UC Berkeley

Theta Tau Epsilon Chapter

Engineering Project: Foosball Table

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1 Introduction

The Theta Tau Upsilon Pledge Class Engineering Project is a covered foosball table for Tause. When not in use as a foosball table, individuals can use it as a regular table, as there will be a medium density fiberwood cover placed over the playing field that will serve as a tabletop. The foosball table will be the same as other standard foosball tables, but our table will include several other unique features, such as a digital scoreboard to keep track of points and cup holders for convenience. In addition to these features, the entire table will be weatherproofed to be fit for outdoor storage.

2 Objective

Our aim for this engineering project is to create a foosball table that provides entertainment, is multifunctional, and can be used in both a social and casual setting. We intend for this foosball table to add to the legacy of the fraternity.

3 Research

3.1 Weatherproofing Wood

The main concern regarding weatherproofing the table stems from potential water damage and mildew growth from the rain and humidity of the Bay Area. To protect against mildew growth as well as UV damage, we will use a waterproof sealant to coat all exposed wooden surfaces of the foosball table prior to assembly. Medium density fiberwood (MDF) is durable and smooth, which makes it an ideal surface for coating.

3.2 Waterproofing Electronics

In order to waterproof the internal circuitry and wiring so it does not short, the table will be covered with an MDF board. With a sealant applied to the MDF board, the cover will serve as the waterproof exterior to protect electronics, as well as the interior of the table. A waterproof cover for the entire table, such as a large tarp, will also be considered if the prior measures seem to be inadequate. A small box to enclose the electronics will also be used if all of the prior measures seem to be inadequate after testing.

3.3 Electronic Scoreboard

Although few of the team members have much experience in programming an Arduino, there are various tutorials, forums, and walkthroughs available that outline how to create a system for displaying a scoreboard with an Arduino, which the Electronics team will utilize to create a functional scoreboard.

4 Anticipated Problems and Potential Solutions

4.1 Water Damage of Wood and Flooding

The table will be prone to water damage if it is left outside for long durations. To mitigate water damage of the wood, all wooden components will be coated in sealant before assembly. In addition, in case the interior of the table does flood, there will be small holes in one or more corners of the table that serve as drains.

4.2 Structural Stability

The main concern involved in building the foosball table is ensuring that the overall structure is able to withstand the forces of natural wear and tear along with weather damage. Additionally, since the nature of the game involves intense and rough movements, the table must be sturdy and stable enough to withstand these forces. Although we believe the table to be sufficiently sturdy without the base, we will include a base frame made of 2" x 4" beams to increase stability.

4.3 Lack of Technical Experience

Although four members of the Upsilon Pledge Class have Jacobs Maker Passes, there is still an overall lack of technical skill and experience, for none of us have attempted a project of this magnitude before. However, we do not believe that this lack of experience will be an obstacle that we cannot overcome. With various resources at our disposal, such as active brothers and design specialists at the Jacobs Makerspace, we are positive that we will be able to find help when we need it. In addition, this project will serve as a chance for us all to gain experience in design and woodworking.

4.3.1 Wood Miscuts

One of the most likely issues to arise are miscuts when cutting out wood components. To prevent this, we will have specialists at the Jacobs Makerspace review our intended cuts before we execute them and ask for their supervision while making the cuts. In addition, we have accounted for in our budget more wood than we would need to build a single table so that if any miscuts do render a wooden component unusable and unsalvageable, we have extra wood to redo the component.

4.4 Safety Issues

Safety concerns during the construction of this project will be appropriately addressed, for most of the construction will take place in the Jacobs Makerspace, which enforces strict safety guidelines. Safety concerns during outside construction time will be addressed on a case-by-case basis. Safety goggles, gloves, and dust masks will be purchased if needed, but most, if not all, of the woodshop work will be done in the Jacobs Makerspace.

5 Project Plan

5.1 Overview

The first step in this project will be to consult active brothers and outside resources for assistance with finalizing the overall plan, including design, materials to be used, fabrication techniques, and timeline. Useful outside resources include Jacobs Design Specialists, internet forums, and videos.

Fundraising will take place throughout the entire duration of completing the project. With two cars at our disposal, logistics with acquiring materials at retail shops such as hardware stores and online catalogs should not be an issue. Although some items on the material list have more priority than others, most, if not all, will be bought in the first week or two of the project (See Timeline for more details). Construction is predicted to begin during the first week of March. Parts that need to be altered prior to assembly will be altered as needed.

By mid-March, we plan to have parts and components finalized and to have begun assembly. At this point, if the Jacobs Makerspace becomes an inappropriate place to work due to the size of the project, it will be moved to the residence of a member of the Upsilon Pledge Class. By late March, before spring break, assembly should be well under way and the final product should begin to be realized. By this time we will need an outside storage area, most likely the residence of a member of the Upsilon Pledge Class. Final assembly should be finished by the end of March. Although the final date of completion is slated to be during the week of April 5, we have allotted ourselves more time, as displayed below in the Timeline section, in order to prepare for any contingency.

5.2 Project Website

The project website will be coded using HTML and CSS. It will contain three tabs: Objective, Team, and Progress. The Objective tab will outline the goals and purpose of the foosball table. The Team tab will contain headshots of the Upsilon Pledge Class. Below each headshot, their position on the project will be listed as well as a brief background description about that particular member. The Progress tab will provide weekly updates in the form of a picture(s) supplemented by a summary of what the Upsilon Pledge Class accomplished in that particular week.

In order to host the website, a DigitalOcean Linux server will be obtained for free using educational credits. Apache will be installed onto the server, the domain registered, and the DNS updated. The final step will be uploading the website files to the server.

5.3 Preliminary Design

5.3.1 Table Frame

The 1" thick MDF planks will be cut into four pieces: two 1" x 16" x 27" boards and two 1" x 16" x 54" boards. 5/8" diameter holes will be cut in the 54" boards. An elliptical hole will be cut in the 27" board for the ball return. These two boards will serve as the outside frame of the table. At one or more of the corners of the frame, there will be a small hole

drilled into the side (1" dia. or less) for the purpose of draining water in case water does enter the playing field.

5.3.2 Table Base

4" x 4" and 2" x 4" beams will be used to construct the base of the table. The legs will be 4" x 4" x 30" beams. The four legs will be connected with 2" x 4" for support and sturdiness. The long side of the base will be connected with 2" x 4" x 52". The short side of the base will be connected with 2" x 4" x 27". At the bottoms of the legs, levelers will be attached in order to have a level playing field even with a rough surface. Corner brackets and lag screws will attach the table frame to the table base.

5.3.3 Playing Field

Between the two long sides of the table frame, there will be two 2x2x27 bars to support the playing field. The playing field will rest on top of these two bars, but they will also be fastened to the goal board as well as the long sides.

5.3.4 Ball Return

There will be a simple ball return system on the two short sides of the table frame. Once the ball enters the goal, it will drop down and a sort of funnel of wooden beams will lead the ball to the elliptical hole on the short side. The space necessary for this system is taken into account by leaving 2 inches on both ends of the playing field between the end of the board and the short side of the table frame.

5.3.5 Players and Rods

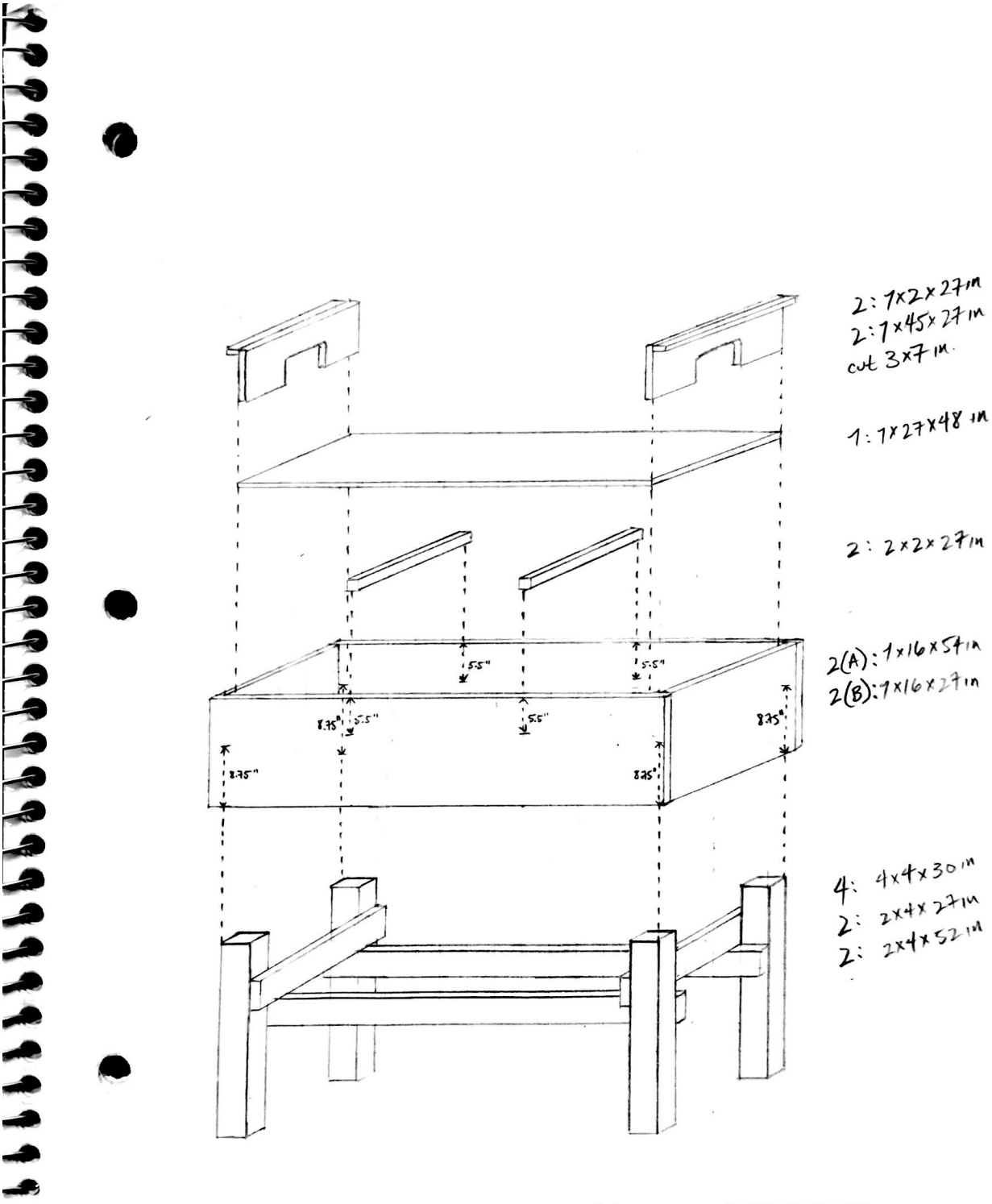
Both the foosball men and the rods will be purchased online. Solid aluminum rods with diameter 5/8" made specifically for foosball tables, foosball men made to fit standard 5/8" rods, and rod handles will be used. Manufactured parts will be much more reliable and durable than self-fabricated parts.

5.3.6 Electronics

Within the table frame, there will be an Arduino that takes input voltages from the buttons on the bottom of the ball catches and updates the scoreboard accordingly (see diagram under Preliminary Designs). In addition, there will be a reset button on the bottom of the table which will reset both of the scores back to 0. Similarly, on the bottom of the table, there will be an on/off button. The main Arduino board and the scoreboard electronics will be separated into plastic cases so as to increase their water resistivity. These cases will be further sealed using electrical tape to create a stronger physical barrier.

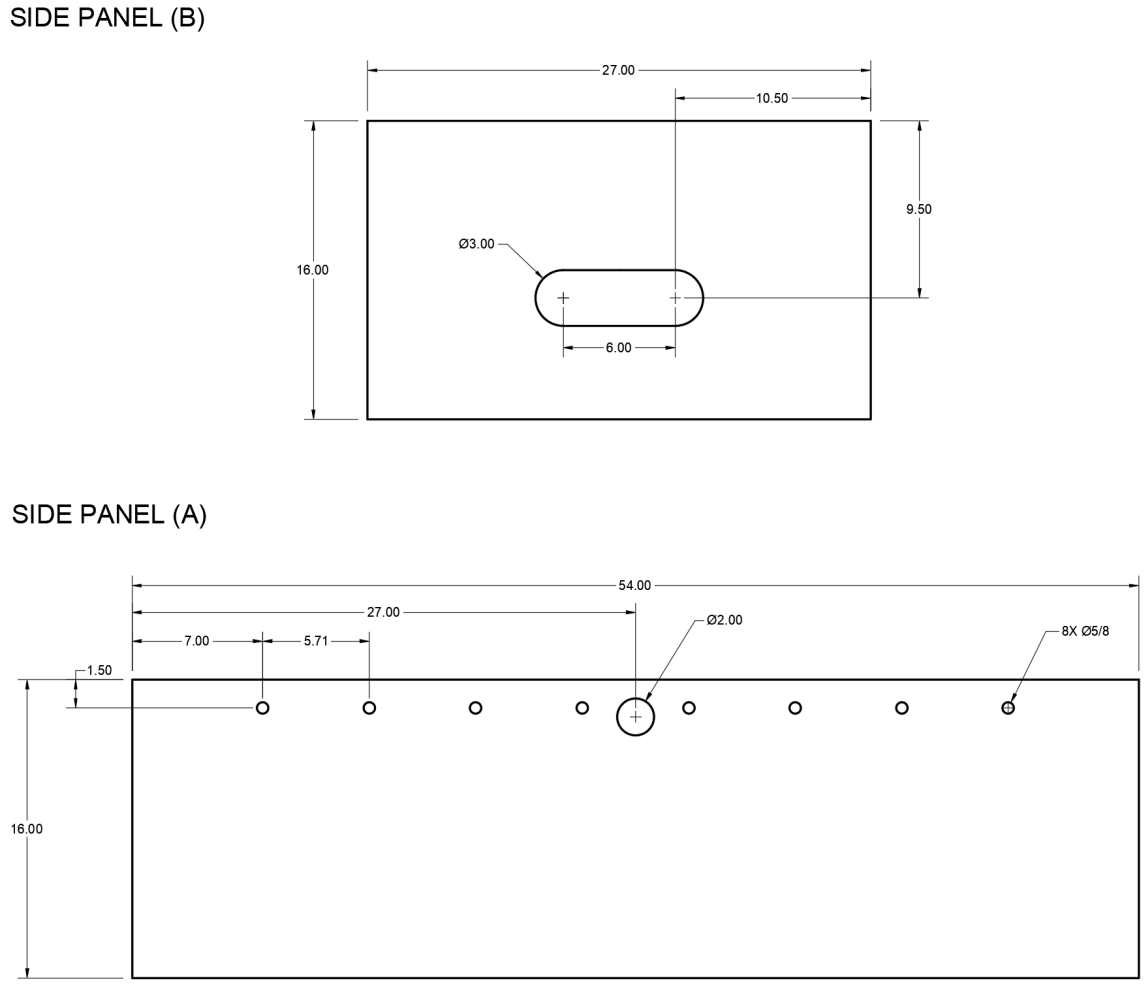
5.3.7 Diagrams

Figure 1: General Assembly Diagram



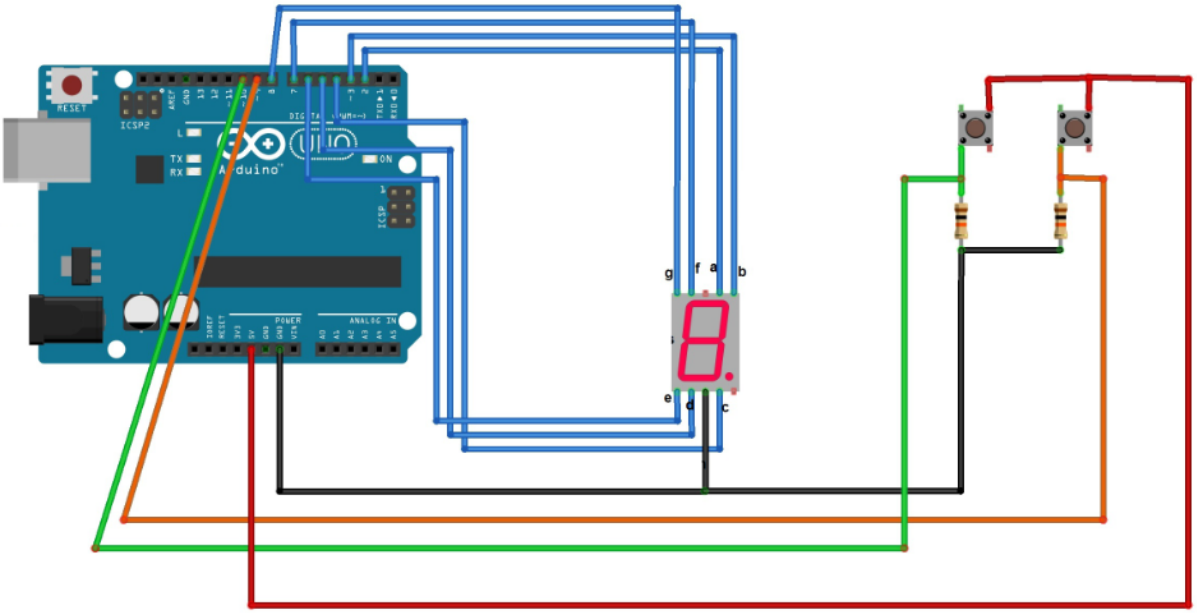
*Side Panel (A) will include 5/8" dia. holes for rods and 2" dia. hole for ball entry. Side Panel (B) will include an elliptical hole for ball return. See diagram below.

Figure 2: Cuts for Side Panels (A) and (B)



Side Panel (B) and Side Panel (A) must be cut with high precision in order to fit foosball rods properly and smoothly through both sides. These holes will be cut at the same time through both boards to ensure that they mirror perfectly.

Figure 3: Schematics for scoreboard and Arduino



6 Budget

Item	Source	Description	Units	Estimated Cost
MDF Board	Home Depot	Side panels (A) and (B)	4	$100
Hardwood	Home Depot	Legs (4" x 4" x 30")	4	$23
Wood	Home Depot	Table Base (2" x 4" x 5')	4	$30
MDF Board	Home Depot	Playing field (0.75" x 30" x 50")	1	$29.96
MDF Board	Home Depot	Cover panel and side panels of cover (0.75" x 34" x 60", 0.75" x 1" x 55")	1	$29.96
Foosball Men	Amazon	Twenty-six foosball men	26	$34.95
Steel Rods	Amazon	Set of eight solid steel rods	8	$120.80
Bushings, Bearings, Washers Set	Amazon	Set of all appropriate rod attachments	1	$26
Handles	Amazon	Set of eight foosball handles	8	$17.99
Foosball Balls	Amazon	Set of twelve balls	12	$8.99
Wood Sealant	Home Depot	Wood sealant for water resistance	1	$36.53
Paint Rollers, Brushes	Home Depot	For applying wood sealant	5	$30
Scoreboard Components	Amazon	Keep track of game	1	$20
Arduino	N/A	Control of lights, buttons, and scoreboard	2	N/A
Breadboard	All Electronics	Circuit creation	1	$6
Wires	All Electronics	Jumper wires for Arduino	1	$7
T-Nut Leg Leveler	Amazon	Set of four for feet, heavy duty	1	$16
Commercial Grade Joist Corner Bracket	Home Depot	Attach legs to panels	4	$10

Stainless Steel External Hex Head Lag Screw	Home Depot	Attach legs to side panels, pack of 5 (0.375" x 3")	8	$73.44
Large Washers for Hex Head Screws	Home Depot	For hex head lag screw, pack of 25 (0.375" inner diameter)	2	$6.28
Philips Square Drive Pan-Head Full Thread	Home Depot	Attach joist corner brackets to side panels, pack of 35 (0.750")	1	$2.10
Zinc Coated Multi-Material Screw	Home Depot	Attach joist brackets, pack of 35 (Number 8, 0.750")	1	$1.94
Cup Holder	Amazon	Plastic cup holders attached to side panels to hold beverages	2	$13.98
Spray Paint	Home Depot	(1 green, 1 white), Matte Finish for playing field	2	$7.32
Masking Tape	Jacob's Institute for Design Innovation	Allows creation of crisp foosball field lines during spray painting process	1	N/A
Wood Glue	Jacob's Institute for Design Innovation	Ensuring wood pieces are joined securely	N/A	N/A
Table Circular Saw, Chop Saw, or Portable Circular Saw	Jacob's Institute for Design Innovation	Making wood cuts	1	N/A
Jigsaw, Electric Drill, or Cordless Screwdriver	Jacob's Institute for Design Innovation	Drilling screws	1	N/A
Eccentric Sander or Orbital Sander	Jacob's Institute for Design Innovation	Ensuring smooth surfaces	1	N/A

Hole Cutter Drill Attachment	Jacob's Institute for Design Innovation	Drilling holes for steel rods to go through	1	N/A
Laser Cutting Machine	Jacob's Institute for Design Innovation	Engraving the Theta Tau Greek letter design into side panels	1	N/A
Estimated Tax				$51.20
Total Price				$757.44

7 Timeline

Date	Agenda
February 28, 2018	Complete Woodshop and Laser Cutter Training for Maker Passes (Jasper Chang, Jon Gill, Victoria Tovmasyan). Begin purchasing materials online and in store. Make trip to Ashby Lumber and Home Depot for wood and hardware.
March 6, 2018	Finish cuts for frame and leg components of the table. Specifically, finish side panel (A) and (B), cut legs to length, cut 2x4's to length, cut goal boards, cut lateral supports, and cut scrap for ball return. Engrave Theta Tau letters into side panels (B). Begin implementation of scoreboard, specifically linkage between Arduino and scoreboard.
March 13, 2018	Complete and weatherproof the scoreboard. Finish weatherproofing of each piece of wood with varnish and sealant and let dry. Attach levelers to bottoms of table legs. Construct website documenting progress of the project.
March 20, 2018	Paint field. Assemble table, including scoreboard, legs, panels, and rods. Attach cup holders. Make wood cuts necessary for table cover.
April 3, 2018	Finish any final adjustments to the foosball table and ensure the quality and functionality is up to par with the brotherhood's standards.

8 Task Division

Title	Description	Names
Project Leads	Be point of contact and keep roles accountable.	Jasper Chang, Jon Gill
Table Base Fabrication Lead	Oversee table base fabrication process.	Jasper Chang
Table Frame Fabrication Lead	Oversee table frame fabrication process.	Victoria Tovmasyan
Electronics Leads	Supervise integration of scoreboard and necessary electronics.	Jeffery Huo, Ray Yuan
Website Lead	Create and manage the website for the Upsilon Pledge Class Engineering Project	Kyle Golden
Logistics and Transportation Leads	Make sure materials and components are transported safely and arrange trips to buy materials.	Jenny Mo, Robert Wilkerson

9 Summary

For their engineering project, the Theta Tau Upsilon Pledge Class will create a foosball table for Tause. The weatherproofed table will feature an electronic scoreboard and cup holders. The purpose of the table is to provide an fun, yet practical and functional piece of furniture.

Construction will begin with wood cutting in the Jacobs Makerspace by the members of the Upsilon Pledge Class with Maker Passes. After all wooden components are cut there will be a sealant applied to all wooden surfaces. Afterwards, they will be assembled and fastened with appropriate screws and brackets.

Fundraising will primarily be done through various events planned throughout the following months. A couple of options include selling Krispy Kreme donuts in San Francisco and Chick-Fil-A around the Berkeley area.

Although there are potential risks and issues involved in constructing the foosball table and making it weatherproof, thorough planning, outside help, and a strict schedule will mitigate these problems and result in a dual-function table that is both entertaining and functional.