Team 33 Game Design Supplement Pages: Rainforest Resupply

What Makes Our Game Unique?

Changing Goal Ownership - The switches, known as CHAMELEONS, allow robots to switch control of the TREES throughout the match. This allows for robots to score at either end of the field, resulting in lots of movement across the field at all times. This makes the scoring possibilities exciting for both drivers and spectators.

Flying Fruit - The catapults, known as DELIVERY STATIONS, allow balls to fly in rather than having the Human Player simply drop them in. This will create an exciting visual dynamic.

Swinging Vines - The chains, known as VINES, hang down from the CANOPY so that robots will climb them during the ENDGAME. Climbing chains is unique to previous FRC games. This is an interesting way to use the ELEMENT because it involves lots of design challenges for robots to be able to climb these unsteady chains.

Multiple Sized Game Pieces - The game pieces, known as FRUIT and SUPPLIES, are two drastically different sizes. Because of this, teams will need to develop mechanisms so that their robot can manipulate the two different balls.

Engaging Theme - Our rainforest theme is both scientific and appealing to a wide audience range.

Scoring Summary:

The points scored in matches are displayed below.

RAINFOREST RESUPPLY Scores		
Period	**Scoring Action**	**Points**
Autonomous	FRUIT to TOUCAN TREES	6
	FRUIT to MONKEY and SLOTH TREES	4
	FRUIT to TORTOISE	2
TeleOp	FRUIT to TOUCAN TREES	3
	FRUIT to MONKEY and SLOTH TREES	2
	FRUIT to TORTOISE	1
ENDGAME	Deliver SUPPLIES	7 (10 in playoffs)
	Hang from VINES	7 (10 in playoffs)
	SUPPLIES guarded by opposing alliance's wall	3

During qualification matches, 1 RP is awarded for all three robots moving off the line, claiming all three TREES, and scoring at least one FRUIT in the TREES during the autonomous period. Another RP is awarded for scoring 20 points in the ENDGAME, 2 RPs are awarded for winning, and 1 RP for a tie.

Our scouting team used data from previous years to predict scores for upcoming seasons based on how many actions they think teams will be able to complete in a match. These numbers increase during the season as robots and teams gain experience. We asked them to help us predict a Week 3 playoff match for Rainforest Resupply. An average winning alliance will be able to score between 160 and 190 points.

RAINFOREST RESUPPLY Average Game Playoff Score for Week 3			
Activity	**# Scored (Robot 1, Robot 2, Robot 3)**	**Points per Activity**	**Total Score**
Auto FRUIT Scored	4,2,2	6	48
TeleOp FRUIT Scored	16,16,6	2.5	95
ENDGAME VINE	0.5,0.5,0.5	10	15
ENDGAME SUPPLIES	0.5,0.5,0.5	10	15
			173
		Score Range:	**160-190**

A combined alliance should be able to score about 8 FRUIT in the TOUCAN TREE during autonomous, with average teams scoring 2, and more experienced robots scoring about 4. This action rewards 6 points per FRUIT scored, resulting in a 48 point total. During TeleOp, we predict that an alliance should be able to score around 38 FRUIT, with two robots being able to score about 16 each, and a slower robot being able to score about 6 FRUIT on its own. With an average score of 2.5 points for the various TREES, this should add up to a 95 point total. Finally, for the ENDGAME, we believe that each robot will either be able to hang from the VINES or deliver SUPPLIES to the CANOPY, giving each robot a 50% chance of completing each task, resulting in a 0.5 for each robot in each category. With both of these tasks worth 10 points each, this sums up to 15 points total for both the VINES and the CANOPY. Adding all of these final scores together, we get a grand total of 173 points. Because of skill variation, timing within the season, and other factors, this score will not be absolutely exact, so we gave the total a range of 160-190 points.

Rule Adjustments:

Even with the game design complete, new ideas were developed in case of issues with the game. These ideas can be put into place if, after observing gameplay, these aspects need to be improved.

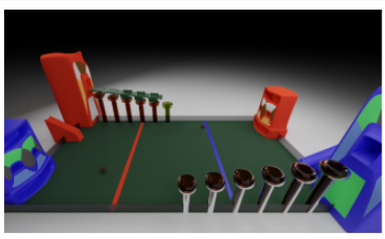
- Rebalance RP and point values from qualification matches to playoff matches
- Change amount of balls
- Change the time between CHAMELEON activations
- Change ENDGAME
    - Amount of time given in ENDGAME
    - Change when SUPPLIES are introduced, such as every 30 seconds throughout the game

Game Design Process:

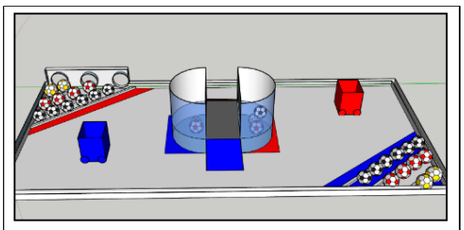
Brainstorming:

We started off our game design process by brainstorming ideas on what makes a good game versus a bad game. We listed these ideas as a team in order to gather suggestions from all of our team members. After examining the different traits that we wanted to incorporate into our game, we began to determine the best ways to include them.

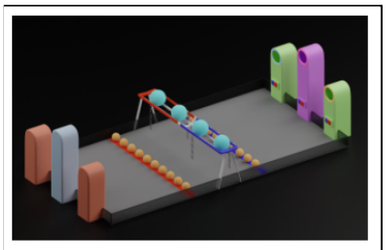
Once we completed our list of game characteristics, we began accepting game ideas from our team members. The concepts in each member's game were very unique from each other. They ranged from mobile goals to balls that rolled down pegs to fall into different tubes. When we had six different game ideas, we looked at each individual game and decided what we liked and disliked about each one. We took these games and made different modifications to them and examined the aspects we liked. We then ended up with three games, which we called "gumball machine", "kiddie pool", and "monkey bars" as seen in the sketches below.



Gumball Machine



Kiddie Pool



Monkey Bars

Analysis and Improvement:

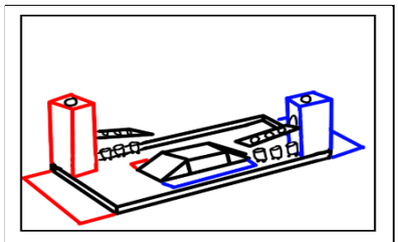
We then took our three game concepts and ranked them with a Pugh Matrix. A Pugh Matrix is a weighted matrix which we used to decide how well each game reached our expectations. We ranked the game characteristics on a scale of 1-5, with 5 being the most important qualities. Each game was scored on a scale of 1-3 on how well it met each characteristic. We then multiplied the two together and added the total scores. The higher the total, the more the game met our expectations. This allowed us to view the games in an unbiased way.

Reevaluation:

What makes a good game?	Ranking 1-5	Monkey bars	Monkey Bars	Gumball	Gumball	Kiddie pool	Kiddie pool	Super game	Super game
visibility to drivers	5	3	15	3	15	2	10	3	15
balance the scoring/requirements	5	3	15	3	15	3	15	2	10
needs help from at least 2 team members	5	3	15	3	15	3	15	2	10
affordable and accessible game pieces	5	3	15	2	10	3	15	3	15
action spread across the entire field	5	3	15	3	15	3	15	2	10
include the element	5	3	15	3	15	2	10	2	10
simplicity for viewing	4	3	12	3	12	2	8	3	12
simple scoring system (destination deep space)	4	3	12	3	12	1	4	1	4
room for improvement	4	2	8	2	8	3	12	3	12
fun endgame	4	3	12	3	12	3	12	3	12
entertaining to play	4	3	12	3	12	3	12	3	12
object and goal cannot be small	4	3	12	3	12	3	12	3	12
multiple activites	4	3	12	3	12	3	12	3	12
predominatly self-regulating (little penalties)	4	2	8	2	8	2	8	3	12
entertaining to watch	3	3	9	3	9	3	9	3	9
rookie teams can score	3	3	9	3	9	3	9	3	9
human player interaction for avg human	3	3	9	3	9	3	9	3	9
look hard, is easy	3	2	6	2	6	1	3	3	9
easy field cleanup	2	3	6	3	6	2	4	1	2
different ways to collect	2	2	4	2	4	2	4	2	4
good theme	2	0	0	0	0	0	0	0	0
qualifications vs. playoffs (rp vs. scoring)	4	3	12	3	12	2	8	2	8
game flow encourage motion over precision	2	2	4	2	4	3	6	3	6
			237		232		212		214

After improving our three main design concepts, we decided to temporarily push those aside and see if combining our favorite aspects of each game would result in a better one. From the monkey bars game we liked the changing goals, we liked the endgame as well as the uniqueness of the gumball machine, and the moveable goals from the kiddie pool game. After debating on how to combine all of these elements into one game we created a new game, which we called the "super game." However, after much discussion, we decided that this game wasn't so super, so we scrapped it. Although we were fairly set on pursuing one of the three original games, we thought it

would be worthwhile to see if going to another extreme and trying something new would be more successful. We put our ideas on hold and tried to create a game that was different from all of our current ideas. We ended up with an idea similar to a carnival game with three different minigames. An alliance would have to compete to win these individual minigames by the end of the match to get points for winning. In the end, this game was not worth further development, but it was a good brainstorming activity as it highlighted the strong suits of our current ideas.



Super Game

Final Decision:

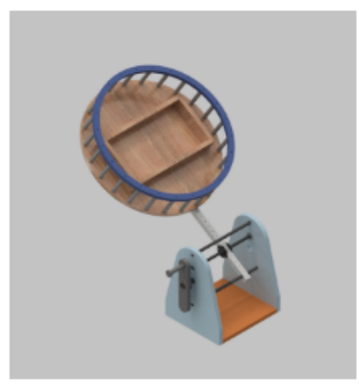
We then took the three original games (kiddie pool, monkey bars, and gumball machine) and figured out ways to further improve them while looking into how we would hypothetically build them. We looked at the areas in the Pugh Matrix that scored low, and we examined ways to increase those scores. We soon realized that the kiddie pool game was very limited, and we could not improve it much. Because of this, we ended up discarding this game and focusing on the gumball machine and monkey bars. We looked at ways to improve these games and ultimately ended up with a nearly identical score for both games in the Pugh Matrix. Because they were so close, we created a list of pros and cons for each game. As a final decision, we voted on what game to pursue and chose the monkey bar game.

Theming:

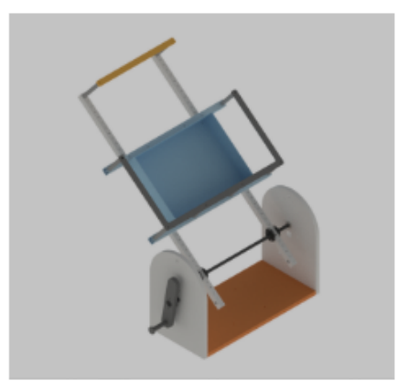
We wanted to design a theme around a game rather than starting with a theme, in order to not limit ourselves to the constraints of a specific category. We brainstormed theme ideas and ultimately chose a rainforest theme, which we decided to call Rainforest Resupply. The majority of our team wanted to bring awareness to the current worldwide issues regarding the rainforest. This decision resulted in a theme that is easy to understand within the context of the game and is a unique theme from previous FRC games.

<u>Catapult Design:</u>

We decided that we needed a unique Human Player mechanism that was both useful to the gameplay and visually appealing. When we started brainstorming ideas for the ball restocking system within our game, we thought of a fun mechanism that has not been used in previous FRC games: a catapult to launch balls onto the field. To us, this seemed like an interesting and exciting way to introduce more game pieces as opposed to just throwing a ball onto the field. In addition, it helped to make the endgame more exciting, as the Human Players launch larger balls with the catapult that the robots place on top of the monkey bar structure. One attribute that we wanted to include in our game is that the Human Player action is achievable by an average person, without the need for strong athletic ability. The catapult helps this as the distance the balls go is controlled by the catapult itself rather than the strength of the Human Player. This catapult system solved many problems, but it created a few issues of its own. For example, it was important to construct a catapult that was safe for everyone to use. We also had to develop a catapult that would be able to launch two different sizes of balls. We soon began to work on potential designs that would fulfill our requirements.



Initial concept



Second concept

First, we started creating a system to allow the Human Player to load the catapult and pull it back without the catapult snapping up and hitting their face. We decided a crank would be the safest way to do this so that the Human Player would be out of the line of fire when launching the balls. We also wanted the catapult to be able to pivot to a certain degree so that Human Players could aim their shots. This could be easily accomplished with a rotating table inspired by a Lazy Susan. The portion of the design that changed the most throughout development is the size and shape of the basket that holds the balls. It should be able to hold two size 3 soccer balls as well as a 75 cm yoga ball. It went through several design revisions, but the simple box-like basket proved to be most effective.

After the CAD development process, it was time to fabricate. The CAD was well designed and we had to make very few adjustments as we built the prototype. We performed different tests on the catapult because we found the initial throwing force to be weak, and it did not live up to our expectations of what we wanted it to accomplish in Rainforest Resupply. As a team we brainstormed different options to increase the distance the ball traveled, so that it reaches ¼ of the way into the field. We changed the location the soccer balls were coming out of to the top of the catapult, increasing the speed of the ball and decreasing the chance of the ball hitting different parts of the frame. To increase the moment of the spring created around the axle, we increased the distance and force of the spring from the pivot. We added the supports at the bottom to strengthen the base and a place to increase the distance of the spring, shown below. In an attempt to reduce recoil, we added weight to the base which increased the distance which balls were thrown.

After finishing our prototype we are convinced that a catapult that will meet our design requirements can be designed. Although our original prototype does not include them, there will need to be shields around the catapult to

account for Human Player safety. That way we can safely incorporate an exciting way to introduce more game pieces from both a participant and spectator perspective.

Our Catapult Prototype:

Front View

Front View with Yoga ball

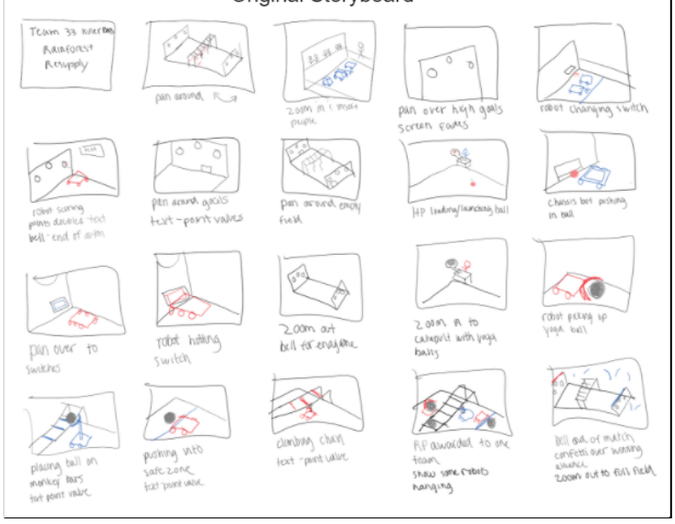
Side View with Yoga ball

Side View with Small Ball

Video Process:

When planning out our video submission, our original idea was to have presenters from our team describe the game with little visual demonstration. After realizing this would not be a very engaging video, we looked at past FIRST game animations for inspiration and soon decided that we wanted to create an animation in a similar style for our new game. However, the members on the team had little to no animation experience, so we began to learn. We talked to one of the alumni of our team who is an animation expert to help us figure out how to approach creating a short video. We learned many new techniques regarding animation during this process, and she gave us very important advice to get us started. She taught us that it is much easier to record audio first, and then build the visuals around it. Because of this, we began writing a voice-over script before anything else. While keeping in mind what we wanted each scene to look like, we recorded the voice-over, so we could start to animate the field around the recording as soon as possible. After finishing up the recording, we drew up a storyboard, using the FIRST animation of the game Destination: Deep Space as inspiration.

Original Storyboard



During this process, another group of students worked on creating a CAD model of the field, using programs such as OnShape, CATIA v5, and Inventor. Students collaborated between modeling the driver station walls, the center structure, and the catapults. While a few students continued modeling work, the others began researching to figure out what animation software we wanted to use. After investigating the different software, we decided on 3DS Max. Once we finished modeling the whole field, we imported everything into 3DS Max. From there, we started adding color and textures to the field as well as original art to go with our theme. We also modeled some basic robot designs and found models online for the Human Players. We watched YouTube tutorials to learn how to create basic animations, and soon we learned how to make objects move, rotate, and do much more. With this new knowledge, it was finally time to begin the final animation.

We began our animation work by finalizing our original storyboard so that it fit accurately with our final script. After everything was finalized, two students divided the scenes so that each would animate, render, and compile their own scenes. Once they had completed their scenes, we compiled the clips into Premiere Pro to stitch them together, and add the voice-over and additional music. We finished off the animation by adding a title screen, credits, and closed captioning.