



AC/DC/EG, São Caetano do Sul, São Paulo, Brazil

Perlite Thermal Insulator (P.T.I)

AC/DC/EG is a Brazilian team founded 15 years ago. Currently, the team consists of 5 members with a first time lineup of only girls. The team name came from the combination of the rock band AC/DC and the acronym of the school, as the first members were very fond of this style of music and the band. Because of this, the team loves to listen to rock'n'roll during meetings.

Medicines transported at incorrect temperatures can have their molecular structure broken down, failing to work as intended. The **P.T.I. (Perlite Thermal Insulator)** is a low-cost solution made of cardboard plates filled with perlite, a crushed volcanic rock that when in contact with heat expands and begins to contain air inside, preventing the interference of external temperature, keeping the transportation of medicine safe.

The Albots, St. Louis, Missouri, USA

The Road Guardian

The team name **Albots** came from combining St. Albert, the patron saint of scientists, with the word "robot." The team members have become close with one another after working together, and they consider their coaches and mentor to be like a compass, guiding them through the entire season. In addition to the team members connecting over their love of food (they consider themselves very food motivated), they connect over a hope that their innovative solution positively impacts the lives of those around them and makes their whole community a better and safer place to live.



Potholes cause cargo damage, decreased fuel efficiency, delayed deliveries, and about six billion dollars of damage each year. **The Road Guardian** is a solution to automate the reporting of road conditions and potholes. An accelerometer is mounted to the framework of a vehicle so it does not mistake human-related movements for potholes, a central database is created in the cloud, and the Road Guardian is installed on 100,000 road warrior-type vehicles including semi-trucks, state vehicles, delivery vehicles, etc. All data from these mounted accelerometers collected while driving is uploaded, making it available to be pushed out to the proper agencies.



Baksteen Valken, Oshkosh, Wisconsin, USA FalconFire

Baksteen Valken decided to name their robots Wonder Woman and Batman, because they have 10 team members from four different schools that “formed a super team like the Justice League.” When not singing musicals while working, the team greatly enjoys the food portion of their meetings, like snack time or when their coach throws candy at them—they are food motivated! For their solution this year, the team did on site research and was thrilled to take a team picture with a thermal imager at their local airport.

According to the FAA, a lithium-ion battery fire occurs on planes every 10 days, posing a danger to pilots and cargo. There are smoke detectors in a plane’s hold but not in the individual canisters. Pilots do not know there is a fire until it breaches the canister and the smoke wafts up to the detectors, however the smoke could be drafted away, allowing the fire to spread. **FalconFire** is device that uses heat, smoke, and infrared flame detectors to sense fires in cargo containers. FalconFire’s WiFi-mesh network relays data between devices in each cargo canister, displaying the information on an app on the pilot’s tablet, allowing them to monitor canisters individually and quickly identify fires.

Blue Star Robotics, Pearland, Texas, USA Damaged Road Tracking Solution (DRTS)

The **Blue Star Robotics** team is a homeschool team of seven kids who bring a lot of different interests and skills to their group. The CARGO CONNECT season was their first season participating in *FIRST* LEGO Challenge. Throughout this season, they learned a lot, shared their strengths, learned from each other, and had a ton of fun as a team! After working together, the team has become a group of great friends.



Online shopping and home delivery have redefined how we purchase goods, and this relies heavily on the use of roads for delivery. At present, damaged roads are identified inconsistently and repairing is inefficient. **Damaged Road Tracking Solution (DRTS** – pronounced “dirts”) is a real-time system to identify, report, and prioritize damaged roads. DRTS will assist cities to identify damaged roads, guide repair crews, and build long-term repair plans that are based in real data. DRTS is a miniature processor programmed to use an accelerometer to measure damage in roads.



CRE8, Mason, Ohio, USA

F.R.E.S.H. Pack

This team has a lot of fun together, and they show their team spirit by singing the team song and doing their special team cheer, "5.....6.....7...., **CRE8!!**" They are passionate about using STEM to change the world for the better and love working together to solve problems, because they believe that everyone does better when you work together as a team. Outside of *FIRST*, the team also enjoys spending time together doing fun activities, such as watching movies or doing riddle competitions. They also enjoy outreach activities, teaching others about robotics, and volunteering in their community.

Lack of refrigerated transportation infrastructure and cold storage results in a 40% food loss in India. **F.R.E.S.H pack (Farmer-friendly, Reusable, Eco-cooling, Scalable, Heat-reducing Packaging solution)** is an eco-friendly, affordable, zero electricity, packaging solution made of natural materials that can be used at various stages in the post-harvest transportation journey of fresh fruits and vegetables. It can reduce the temperature of the contents 20+ degrees F and allows for produce to stay cool and last longer.



Darth Rappers, Cary, North Carolina, USA

'MILE'NIUM F.A.L.C.O.N -

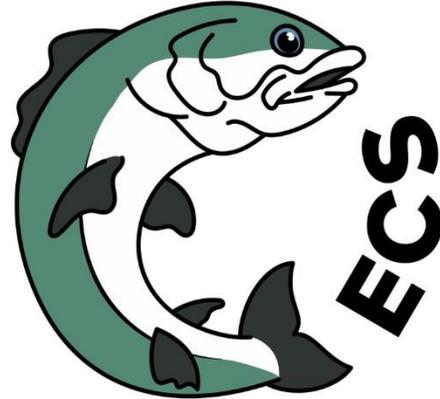
The Darth Rappers is made of team members who have different goals, mindsets, and interests, but despite their differences, they work together well. Every year, the team cannot wait for the challenge because they love brainstorming and building innovative solutions that improve people's lives. Their decision-making philosophy relies on consensus, and they have developed objective scoring systems based on data and facts to help quickly make decisions. In addition to creating this year's innovative solution, they have generated two patent applications on past project ideas (both published) and built fully functional prototypes.

Getting a COVID vaccine or other medicines can be impossible in low income countries because of inaccessible roads, a lack of drivers, and an unreliable cold chain. What if there was an autonomous drone with a freezer for last-mile delivery of vaccines? That is just what the **MILE'NIUM F.A.L.C.O.N** (last MILE delivery of vacciNes In an aUtonomous Mini-Freezer-on-A-drone for Life-saving medicines and COvid vacciNes) is! It uses active cooling and autonomous flight of a custom-built Raspberry Pi-based drone.

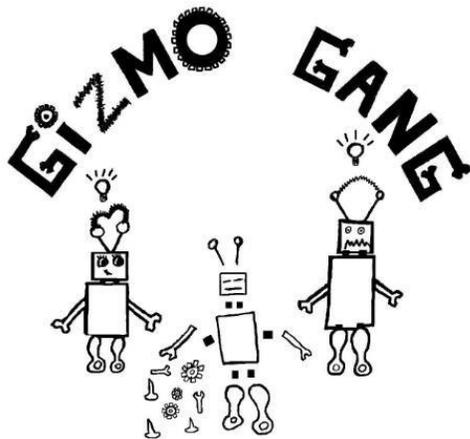
Eco Cargo Solutions, Hessa skole, Ålesund, Norway

Pack-man solution

Eco Cargo Connect is a group of 7th graders who have grown up surrounded by the ocean with the seafood industry being a huge part of their culture and identity. Throughout the season, the team members have bonded as a class and learned to use everyone`s different strengths when working on this project. They discovered that each team member has qualities that is valuable to their team. Some are amazing at presentations, some are gifted with amazing technological skills, some awesome with codes, and some great at writing reports. Together they are strong and smart!



In Norway and Europe almost all fresh fish is transported on trucks, using Styrofoam boxes with draining holes and 4-6 kg of ice with the fish, which starts to leak. The meltwater contains fish oil, blood and has a slimy consistency and when leaked out on the roads, it is a threat to the traffic safety as it gets very slippery. The **Pack-man solution** is a half-pipe that covers the gaps on the truck and leads the meltwater through a hose down to the tank where it`s stored until it can be emptied.



We work together like Gears in Motion

where it dispenses the detergent from the totes to reusable jugs to the consumer, reducing packaing waste.

Gizmo Gang, Omaha, Nebraska, USA
HAGL Dispenser and Tote System

The team members of **Gizmo Gang** have completed three seasons together in the *FIRST LEGO* League, each year creating solutions that reduce the use of plastics. The team loves to work together, learn together, and have fun together. They are so enthusiastic about redcuing plastics, that they incorporated it into their team chant.

This team set out to reduce the number of trucks on the road to reduce emissions and increase safety on the road. **HAGL Dispenser and Tote System** delivers laundry detergent in bulk (330-gallon totes) to stores,

The Great Gatsbys!, Minneapolis, Minnesota, USA

PAWSome Packing Product!

The Great Gatsbys is a team with three team members. Creativity, perseverance, diverse interests, and unique talents combined in the perfect blend of components for developing their patent-pending solution to this year's challenge. This team's quirky personalities came together in a way that allowed their individual strengths to shine as they learned from and built on each other's differences. The result is a unique combination of young minds that approached this year's innovation problem from several angles, allowing them to hone in on potential ideas, and then go far beyond that to develop a solution that is truly unique and incredible!

PAWSome Packing Product is a packing product composed of entirely recycled materials, capable of a secondary use for small mammals, and finally able to be composted upon end of life-cycle. This product can prevent the use of fossil-fuels based packing products (packing peanuts, air pockets, etc...), eliminate the mining of over 1.041 billion pounds of clay-based products annually, and prevent the eventual landfilling or incineration of those products. Their secondary use as cat litter/animal bedding creates a psychologically supported incentive for people to opt to use their eco-friendly packing product in the first place.

The Green Brick Road, Mamaroneck, New York, USA

Green Path Delivery - GPD

The Green Brick Road is a robotics team of 7 middle-schoolers from all around the world who are currently students at the French-American School of New York. Together, they represent 7 countries, and they feel their diversity makes them stronger! As a team, they were excited to learn about the transportation of goods and address a real-life problem which affects all of us. They discovered that even if a solution exists, one can always improve on it and have a significant impact.



Green Path Delivery (GPD) is a home delivery drop-box to reduce packaging materials. This weatherproof and anti-theft drop-box secures package delivery (with rapid-opening Bluetooth-enabled RFID lock), so goods arrive in original manufacturer packaging hence less recycling/waste and more trees spared. A street-side location reduces driver delivery time (1-3 hour/day), improves driver work conditions and increases public safety. If only 5% of Amazon Prime "super" users use GPD, we can save >1.27 million trees and \$500M in shipping costs each year, while improving delivery drivers' conditions.



Herobotics - Gold, Springdale, Arkansas, USA SPOT - Sensor Powered Organ Transportation

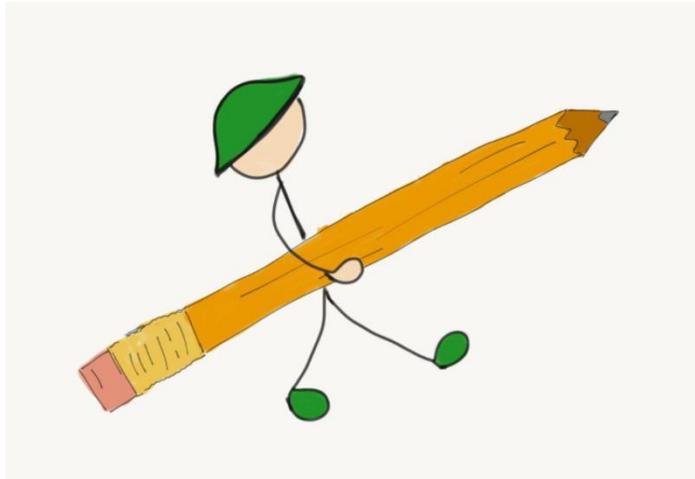
The Herobotics team is not just a team; it is a family. They use an acronym, CODE, which stands for Connect, Objectives, Delegate, and Engerize, to stay connected and on task as a family. Working together has allowed them to form great friendships and gain more confidence. Being an all-girl team motivates them to make their innovative solution, SPOT, a reality so they can inspire other girls to chase their dreams as well.

If an issue were to occur during the kidney transplant transportation process, the doctors would not know, resulting in a less successful transplant. However, **SPOT** allows these issues to be identifiable by medical professionals, by remotely notifying the Arkansas Regional Organ Recovery Agency (ARORA) representative. When a kidney has gotten over/below a safe temperature, the ARORA representative calls the courier and the kidney can be returned to a safe temperature. SPOT can also handle other difficulties such as the kidney box falling over or the kidney getting lost.

iAmicos, Yorktown Heights, NY, USA

FlexShelf

The team name "**iAmicos**" is made up of "Amicos," meaning friends, and a lower-case "i" because the team believes teamwork and friendship are more important than the individual, while still respecting and being open to each other's ideas. Each team member works to practice *FIRST* core values everywhere and always treat each other with respect and practice gracious professionalism.



Packages marked "not stackable" lead to unused space during the transportation process, with shipping containers being 24% empty on average. **FlexShelf**, solves this problem through a height-adjustable platform enabling products marked "not stackable" to be placed underneath while additional cargo is loaded above the platform, maximizing the space in the container. Using the FlexShelf would significantly alleviate congestion at shipping ports since fewer containers would lead to fewer container trips and reduced greenhouse emissions by the shipping industry.

**The MailMasters, Redmond,
Washington, USA
Flexi-Box**

The MailMasters team members are very funny, inclusive, innovative, and extremely helpful. Their top priority as a team is Discover. They are a very open-minded team, always expressing their ideas openly. In addition to working hard on their solution, the team had a lot of fun at this year by eating donuts and playing freeze tag during breaks. Their team slogan is “Do-nut get less than 350 points in robot runs!”

Flexi-Box

The problem this team chose to solve is to reduce wasted space in packaging. Companies use fillers to fill the wasted space for protecting cargo. These fillers end up becoming environmental waste. According to Packaging360, 38% of cargo is wasted space that increases transportation costs by 46 billion dollars yearly. Wasted space also affects shipping capacity resulting in more trips for transporting goods thereby increases pollution. **Flexi-Box** is based on the origami “bellow fold” which can compress and expand. If you need to ship a smaller item just squeeze the box down until you reach the desired size and then tape it.



New Cats On The Block, Johnston, Iowa, United States

The Food Bank Flat

The team name **New Cats On The Block** honors the team’s coaches’ cats and their team that came before called Just The Cats. They love the *FIRST* Core Values, and follow an acronym they made to make sure they always remember the Core Values, DiiFIT (Discovery, Innovation, Inclusion, Fun, Impact, Teamwork). The team

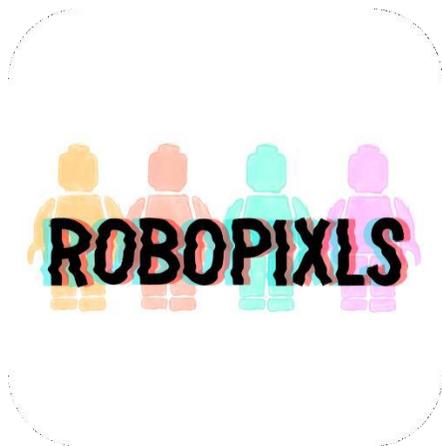
This team created **The Food Bank Flat** after meeting with the Food Bank of Iowa and learning about their Backpack program that “provides a sack of kid-friendly, nutritionally balanced food to children every Friday during the school year.” The Food Bank Flat holds the included foil cups (like applesauce) more securely in the backpack and prevents damage to the foil packaging and is made of low-cost, recyclable materials. The cups are placed in the two holes of the rectangle flat, the flat is then folded together and stapled on two corners.

Robo Raptors, Fair Lawn, New Jersey, USA Cargo on the Clock (C-Square System)

The **Robo Raptors** team name originated from their love of Jurassic Park and Robots, though the team members call themselves “The PINK SIX.” Their team motto is, “together we go far!” and they like to describe themselves as a computer. Just like how computer parts work, they rely and trust each other to meticulously get the work done. They work hard and then celebrate our achievements by playing cricket, silly video games, having dinner at Ming’s (a famous Indian restaurant) or having long sleepovers!



Cargo on the Clock uses Radio Frequency IDentification (RFID) technology to decrease the time taken to find a package in the back of delivery trucks, reducing carbon emissions and traffic jams. The team built their prototype using LEDs, Arduino, GPS, RFID readers and labels to detect driver’s delivery stops and signal LEDs on the shelves to show the exact location of packages in the truck. This creates a 3-way win: Customer, Company, and Driver. The customer receives their packages faster. The company has greater employee satisfaction, along with operational cost savings. The greatest effect of our system is on the driver due to the fact that they can easily find their packages without frustration and spend 65 minutes less in the back of their truck.



RoboPixls, San Jose, California, USA PAC (Pixl Affordable Cooling)

RoboPixls consists of four seventh graders in their third year of *FIRST* LEGO League Challenge. In their spare time, they chat, play tag, board games, badminton, or video games. They have an 80s arcade theme this year, and they are called the RoboPixls because like pixels make a picture, the four of them make a team. The RoboPixls love learning and sharing their *FIRST* LEGO League experiences.

PAC, or Pixl Affordable Cooling, reduces the spoilage of food and medicines due to lack of refrigeration in developing and underdeveloped countries. It is a portable refrigeration device, using a team designed PAC power hub that combines the electricity generated from a solar panel, two bicycle wheel-driven dynamos, and an optional grid power source, creating a portable, bicycle-friendly, low-cost refrigerator that can cool an insulated box to 30-40 degrees Fahrenheit for several hours.

SustainaBot, Milano, Italy

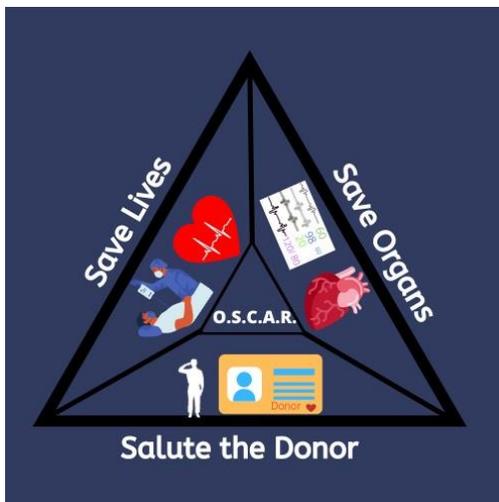
FrostBox

Team Description:

Team **SustainaBot**'s name represents the importance of thinking about sustainability in every new technological development. They like to explore the world and how they can make it better, often drawing inspiration from their home city. They feel it is also especially important to think about what is best for others, and to try and create a better world around them, doing all they can. The team likes spending time together and chatting a lot, sometimes a little too much, so their coach in a couple of occasions has had to bribe them with candies to back to work.



FrostBox is a portable medicine transportation system powered by rechargeable lithium batteries that prevents mechanical damages and, more importantly, is thermally insulated and can self-regulate its internal temperature. FrostBox contains a thermometer, a GPS, and an AI, which constantly communicate to the owner the position and conditions of the goods. Peltier cells heat on one side and cool on the other to return the temperature to the right temperature. The FrostBox can also be adapted to transport organs.



The Swag Hats, Waukee, Iowa, USA

OSCAR- Organ Sensing Cargo Alert Reader

The Swag Hats is a diverse team of 6 students from 5 schools, 4 cities, 3 school districts, grades, and ethnicities. Their mascot is Buddy the Dog, and he is part of all their meetings. They love participating in STEM outreaches to promote *FIRST* along with the a local *FIRST* Tech Challenge team. In addition to working hard on their solution, the team likes to have fun, saving the last 15 minutes of every meeting specifically for fun.

Hundreds of organs get lost or jeopardized during transport with no straightforward way of tracking them.

The goal of **OSCAR** is to know the current status of an organ in transport for tracking updates or any issues. OSCAR (Organ Sensing Cargo Alert Reader) is a cooler with sensors and a tracker that helps keep organ alive during transport by alerting everyone connected to OSCAR if there is a problem. It also has information about the specific organ that is being transported, its needed conditions, and instructions to take care if there is a problem. Save Organs, Save Lives and Salute the Donor.

Takevians, Samsun, Turkey **DURABLE PACKAGING, SOLID CARGO**

A strong and determined team, **the Takevians** recognize that they have been more successful in what they do by having fun and supporting each other. Each team member offers a valuable contribution to their team. They realize that the smallest ideas can be solutions to big problems, and their goal is to activate and excite the people around them.



The team set out to strengthen the most used cargo packaging, corrugated cardboard boxes, in the world without changing the amount and type of material. Their solution, **DURABLE PACKAGING, SOLID CARGO** does this by making use of the newly discovered epithelial tissue cell shape, the "Scutoid" shape. The corrugated layers in cardboard boxes are always in the same direction, even if there is more than one layer. While it provides high resistance in the vertical position to the surface, it can be easily bent in the horizontal position, however a Scutoid shape can evenly distribute any force applied.



TriTech, Dix Hills, New York, USA **SCOUTbot**

TriTech is a group of four students bound together by a strong passion for science and technology. The "tri" component of the team's name stands for the three equally vital components of *FIRST* LEGO League: Core Values, Innovation Project, and Robotics; each of which help develop the skills they need to be positive contributors to society. The name TriTech also considers the strength of the triangle, the strongest shape. They are motivated to confront challenges presented by *FIRST* LEGO League by being the best researchers, innovators, and humans they can be, but most importantly, they do it with friendship and fun.

SCOUTbot is an autonomous robot that travels ahead of freight trains to scan for track damage or objects on the track to signal the train to stop before a collision occurs. Cargo train derailments can cost up to several million dollars especially if there are hazardous spills involved. Trains cannot stop in time because of its speed and mass, taking a mile or more to stop, but SCOUTbot works by traveling ahead of the train to search for obstacles or unsafe track conditions and provide early detection to trains to greatly reduce derailments. The solar-powered train robot will use LiDAR, RADAR, distance sensors, cameras, ultrasonic sensors, and GNSS to help prevent train derailment.