# Fountain Wars: Pirates of the Prairie

J. Barnett[1] • E. Ogle[1] • K. Garman[1] • K. Wehkamp[1] • C. Shultz[2] • B. Stout[1] • E. Spurgeon[3] • C. Boudreaux[1] • G. Brady[1] • P. Mahoney[1] • A. Cioffi[1]

[1]Department of Biological & Agricultural Engineering • [2]Department of Civil Engineering • [3]Department of Mechanical Engineering • Kansas State University

## Introduction

Fountain Wars is an interactive competition where teams design, construct, test, and compete with two technical tasks and an aesthetics display all completed by water pumps, solenoids, and biological materials.

## Objectives

**COMPETITION**

- 120 minute on-site construction time

**TECHNICAL TASKS:**

- *Water bowling*: Consistently bowl strikes to knock down maximum pins in ten minutes.
- *Motion Machine*: Keep the ball in motion while elevating the ball above the 6 foot requirement and free falling 3 feet using 10 feet of horizontal track.
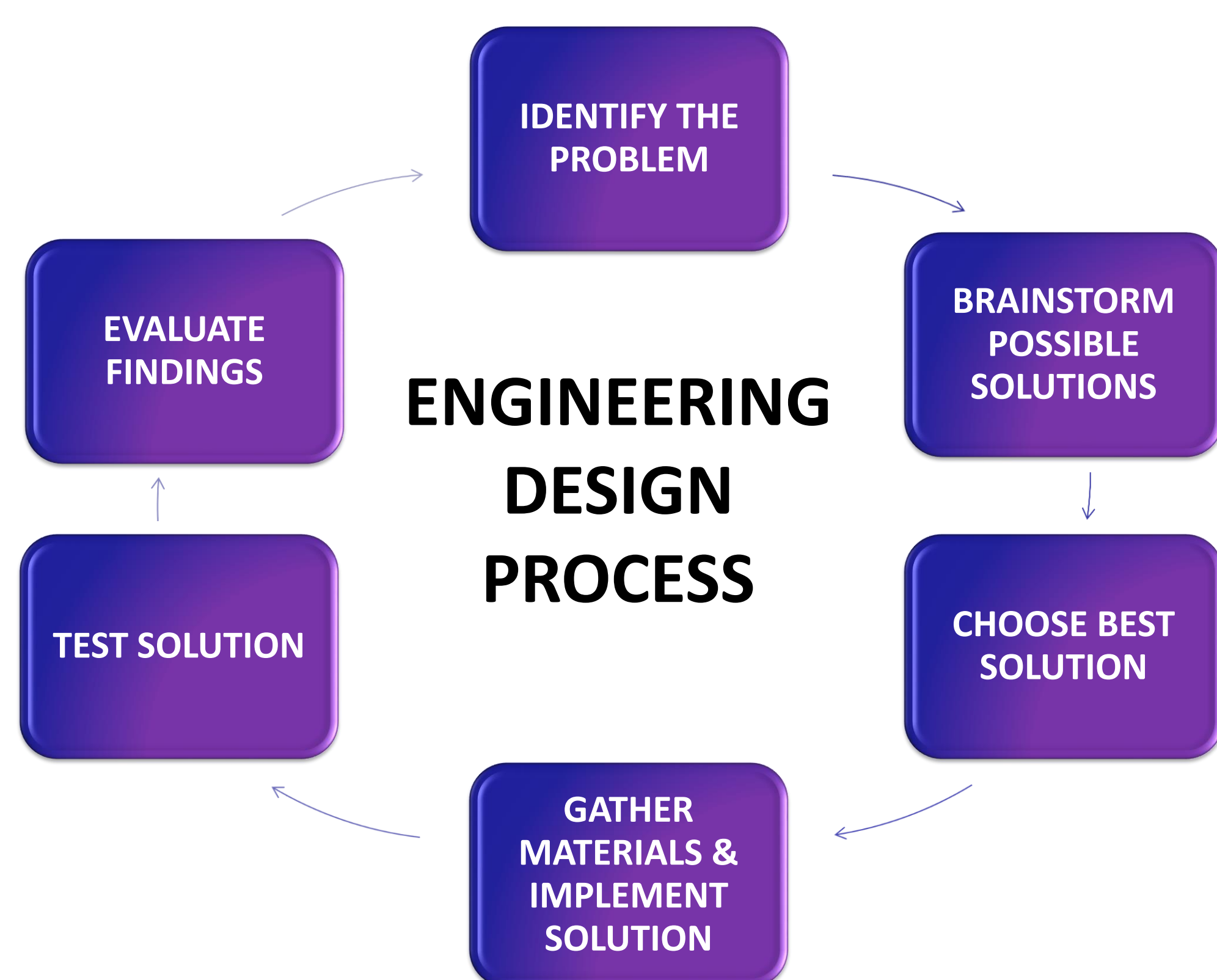
**AESTHETIC DISPLAY**

- "Pirates of the Prairie" theme
- Exciting 90 second aesthetics display
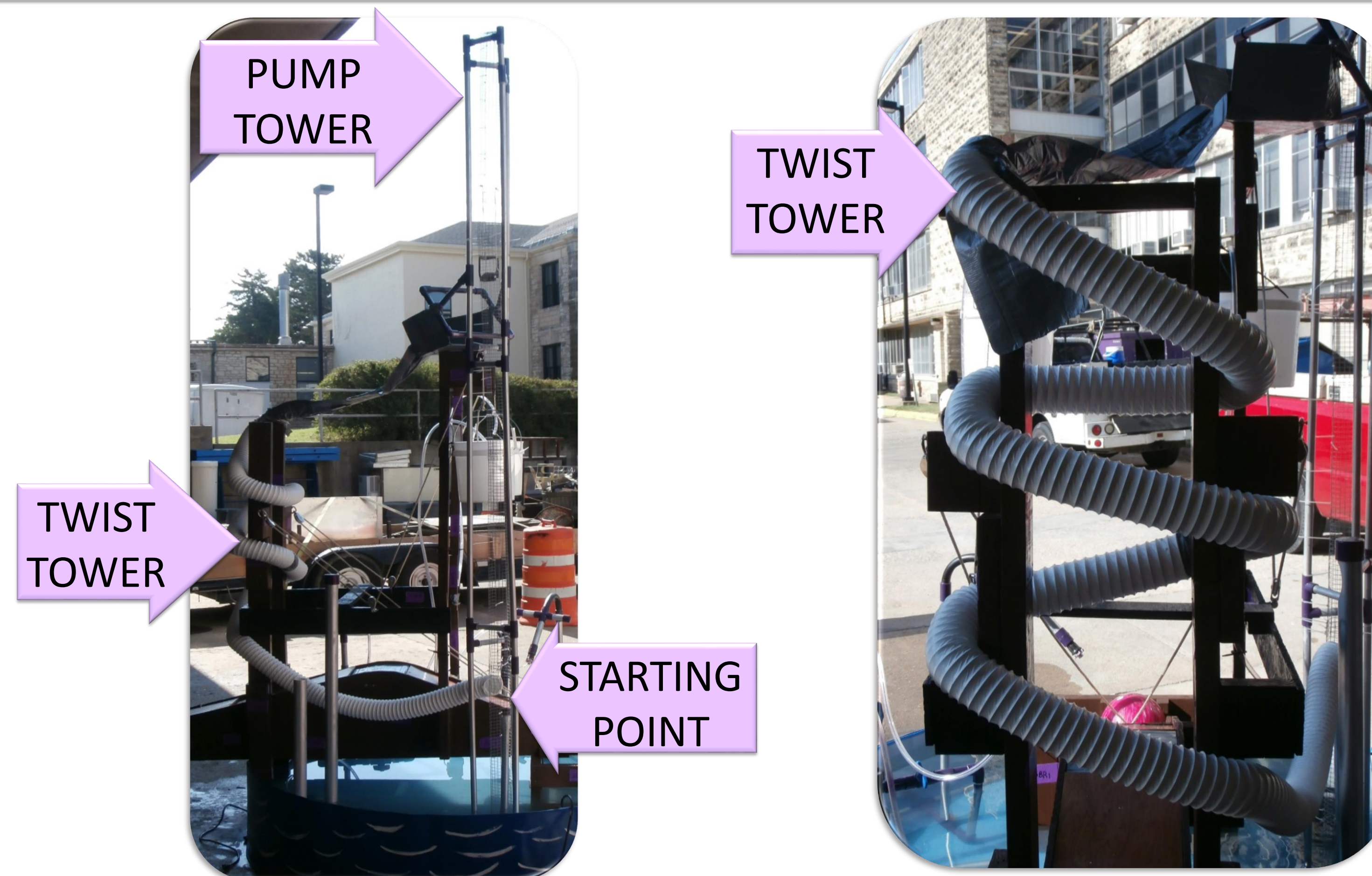- Biological materials earn bonus points

## Safety

Ground fault interrupter, safety glasses, 10 ft. electronic distance from pool
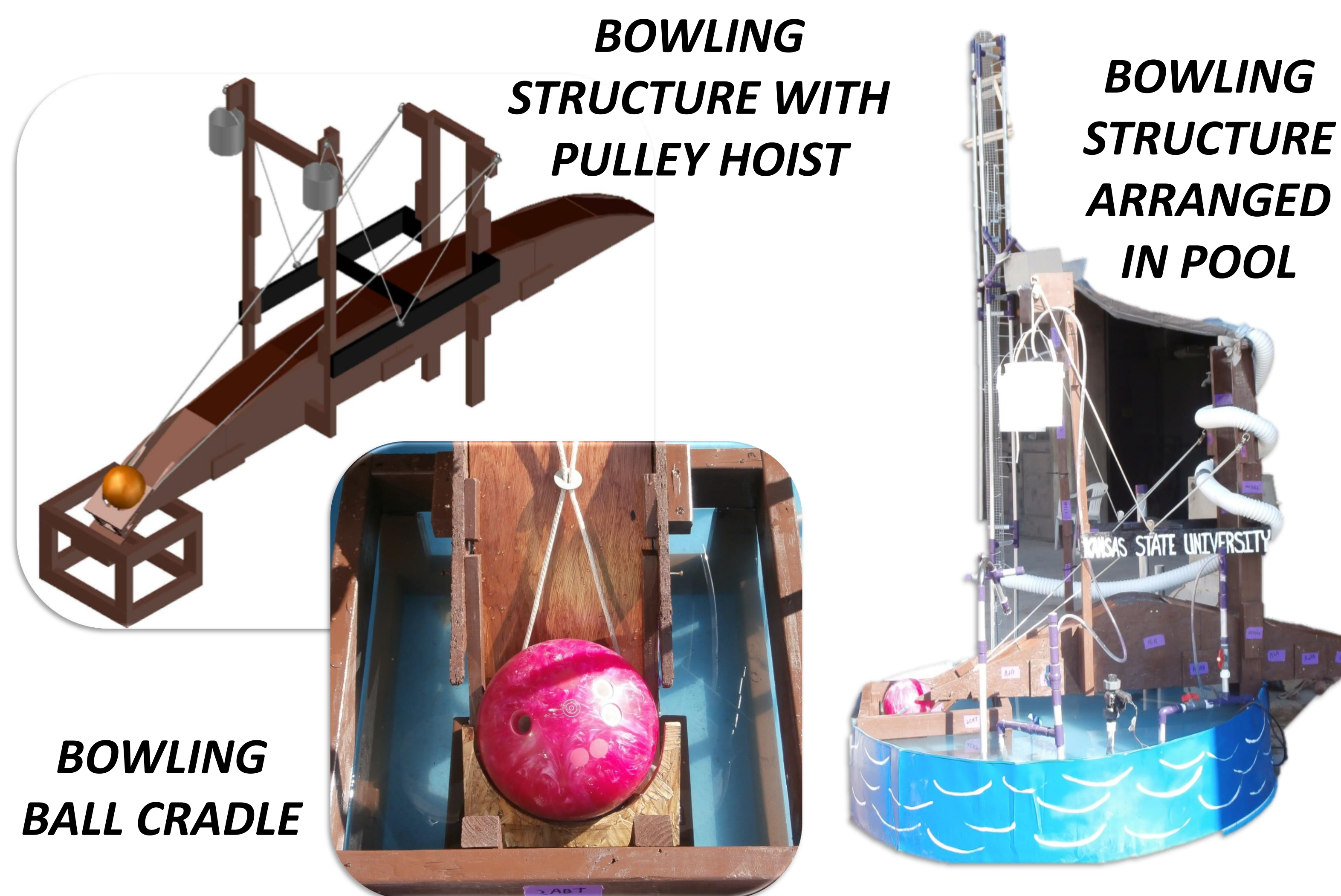
## Methods



ENGINEERING DESIGN PROCESS: IDENTIFY THE PROBLEM → BRAINSTORM POSSIBLE SOLUTIONS → CHOOSE BEST SOLUTION → GATHER MATERIALS & IMPLEMENT SOLUTION → TEST SOLUTION → EVALUATE FINDINGS

## Task 1: Motion Machine



PUMP TOWER • TWIST TOWER • TWIST TOWER • STARTING POINT

- 6 ft. vertical rise, 3 ft. free fall, 10 ft. horizontal track, 4 ft. horizontal displacement from origin, and continuous racquetball motion
- The ball is propelled to the top of the 10 ft. tower, pump action ceases, and the ball free falls 3 ft.
- Stopping the ball is a flap that folds in, directing it down a ramp to the twist tower
- The ball enters the twist tower and is routed back to the starting point, in order to repeat the task

## Task 2: Water Bowling



BOWLING STRUCTURE WITH PULLEY HOIST

BOWLING STRUCTURE ARRANGED IN POOL

BOWLING BALL CRADLE

- 16 lb bowling ball with pins 10 ft. away
- Bowling ball starts 6 in. below pool's rim
- 2 gallon buckets on each side of ramp are simultaneously filled with water via pumps
- Buckets will lower & cradle holding bowling ball will slide up ramp
- Ball will reach peak & slide down ramp, colliding with bowling pins

## Aesthetics



FILL TANK • WATER GUN • SOLENOID BLAST

- 90 second interactive display
- Participant manually aims water gun to the fill tank
- Arduino program triggers water level sensors to activate an alarm sound and a solenoid fountain blast to represent a pirate encounter

## Conclusions

- 10 months of hard work, team bonding, and trial & error
- Successful runs during practices
- Developed real world engineering design skills

## Acknowledgements

ASABE

KANSAS STATE UNIVERSITY COLLEGE OF ENGINEERING

# Kansas State University Fountain Wars Design Team: Pirates of the Prairie

**Jessica Barnett, Chloe Boudreaux, Alison Cioffi, Kevin Garman, Phil Mahoney, Erin Ogle, Chris Shultz, Eric Spurgeon, Breanna Stout, and Kayla Wehkamp**
**College of Engineering, Kansas State University**

## ABSTRACT

The 2013 Fountain Wars Design Competition took place at Crown Center in Kansas City, Missouri on July 21 and 22 as part of ASABE's Annual International Meeting. This interactive competition compels teams to design, construct, and test a fountain capable of performing two technical tasks and to incorporate an aesthetics display. This year, the pair of technical tasks requires the fountain to keep a ball in motion for the duration of the judging period and knock down bowling pins with a bowling ball that are set 10 feet from the edge of the pool. Additionally, the aesthetics display must use pumped water for a 90 second show. The following report summarizes the background and specifics of the Kansas State team's design.

## INTRODUCTION

The Fountain Wars Design Team from Kansas State University utilized the experience gained from previous competitions, particularly from the 2012 campaign, and applied that to this year's tasks. However, especially the aesthetics display, the team planned to introduce a new set of ideas that will keep the competition as exciting as ever. This year, the Kansas State team chose to work with a unique theme in hopes to set them apart from the rest: "Pirates of the Prairie."

## DESIGN OBJECTIVES

Throughout the design process, the team has invested a significant amount of time planning the design, especially the pair of technical tasks. While there were several minor design objectives, the major goals were to make the design efficient to build, technical tasks quickly completed, and the aesthetics display to show great creativity.

1. **Efficiency:** With a construction time for the entire fountain limited to only 120 minutes, the design was chosen to be easily assembled under time pressure.

2. **Accuracy:** Both technical tasks place a level of importance on accuracy. With the water bowling technical task, the majority of the score is based on how many pins can be knocked over in 10 minutes or by continuing to get balls in 10th frame scoring. For the Motion Machine II task, the bulk of the score is based on keeping the ball in motion while elevating the ball above the six foot lift requirement and free falling beyond the 5 foot minimum for points to be awarded.

3. **Creativity:** A significant portion of the competition is based on the aesthetics display. Our design is geared to not only catch the audience's attention, but to maintain their attention and excite them for the entire 90 second period.

## TECHNICAL TASK 1: THE MOTION MACHINE II

The objective of the Motion Machine is to keep a racquetball in motion for 3 minutes while also completing the following requirements:

- A minimum of six feet vertical displacement of the racquetball must occur
- The ball must have a minimum horizontal displacement of 4 feet
- The ball must move on a minimum of 10 feet of horizontal track
- The path must include a vertical free fall of at least 3 feet
- The ball must be largely visible along its path

The team chose a design that contained the ball within a vertical structure for the vertical rise and drop portions, with an additional structure supporting a twisting section for completion of the horizontal distance and displacement requirements.

## TECHNICAL TASK 2: WATER BOWLING

The 2013 Fountain Wars Guidelines specify that a 16 pound regulation bowling ball is to be elevated and propelled using water power in order to knock down bowling pins which are placed 10 feet away from the pool. The bottom of the bowling ball must start 6 inches below the rim of the pool. The major difficulties with the task are dealing with the weight of the ball, raising it to the desired height, and keeping the ball in the preferred trajectory for the entire 10 feet to have an accurate and consistent shot. The team's primary goal for the task was to create a sturdy and accurate apparatus in order to maximize the number of pins knocked down.

## AESTHETICS DISPLAY

As with previous years, the fountain is required to perform a 90 second aesthetics display. Rules for this part of the competition are sparse and only include a need to use pumped water and start within 60 seconds of the judge's order. This year, a new requirement of keeping all electronics 10 feet away from the pool will be enforced. The team decided to focus on a game-like aesthetics display. To combine a pirate theme with electronics, the team created the "Pirate-Ship Battle."

## FINAL RESULTS

The 2013 Kansas State University Fountain Wars Design Team received second place at this year's international competition. The design for the racquetball was successful with continuous movement for three minutes and meeting the minimum heights and displacement. The bowling ball design encountered last minute setbacks that influenced the final bowl to become off centered and did not earn us maximum points. The aesthetics display electronics program was successful however, PVC fittings came unglued and the water pressure was not able to spray as far in order for the audience to witness the pirate ship battle. Our poster, presentation, and written report were all successful which helped us earn second place. The team has been able to take this experience and apply it to improve for next year's competition in Montreal, Canada.