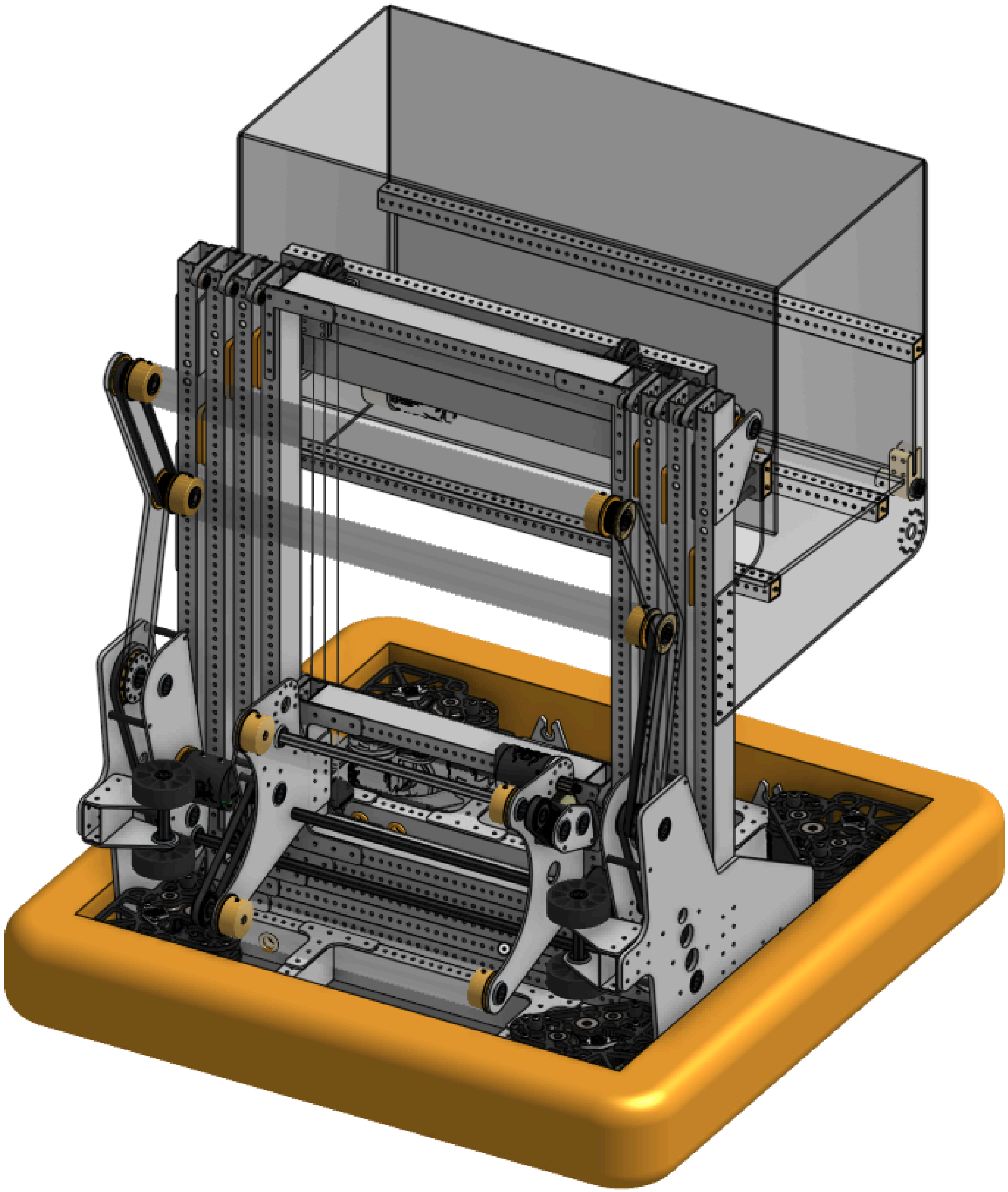
LELAND ROBOTICS

QUIXILVER

604



FIRST Team 604

DunkTank Design Binder

Strategic Design

Game Analysis

After reviewing the game manual in detail, we created a list of potential actions a robot could perform during a match. We used this action list to inform our game analysis, where we investigated which actions a robot should perform in autonomous, teleoperated, and endgame to earn as many points and ranking points as possible. Our key insights are summarized below:

- Two different game pieces of different sizes (Basketballs and Electrolytes (wiffle balls))
- Three different heights of hoops to score basketballs in
- Robots can hold up to one basketball at a time but no restrictions on amount of electrolytes
- The rules do not prohibit from scoring in opponents' goals
- In autonomous, you can score in any hoop regardless of stack completion, but in teleoperated the low and mid stacks must be filled before the high
- It is possible to score 2 stack clears without a ground intake (250 electrolytes available through human player, 100 needed for each stack clear).
    - Though it is necessary to gain 3 stack clears for the ranking point, the alternative is one stack clear and one bonus mode, which is possible without a ground intake (100 electrolytes for the stack clear and 100 electrolytes for the bonus mode)
- Since basketballs at the start of the match are on the ground and are reintroduced onto the ground after the alliance stack clear, a ground intake is necessary to pick up basketballs. In order to be introduced onto the field, electrolytes must be dropped by the human players, meaning that a ground intake isn't necessary to score electrolytes, but would offer a competitive advantage for after electrolytes are released after the stack clear.
- Basketballs must be scored from above the rim of the hoops, aka Dunked.

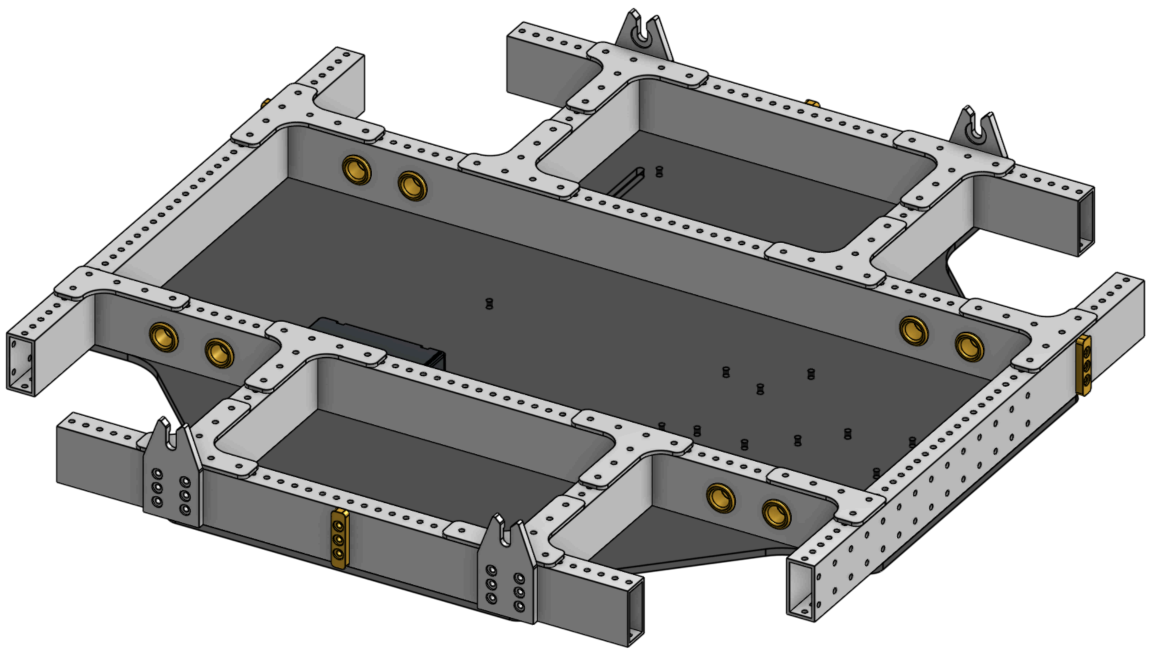
Robot Requirements

We used our game analysis insights and a consolidated version of our robot actions list to determine our robot requirements. By explicitly stating what we need to have, should have, and strategically won't have, we have a criteria for which we can assess potential robot architectures. Our robot requirements list is summarized below:

Need to have	**Should have**	**Won't Have**
Dunk in All Hoops (Low, Mid, High)	Hold both Basketballs and Electrolytes	Ground intake for electrolytes
Score Electrolytes		
Ground intake for basketballs		
Reliable drivetrain		

Chassis

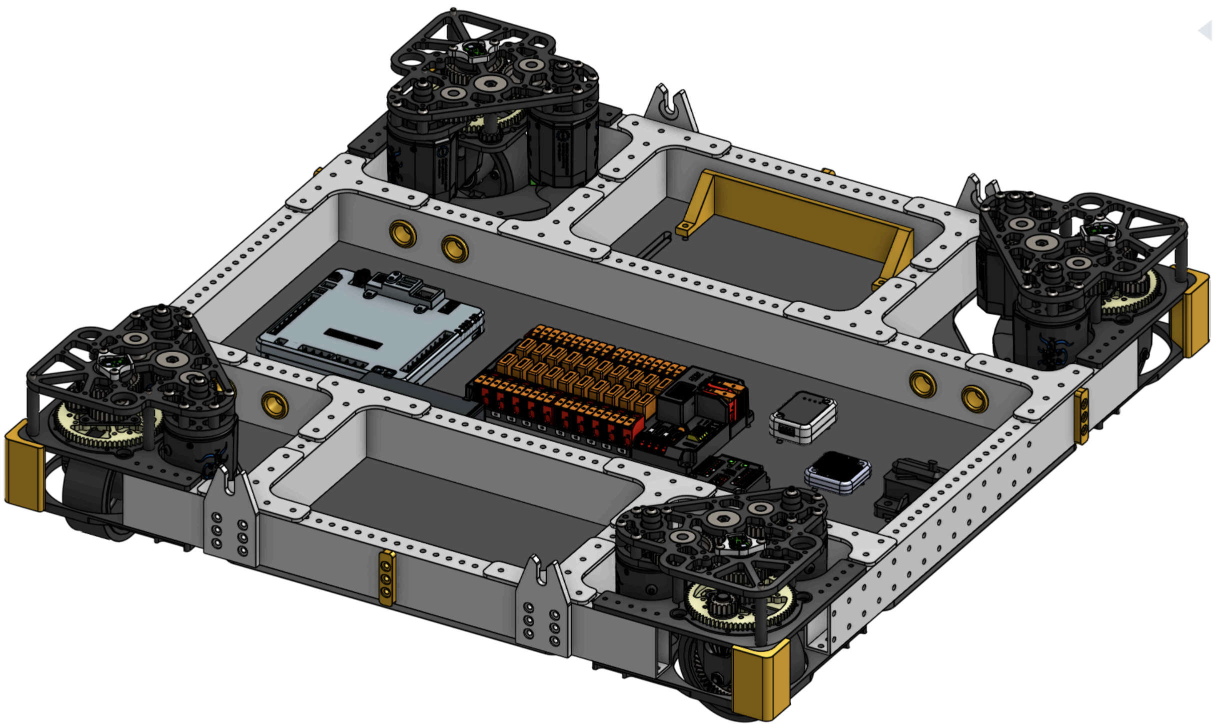
Tube/Bellypan Layout



Pre-drilled aluminum tubing with custom CNC gussets were selected as the primary material for the chassis structure. 2” by 1” tubing lends itself well to modularity due to the pre-drilled holes. The chassis perimeter dimensions are 29” by 29.” 0.75″ diameter holes are cut out in the chassis structure to allow for grommets for wiring.

A 29” by 29” polycarbonate sheet was selected as the material for the belly pan because it is easier to manufacture in-house than aluminum. Rivets were used to mount the belly pan to the chassis, primarily because they are lighter than bolts.

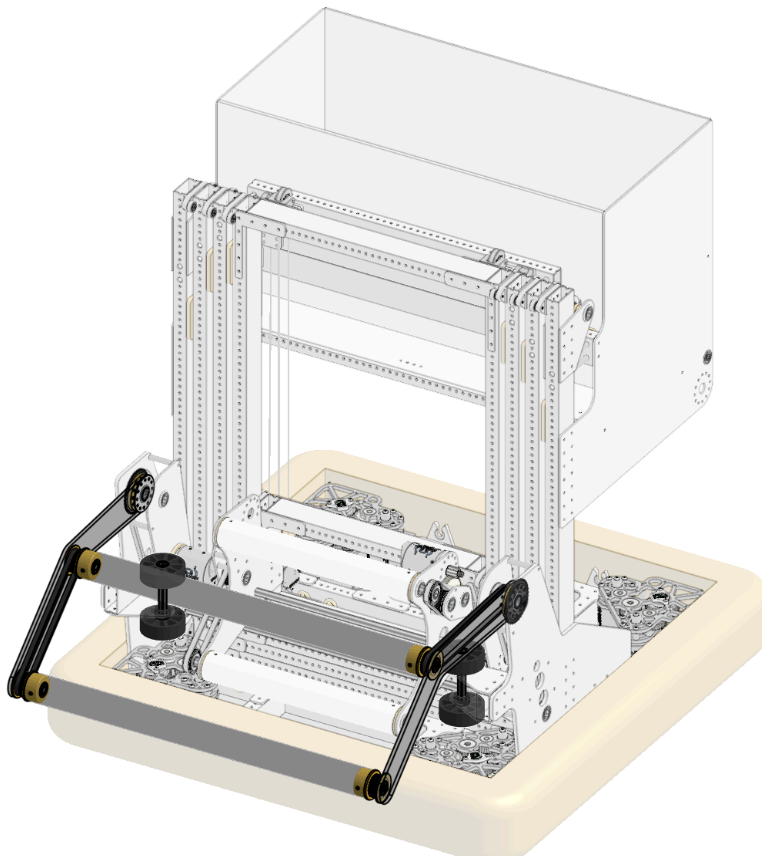
Drivetrain



We decided that continuing to use a swerve drivetrain would be optimal for this challenge due to its high maneuverability and our team's previous experience. With swerve, the robot is easily able to translate in all directions, rotate, and align with the hoops, dunk tanks, and inbounding boxes.

Our drivetrain uses WCP SwerveX Flipped modules with Kraken X60 motors. We chose to use the X3 variation for this year's game because full-field cycles necessitated a higher top speed. To balance our acceleration and top speed, we chose the 10 tooth pinion to offer a balance of acceleration and top velocity (19 ft/s).

Intake



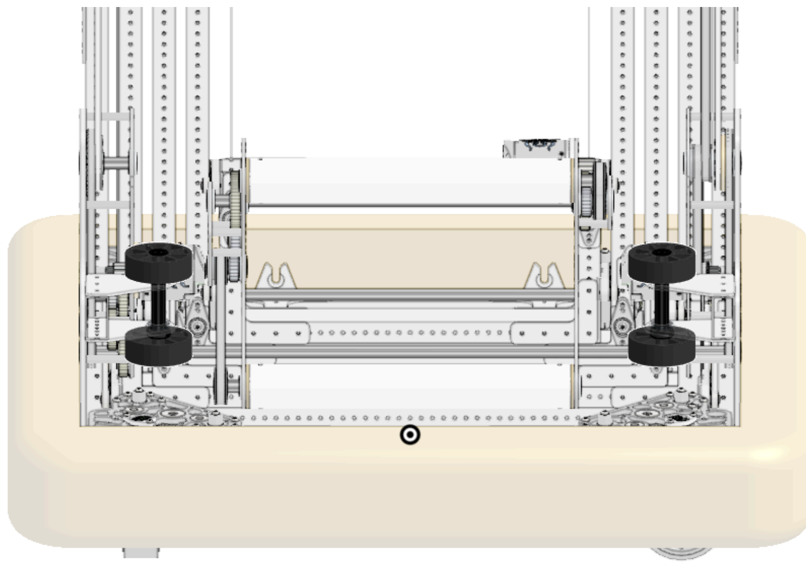
Design Requirements

We brainstormed potential intake mechanisms, and listed features that all potential intake designs would have to include:

- Full width/maximized intake width to allow tolerance in driving
- Center Basketballs to pass through to Basketball Dunker
- Be lightweight and flexible upon impact

While strategically it would be beneficial to have the intake and scoring mechanism on opposite sides of the robot, due to the presence of the elevator and the electrolyte scoring mechanism, it would have been difficult to package the intake on the opposite side of the robot. We attempted this in 2d and 3d Block CAD, and found that in order to have the intake on the opposite side, there would be significant restrictions on space on the chassis for electronics, wiring, and swerve drives on the proposed intake side of the robot.

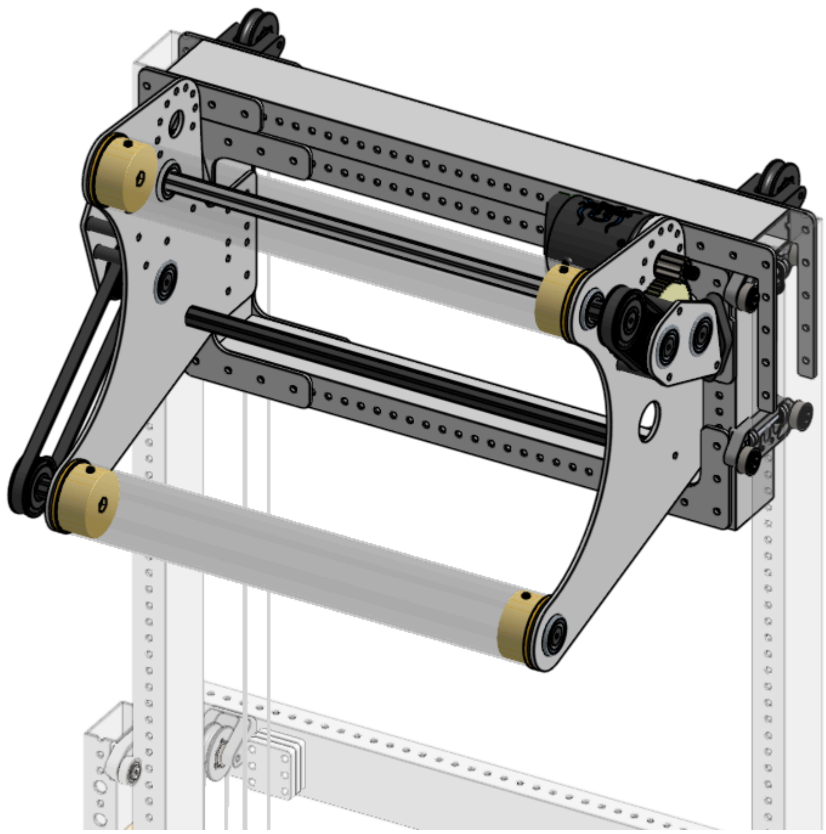
The intake's pivot is 16" off the ground such that the lowest roller is 8.5" off the ground in order to provide compression on the 9.39" basketball against the bumper to intake the basketball.



Two 3" Diameter compliant wheels on either side of the intake mounted to the baseplate of the elevator center the basketballs towards the Basketball Dunker.

The rollers are made of polycarbonate for increased flexibility and will have Cat Tongue tape on them (not featured in CAD) to increase grip against the basketballs

Basketball Dunker



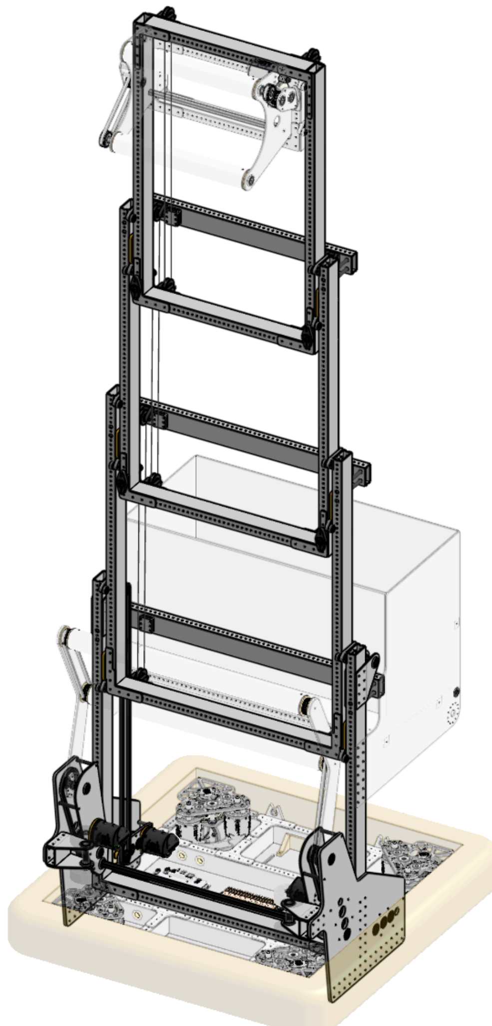
Design Requirements:

When brainstorming mechanisms for the Basketball Dunker, we accounted for different criteria we found during brainstorming:

- Must only hold one basketball at a time to eliminate potential for fouls
- Must be lightweight since it will need to be raised to dunk at heights up to 90″
- Must be smaller than the rim size to ensure accuracy

The Basketball Dunker is mounted on a vertical elevator, and features two polycarbonate rollers each of 2″ diameter which would be covered in Cat Tongue tape to increase grip. It is 14.75″ in width, smaller than the 24″ diameter of the hoops, in order to ensure basketballs held in the dunker will go in regardless of position within the dunker. The rollers are 9″ apart vertically in order to provide compression against the basketball without deforming it.

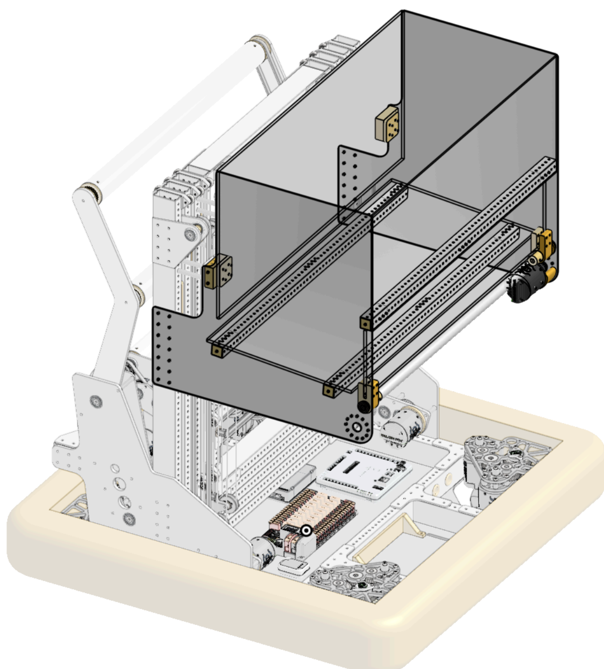
Elevator



Design Requirements:

We identified that in order to score in the High Hoop, the robot must reach >90″ off the ground. We decided to have a vertical elevator with multiple stages in order to reach the 90″. We calculated that we would need 4 stages on the elevator including the carriage portion with the Basketball Dunker, since we accounted for overlap between stages for greater stability. The overall design is a cascade elevator, and each of the 4 stages travels 21”, this design makes it so that the elevator can score on any height hoop. In total, the elevator reaches a maximum of 100″ off the ground to account for the diameter of the basketball between the height of the elevator and height of the highest hoop.

Electrolyte Scoring Mechanism



Design Requirements:

- Hold a significant amount of electrolytes
- Be quick to dispense the cargo
- Lightweight enough not to affect center of gravity harshly
- Store electrolytes above 2 ft to utilize gravity to dispense electrolytes

Through our analysis we decided that the most efficient way to score electrolytes would be to utilize a hopper mechanism, and a flap to keep the scoring hopper closed when not dispensing electrolytes. Since electrolytes are a very high volume game piece, we knew that designing a robot with a large hopper dedicated to storing them would be essential, but also hard to strike a balance. We decided that the optimum size is approximately 6500 inches cubed, which would be big enough to score a significant amount of electrolytes, but compact enough to have extra space for our elevator and intake. To accompany the large volume of electrolytes, we needed a quick way to dispense them, which we decided to use as a motorized flap. Since the bottom of the hopper is angled, the electrolytes would naturally roll out of the hopper, and a flap is considerably lighter and easier to implement than a set of rollers.

We discussed having a ground intake for electrolytes, but upon further consideration found that since it was possible to earn the ranking point by achieving one stack clear and one bonus mode and score high without having a ground intake for electrolytes, the added complexity of the additional mechanism would be unnecessary.