**FIELD GOAL FRENZY**
Kick Off Design Challenge
KNW2300: Introduction to Engineering Design, Fall 2017

**Challenge:**
Your challenge is to build a machine that can move forward on its own and throw a ping pong ball through a goal at a team-defined height. You will get two attempts in each round; each ball may be thrown at the same height or different heights. Points will be awarded based on whether the attempt was successful at the height of the goal. A scoring formula is provided below.

This is a fierce and worthy competition across all sections of KNW2300 in which teams will compete for a pretty attractive grand prize (see below).

**Guidelines:**

- The target is between two goalposts set 2' apart, below a bar set at 10', and above a bar set at a team-determined height. The lower bar may be placed anywhere between 1' and 8' in height in one-foot increments. ***See diagram for more details.***
- You will be allowed two attempted shots from the same start line. At each attempt, you may elect to change the height of the lower bar. The goal will be set 10' away from the start line. Your machine may launch the ping pong ball beginning at 3' away from the start line. It may not launch before this or the attempt will be counted as a misfire. A 6" tall fence will be placed 7' away from the start line (or 3' away from the goal); your ball must be launched by this point. ***See diagram for more details.***
- You may begin/trigger the start of your attempt however you choose, as long as your machine begins behind the start line. Machines must be self-powered for the entire attempt; it may not be pushed or otherwise propelled by a team member before the start line. Once your machine crosses the start line, you may not help/touch/interact with it for the duration of the attempt. You may touch/reset the machine between attempts.
- Your machine will launch a ball toward the target. You will receive points corresponding to the height attempted (e.g. 1' = 1 point, 8' = 8 points, etc.). An unsuccessful attempt – which is any ball scored outside the goalposts, above the 10' upper bar, or below the lower bar – will receive a score of 0 points. Contact with the goalposts and upper and lower bars is allowed as long as it makes it through the goal. Any ball that is not launched within 30 seconds after the

beginning of an attempt will also receive a score of 0 points. You may only score once per attempt.

- You may not affix anything to any part of Caruth Hall.
- Each team will have 4 minutes total for set up and completion of BOTH attempts. The timer begins when the staff says so.
- Dry-fire/misfire – any ball launched at the target before the 3' mark after the start of an attempt will count as a misfire. If the ball fails to launch within 30 seconds after it hits the 7' mark, it will also be counted as a misfire. All misfires count as attempts and will receive a score of 0 points. An accidental launch that occurs when the machine is still being setup or entirely before the start line does NOT count as a misfire/attempt.
- Bounces – if the ball hits the ground before going through the goal posts, it is still counted towards your score as long as the ball goes through the goalposts above the bar set at the team-determined height.
- Hail Mary – a "Hail Mary" is a 2x points multiplier achieved only when your machine is able to score successfully as well as hop over the 6" fence at the 7' mark in the same attempt. You may only hop after your ping pong ball has been launched. If the machine does not also score successfully, you will receive 0 points. The multiplier only applies with successful scoring. You may attempt a "Hail Mary" on both scoring attempts.
- The score of both attempts will be added together. The cumulative score represents your team's final score in each round.
- All teams will initially compete in a round of 16. The top 8 scores from that round will move into the round of 8. The top 4 from that round will move into the round of 4. The top 2 from that round will move into the final round.
- In the event of a tie between teams vying for the cutoff position in each round, competing teams will have one attempt to score the longest possible launch measured from the final resting place of the machine DIRECTLY to the first impact of the ping pong ball. The goal will be removed in the tiebreaker. ***See diagram for more details.***
- TA's will take great care in enforcing adherence to the constraints of this challenge. Any team found to be performing outside of the guidelines – of timing, material usage, and other rules – laid out in this document will be disqualified. However, they may still be eligible for the Design Prize.

**Scoring:**
Final score (per round) = Attempt 1 score + Attempt 2 score

**Materials:**
You can use ONLY the following materials for your machine:

- Cardboard –
    - Each team will be provided with two stiff sheets of new cardboard. This is your limit for the entire challenge including prototypes so use it wisely.
    - You may use any amount of additional recycled (used) cardboard; you may not purchase cardboard or otherwise acquire new cardboard.
- 24”x24” piece of MDF, ¼” thickness.
- 3D Printer filament (for 3D printed parts only)
- Rubber bands – any size, any number; a limited variety will be provided.
- Paper clips – any size, any number; a limited variety will be provided.
- Flat washers – any size, any number, a limited variety will be provided.
- Hex nuts – any size, any number, a limited variety will be provided.
- 6 feet of string – a variety of string will be provided.
- 6 feet of dowel – a variety of dowel will be provided.
- 6 feet of duct tape – standard width; provided.
- Hot glue – unlimited amount; provided.
- 6 ping pong balls
- 25 coffee filters (8-12 basket size)

You may use additional materials for decoration, but these additional items absolutely must not be functional in any way.

You may procure alternate rubber bands, paper clips, string, flat washers, or hex nuts. If you have any doubt about whether your alternate choices will be permitted, we recommend you consult with one of the professors to have your item approved. Rickey Crum, Lab Manager of the Deason Innovation Gym, has the final say in constraint related decisions.

NOTE: Your design MUST include at least one (custom-designed) part that has been 3D printed and at least one (custom-designed) part that has been laser cut.

**In the classroom:**
We will provide cutting mats, hot glue, x-acto knives and blades, metal rulers, map pins, a compass, and a hand saw and vise. All tools provided are for communal use among

all teams across all sections. Do not remove tools from the classroom for any reason. If your team is known to have taken supplies from the room you will be disqualified.

You will have 24-hour swipe access to Junkins and the classroom. FYI, there is video surveillance in this particular classroom. We just thought you should know that.

**Grand Prize:**
Each person from the winning team will receive a three-percentage point bump in their final grade.

**Design Prize:**
Members of the teaching team will judge machines on the following:

- Craftsmanship: Did the team take care in constructing their machine? Does it look great?
- Engineering: Is the function, structure and material usage of the design sound, efficient and effective? Is the design unusual, surprising or clever?
- Showmanship: Is the presentation of the design an experience to behold? Are we delighted as an audience?
- Teamwork: Does this appear to have been a collaborative effort (this can be based on observation over the course of the project), and are all members involved in the design and presentation?
- Effort: Keep in mind effort can be rewarded even for a failed attempt. Fail with flair!

Each person from the highest scoring team across these categories will ALSO receive a three-percentage point bump in their final grade. In the event that the Grand Prize winner and the Design Prize winner are the same team, there will only be a three-percentage bump, not six. Don’t even try to negotiate this.

**Schedule:**

Class 1 (week of 8/22):

Intro to project, intro to cardboard construction, begin working as a team.

Interim deadline: 8/28 at 11:59pm

We want to see that you have tried a lot of different ideas already one week in. To do this, we ask that you set up a blog that is accessible to the profs and TAs (We recommend tumblr or blogger, but it's up to you.), and photograph and comment on various attempts, failures, prototypes and iterations. For example, "Here is a photo of the failed such and such mechanism. We learned that making our own springs out of paper clips isn't going to work." You should have at least twelve photographs and comments. We will provide an assignment on Canvas where you can link to this blog.

Class 2 (week of 8/29):

You will have this class primarily as working time as a team.

Competition (Friday 9/02, 2:00pm):

Meet in the 2nd floor atrium of Caruth Hall.

# KNW2300 Mini Design Challenge Reference Diagrams