



# Mechanical Engineering Portfolio

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## High School Project:

# Air Conditioned Bee Hive

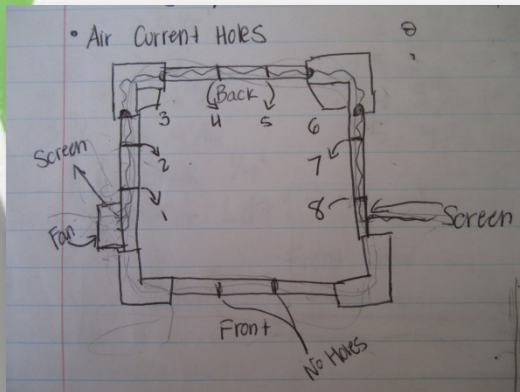


Interior measurements  
taken from a regular  
beehive box

**Problem:** Colony Collapse Disorder. The worker bee population has been declining, which may be due to the effects of global warming. Bee hives get too hot during the summer and the worker bees are exhausting themselves to maintain the temperature inside, rather than pollinating.

**Project solution:** Designed and built an air conditioned hive. Drafted by hand. Includes solar powered fan and air channels to circulate a cool breeze between the walls. Walls are designed to be like dual pane windows for temperature management. Construction required a lot of precision.

- **Power tools skills:** table saw, drill press, belt sander, angle grinder



Left: Initial idea sketch. Fan draws in air, which circulates counterclockwise around hive and exits on the right, through a screen.

Right: Final product. Submitted to **California State Fair 2010**. Received **1<sup>st</sup> place in Industrial & Technology Education category**.



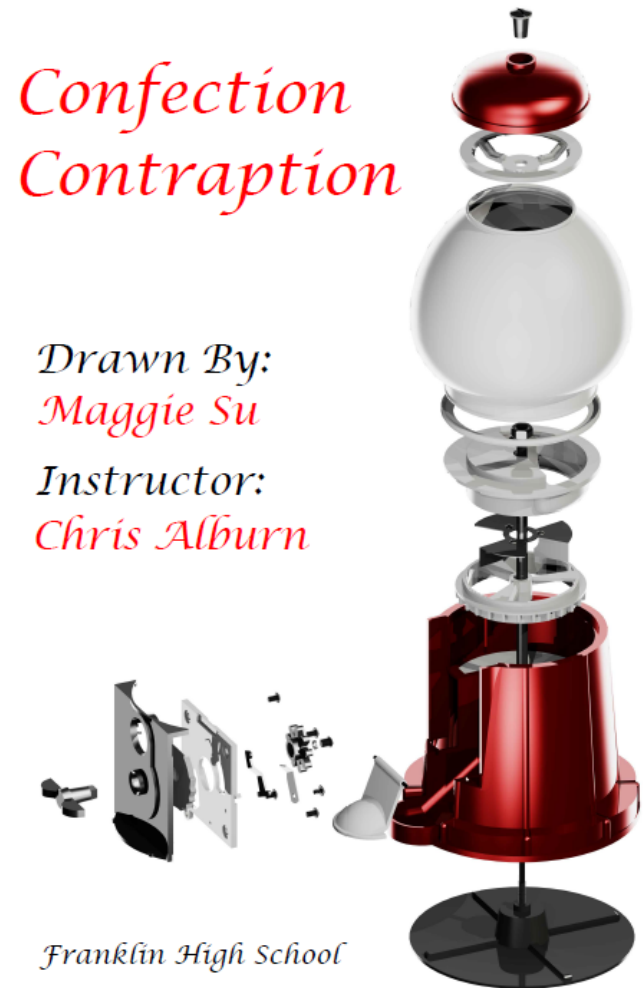
High School Project:

# Miniature Gumball Machine CAD

Took apart a gumball machine, measured every part and produced a model using **AutoCAD 2010** for CAD class.

Submitted project to **California State Fair** in 2011 in **Industrial & Technology category**. Received **honorable mention**.

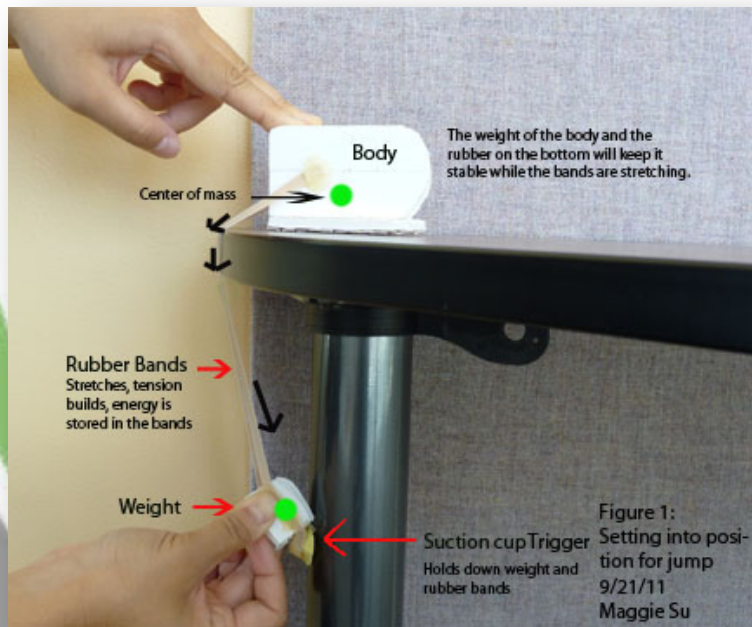
**2010-2011**  
**Senior year**



# First Year Project:

## Hopper Toy

- Design and built a toy that mimics a insect or animal that can jump. Introduction to design process
  - Personal goal: Hop 3 ft forward (achieved)
  - Studied creatures
  - Created model with SolidWorks & prototyped
  - Constructed working toy with some basic machining.



Left: Prototyping with mainly foam board and demonstrating toy operation. Similar to a sling shot motion. Relies on friction to hold it down before the suction cup by the weight to release and launch the body forward.



Above:  
Final version: Delrin pieces, elastic tubing, suction cups, wires, and balloon.



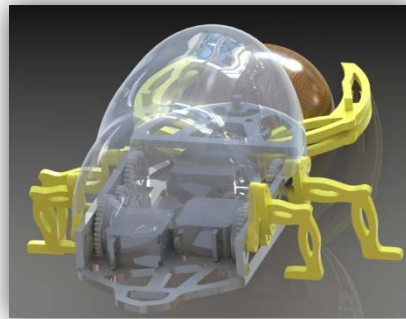
First Year Project:

# Dung Beetle Toy & Game

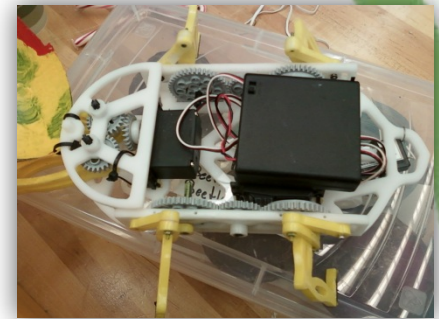


1

2



3



**Goal:** Create a bio inspired toy and game with a group for 4<sup>th</sup> graders (who will review the final product)

**Toy:** Push a ball like a dung beetle. Beetle can be driven with a remote control. Inner electrical and mechanical components concealed with a heat formed plastic shell.

**Game:** Beetle will navigate a ball on a flat surface and then push it down a ramp with obstacles and holes (pretend dung beetle nests) to score.

4



1. Dung beetles in real life
2. Final SolidWorks CAD rendering of toy design
3. Top view of constructed toy with out shell
4. Game field with beetle toy at top.

First Year Project:

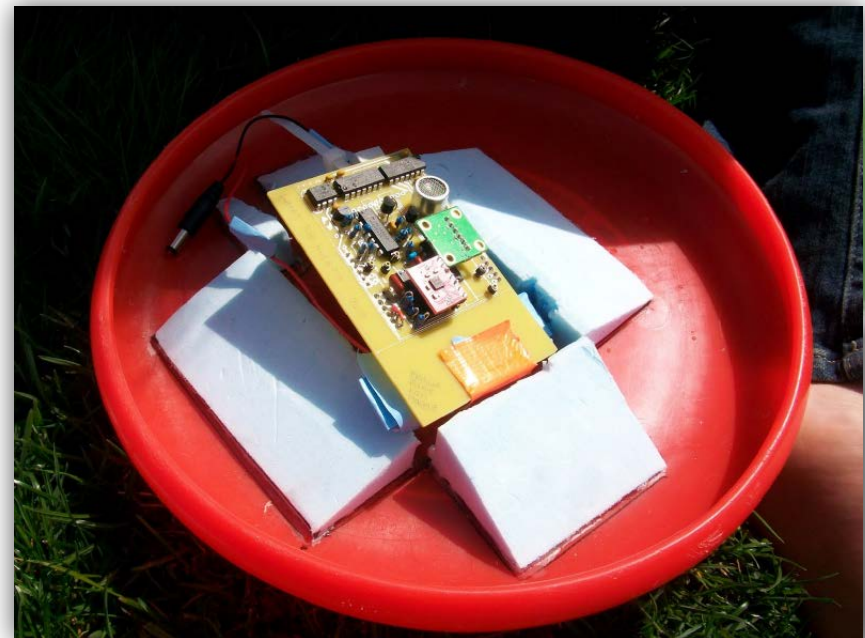
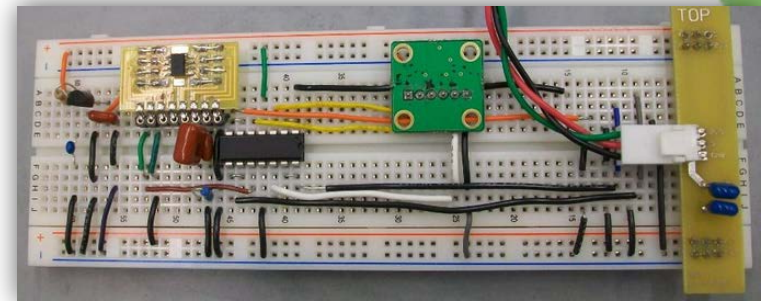
# Frisbee Movement Tracker

**Goal:** Use electronic sensors to measure the flight (linear acceleration, velocity, position) of a frisbee.

1 Ultrasonic range finder (height),  
1 accelerometer (linear acceleration),  
1 rate gyro (velocity/yaw) was placed on a PCB connected to an Arduino UNO (collecting data) and a 9V battery.

Everything was secured on the underside of a frisbee.

**Results:** It was a challenge to make every component work at the same time and interpreting measurements, but still learned about circuits and electronics.





## First Year Project:

# Material Science – Stainless Steel

**Goal:** Compare the mechanical properties of forged and stamped stainless steel spoons

- Tested properties of dining hall stainless steel spoons
- Forged and tested spoons from a strip of 4000 grade stainless steel
- Compared properties of the two types with microscopy and Rockwell hardness testing
- Compared manufacturing processes and energy usage

**Results:** Forged spoons were less hard than stamped spoons because the grains of the steel were less structured due to the forging and after treatment process.

### Microscopy



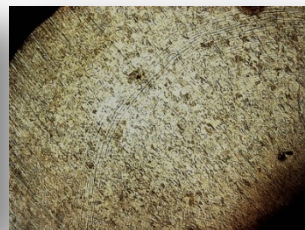
Rolled Bar



Dining Hall Spoon



Forged Spoon



### Forging



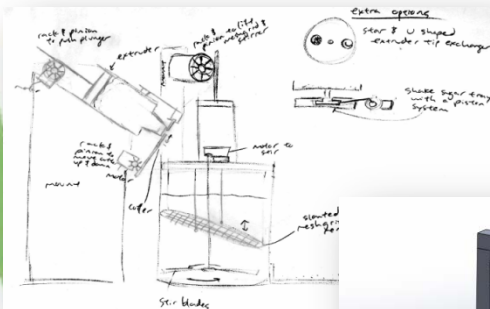
# Second Year Project: Churro Maker

**Goal:** For Principles of Engineering class, design and build a contraption that fries churro dough and coats them in sugar

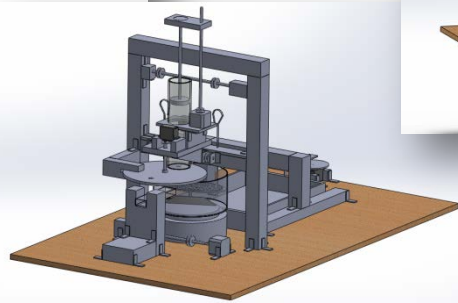
5 major components:

1. Extruder to dispense dough
2. Cutter & shape exchanger. Length and cross-sectional shape of churro can be chosen.
3. Pot of oil heated with stove. Includes a stirring mechanism in pot.
4. Pulley system to lift a mesh grid to move churros from pot to sugar tray
5. Sugar tray will catch churros and shake with a piston mechanism to coat them with sugar

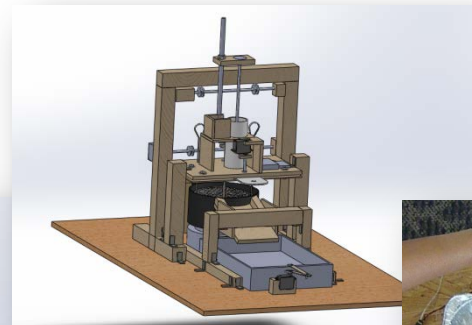
Designed with SolidWorks. Buttons included to allow user interaction.



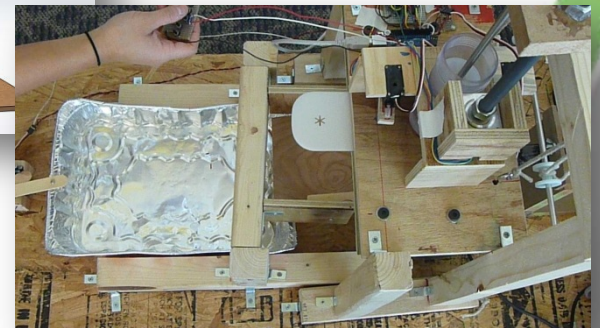
Initial sketch



2<sup>nd</sup> Version CAD



Final Version CAD



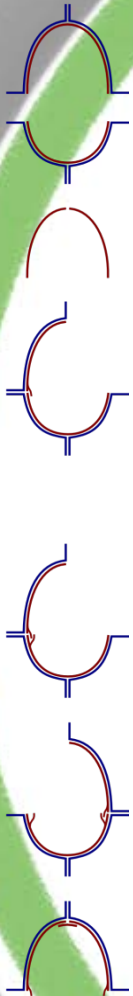
Final product



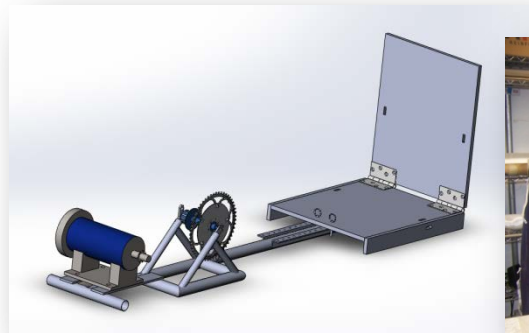
Club Project:

# Human Powered Vehicle

- Team created a monocoque recumbent bike with a full fairing
  - Redesigning a power rig to measure the power output from riders when they pedal with a mock recumbent bike
    - Includes the ability to shift gears
  - Helped with fairing fabrication
    - Used female mold method; Created miniature version for test and then applied it to full size
- Competed in 2012 Human Powered Vehicle Competition East at Grove City College;
  - **3<sup>rd</sup> place overall**



Female mold process



2013 power rig



Fiberglass mold lay up

2012 HPVC East race day



# Summer Work:

# Projects for Lit Motors

Lit Motors is an automobile startup company that is creating a self-stabilized (with gyroscope technology), fully enclosed electric vehicle called the C-1.

Worked with a team of engineers to improve the prototype.

## Projects I've worked on:

- Creating bill of materials for prototype vehicle
- Comparing fuel costs for a passenger vehicle vs. C-1
- Preliminary failure analysis
- Ideating for landing gear system
- Documented electrical system and wiring diagrams with AutoCAD 2013
- Flywheel optimization analysis for gyro system using MatLab
- Improved design of gyro test bed
- Designed another test bed to measure torque output of gyro system

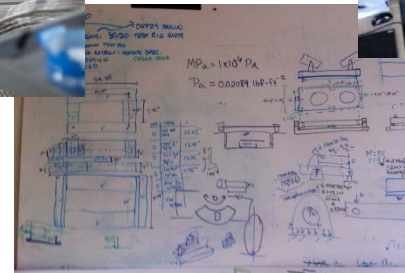
Presentation at 2012 TechCrunch  
Disrupt in San Francisco



Gyro system with  
new test bed



Some of the team  
members



Sketches and calculations for  
test bed design

July – Aug 2012

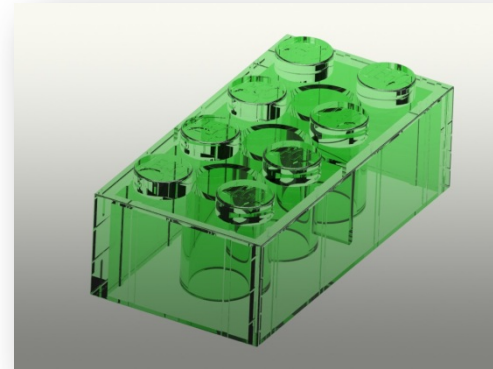
Photo Credits to Kevin Lomeli

# CAD for fun

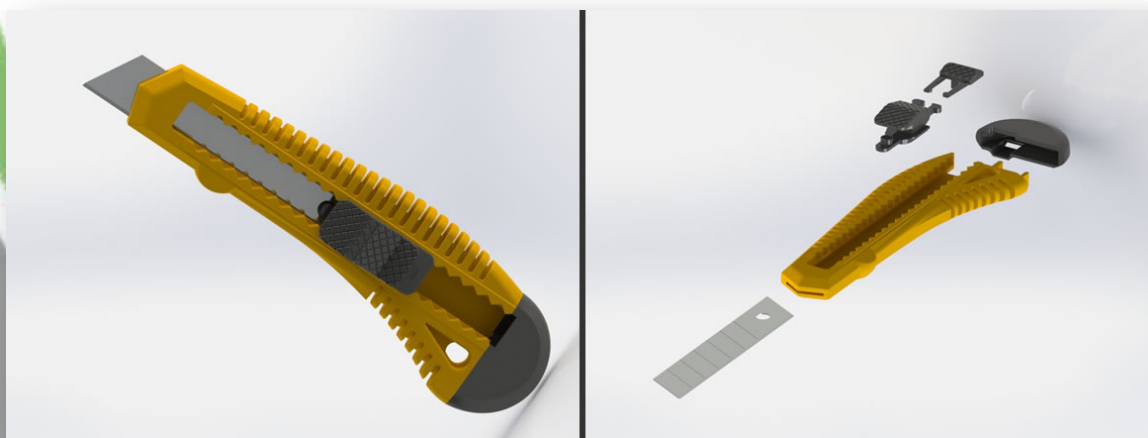
These are some objects I have drawn in SolidWorks during my spare time



Lego  
sword  
(2011)



Lego  
piece  
(2011)



Cardboard  
cutter  
(2012)