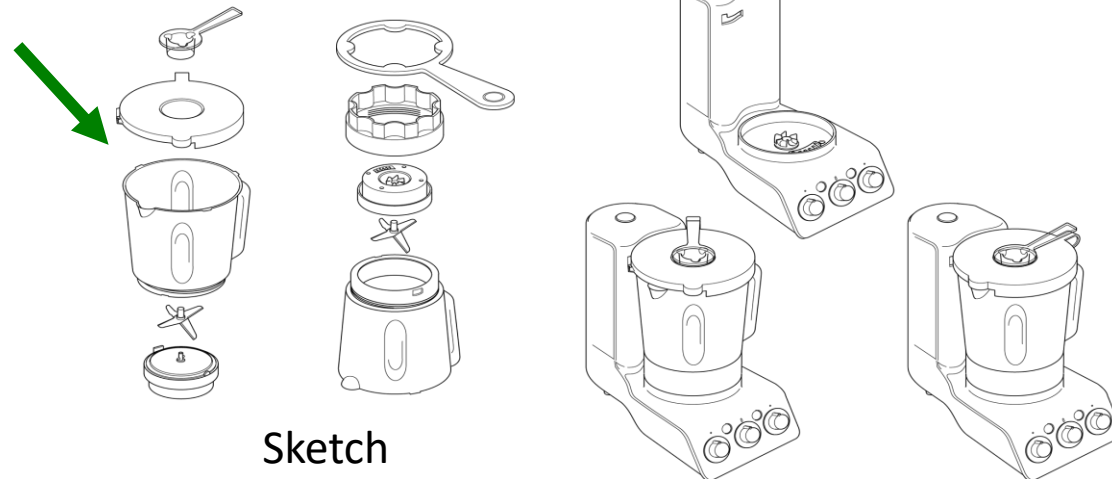


View Drawing

Scale Drawing



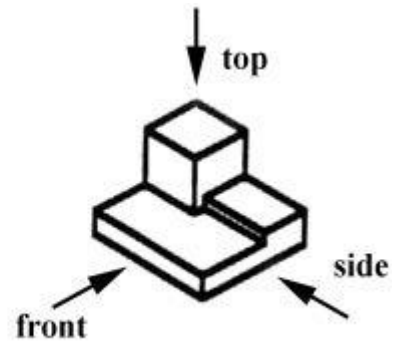
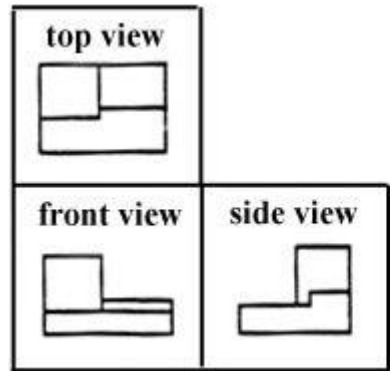
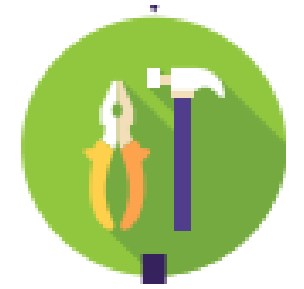
Explode the View



Sketch

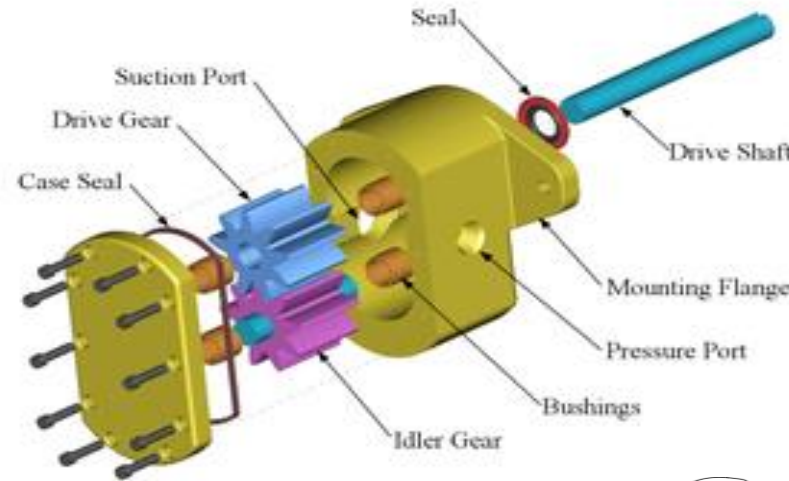
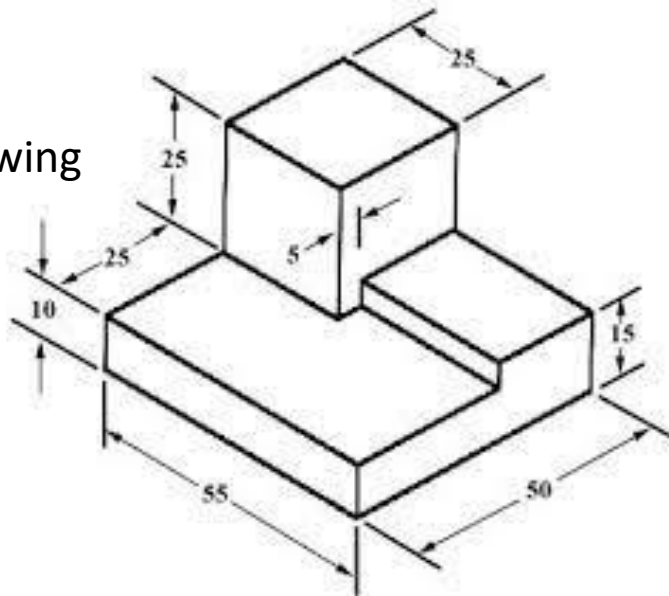
Design - Draw a Model

Prototype and Develop Solution Part 1 - Design

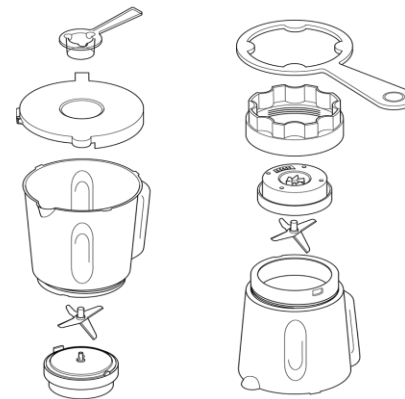


View Drawing

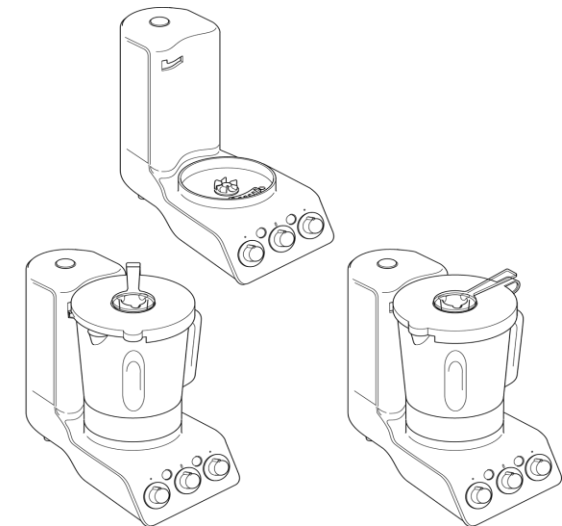
Scale Drawing



Explode the View

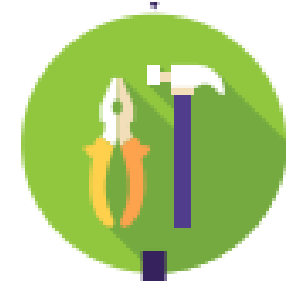


Sketch



Design - Draw a Model

Prototype and Develop Solution Part 1 - Design



From our Journaling slides:

College student

10.1.04

Weight Load - Est 60-100kg

On the x-y plane (the fullest face of the parabola, corner to corner)

$y_0 = \text{Diagonal of frame} = 103''$
 $x_0 = \text{width of panel} = 51''$

Weight load of bearing at $x = \frac{1}{2}x_0 \therefore y = \frac{1}{2}y_0$

If motion is tracked on one axis... (i.e., rotated about point 0 about the x-axis only (at the point $y = \frac{1}{2}y_0$) and assuming weight is evenly distributed over the length of the parabola...

SIDE VIEW

approximate a block

symmetric about the $x = \frac{1}{2}x_0$ line

$m_j \quad R = mg$

Max moment about Point A -
 $M_A = \frac{1}{2}(\text{parabola height}) mg = 33'' \cdot 80 \text{ kg} \cdot 9.8 = 0.8382 \text{ m} \cdot 980 \text{ N} = 822.24 \text{ Nm}$

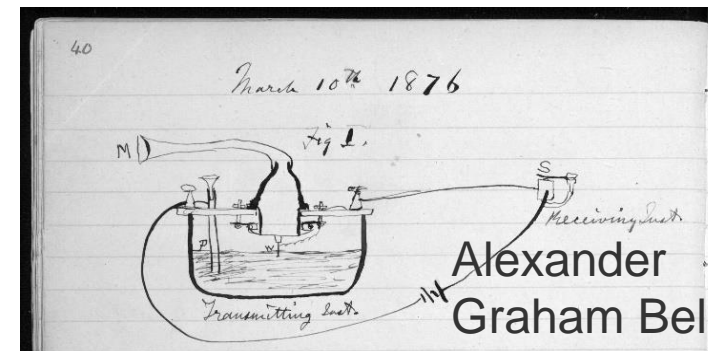
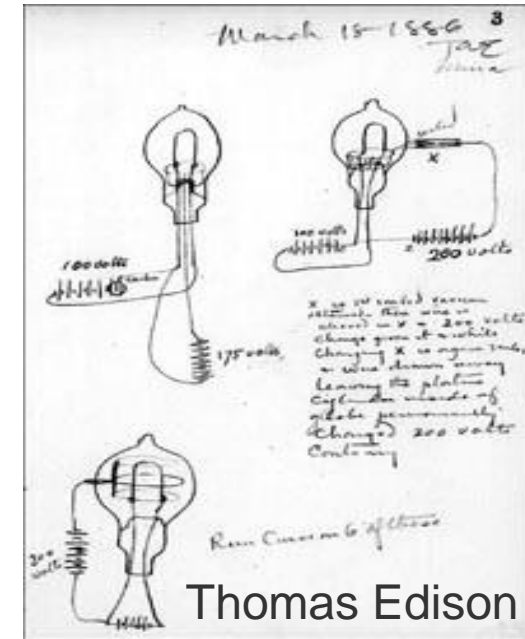
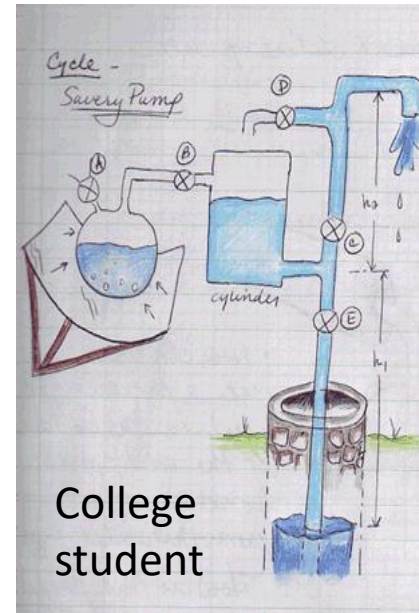
Max $x = \frac{1}{2}$ parabola height

$103^2 = 79^2 + x^2$
 $x^2 = 4368$
 $x = \sqrt{4368} \approx 66''$

Average est mass = $\frac{60+100 \text{ kg}}{2} = 80 \text{ kg}$

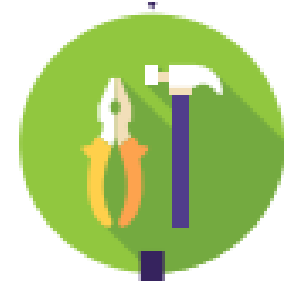
A = 79"
 B = 72"
 C = 51"
 D = 103"

$\frac{1}{2} \cdot 51 \cdot 33 = 838.269 = 0.8382 \text{ m}$



Design – Model

Prototype and Develop Solution Part 1 - Design



What kind of model is it?

What could be added to make it more useful?



Design – Model

Prototype and Develop Solution Part 1 - Design



What kind of model is it?

View Model

What could be added to make it more useful?

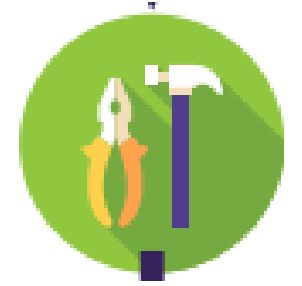
Dimensions &

Other Measurements



Design – Supplies

Prototype and Develop Solution Part 1 - Design



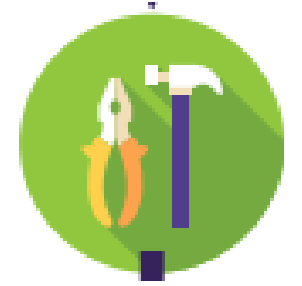
What supplies are needed to build this birdhouse?

Where could you find them?



Design – Supplies

Prototype and Develop Solution Part 1 - Design



What supplies are needed to build this birdhouse?

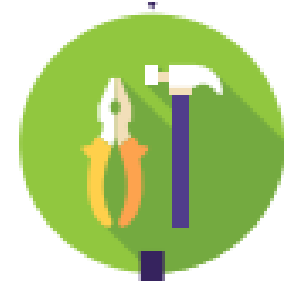
- Old license plate
- Wood
- Dowels
- Rope/string
- Nails/screws
- Hinge
- Glue...

Where could you find them?



Design – Skills

Prototype and Develop Solution Part 1 - Design



What skills are needed to build this birdhouse?

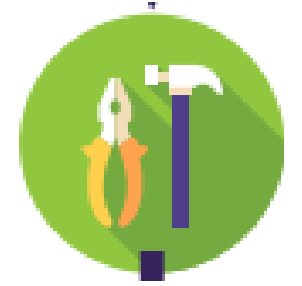
Do you have those skills?

Who do you know that can help you with this?



Design – Tools

Prototype and Develop Solution Part 1 - Design



What tools are needed to build this birdhouse?

- Saw
- Tape measure
- Square
- Screw Drivers
- Drill
- Drill bits (including circular bits)
- Hammer...

Where can you get those tools?

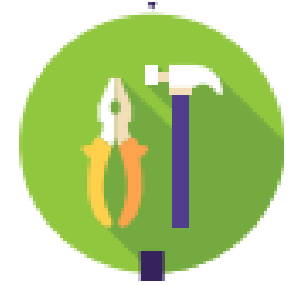
Can you borrow them from someone?



Design – Other Problems

What other problems might you have?

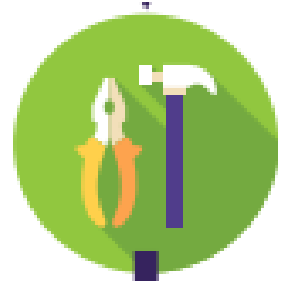
**Prototype and
Develop Solution**
Part 1 - Design



Design – Other

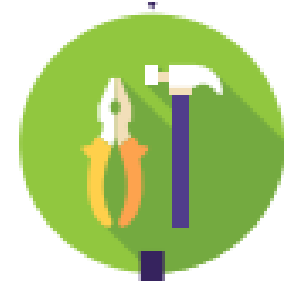
Explain how the design will function.

Prototype and Develop Solution Part 1 - Design



Design – Process

Prototype and Develop Solution Part 1 - Design



Explain the steps you will take to build.

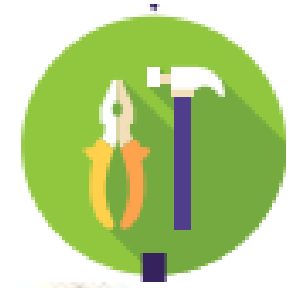
- 1.
- 2.
- 3.
- 4.
- 5.



Write out your instructions for making your project.

Design – Materials You May Not Have Thought Of

Prototype and
Develop Solution
Part 1 - Design



Mostly Mechanical:

- Lego, Lego Mindstorms, Lego Technic
- Fishertechnik
- Meccano
- Erector Set

Mostly Electrical

- Solderless Breadboard (ex. Arduino or Elegoo)

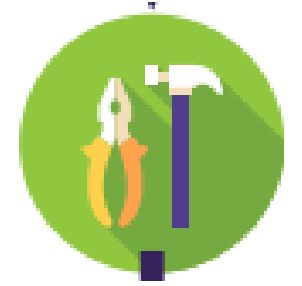
Computer Engineering

- Qiskit or Cirq (open-source quantum programming frameworks for students)



To Do:

Prototype and Develop Solution Part 1 - Design



- Journal all work on project– Include in your journal:
 - a detailed drawing of what your project will look like
 - a written description of how it will work
 - a list of materials you will need and where you will get them
 - a list of tools you will need and where you will get them
 - a list of skills you will need and how will teach/show them to you
 - a list of any other issues / constraints you anticipate and how you will solve them.
 - your step-by step instructions for building your first prototype.
- Though not required this week, it would be a good idea to start gathering all the supplies you will need to build your prototype/project.



**I MAKE MORE
MISTAKES
THAN ANYONE
ELSE I KNOW.
AND, SOONER
OR LATER,
I PATENT MOST
OF THEM.**

Thomas Edison

A close-up portrait of Thomas Edison, an elderly man with white hair, wearing a dark suit and a red bow tie. He has a serious, determined expression.

**I MAKE MORE
MISTAKES
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Thomas Edison

Next week, we start the final phase of our engineering project: build – test – refine.

Read the quote, remember it in times of trouble or struggle!

Don't quit!!