The 38th Annual Senior Projects Celebration
Saturday, April 9th
2022
This is a map of the lobby of the VanNoord Arena where each team is presenting their project. The red arrows point the presentation rooms in VanNoord Arena.

The blue arrow below directs you to the Hoogenboom Center. HC204 is behind the TV in the lobby and HC 280 is on the left side of the north/south hallway along the west side of the gym.
For anyone attending the Celebration Ceremony @ 4:00 p.m., please allow time to walk to the CFAC. Follow the arrows on the map to the main entrance of the auditorium. For those needing assistance there will be golf carts available at 3:20 p.m. in front of the main entrance to VanNoord Arena. (South entrance by the circle drive.)
# Schedule

1:30—4:00 p.m.  **Prototype Open House — Lobby of Van Noord Arena**

2:00—4:00 p.m.  **Presentations of Projects**

<table>
<thead>
<tr>
<th>Van Noord Arena North Gym (Civil &amp; Environmental)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00 pm</td>
<td>Team #4</td>
</tr>
<tr>
<td>2:20 pm</td>
<td>Team #1</td>
</tr>
<tr>
<td>2:45 pm</td>
<td>Team #2</td>
</tr>
<tr>
<td>3:10 pm</td>
<td>Team #3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Van Noord Arena South Gym (Mechanical)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00 pm</td>
<td>Team #5</td>
</tr>
<tr>
<td>2:20 pm</td>
<td>Team #6</td>
</tr>
<tr>
<td>2:45 pm</td>
<td>Team #7</td>
</tr>
<tr>
<td>3:10 pm</td>
<td>Team #8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Van Noord 235 (Electrical &amp; Computer)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00 pm</td>
<td>Team #9</td>
</tr>
<tr>
<td>2:20 pm</td>
<td>Team #10</td>
</tr>
<tr>
<td>2:45 pm</td>
<td>Team #11</td>
</tr>
<tr>
<td>3:10 pm</td>
<td>Team #12</td>
</tr>
</tbody>
</table>

---

2
Hoogenboom Center 280 (Mechanical)

1:45 pm  Team #13  RailCARD
2:05 pm  Team #14  Gravity Cruisers
2:25 pm  Team #15  Bycyclamp
2:50 pm  Team #16  Project APMS
3:15 pm  Team #17  Inertia

Hoogenboom Center 204 (Chemical)

2:00 pm  Team #18  Planthanum
2:20 pm  Team #19  JAGS
2:45 pm  Team #20  Go Green
3:10 pm  Team #21  Hydrobros

4:00—4:45 p.m.  Senior Celebration in CFAC Auditorium*

  * Seniors need to make their way to CFAC no later than 3:45 p.m.
The goal of Team 1 is to design a residential house model that will withstand a 7.2 magnitude earthquake, have a minimum life span of 50 years; be financially viable (under $10,000) for a family of four in Port-au-Prince, Haiti. We designed and modeled a house in STAAD.Pro, RAM Elements, and Revit under these requirements. The house was designed using a technique called confined masonry. This affordable construction technique has been observed to be successful in resisting seismic forces in countries like Peru and Argentina and therefore was a workable method for us to use. Our main building material is concrete.

Using the building codes from ASCE 7-10 and ACI 318-19, the house was modeled to be able to resist a 7.2 magnitude earthquake, which is the greatest magnitude of the most recent three earthquakes happened in Haiti in the past century. The main materials of the house are concrete, masonry bricks, structural steel, and timber. Masonry brick is the main component of the walls, and it is then incased by two concrete beams and two concrete columns. Steel bars inside the concrete were chosen to have a Grade 60, number 8 bars, 12-in spacing. Instead of using a truss system, we decided on supporting the roof with rafters. These rafters are made of 2x4 wood.

During the design process, team 1 had been in contact with Build Change, a non-profit organization that designs and builds disaster-resistant houses and schools in Haiti. Our design will be sent to them, in hopes that they will be able to use it to build homes.

I focused on caring and cultural appropriateness while designing this house. We hope this house will be used to protect the Haitian people and bring trust in their infrastructure, and communicate a spirit of stewardship.
Creation Connections sought to provide access for students of all mobility levels at Grand Rapids Christian Middle School (GRCMS) to outdoor learning spaces through the design of a 20-year masterplan. Seeking to grow the school’s outdoor education program, the team focused on the design of a trail that would safely guide students and teachers to the bottom of a ravine for interactive environmental-based learning. Our team name is derived from this desire to provide a critical linkage between the majesty of God’s natural world to the educational environment for His children.

Trail design involved GIS topographical modeling using LIDAR datasets and a watershed analysis for the 100-year floodplain in HECRAS. In accordance to ADA standards, the trail route is optimized to minimize cost, slope, and environmental disturbance through following existing contours. Property boundaries have also been further catalogued for school use. Creation Connections has modeled all planned changes in Civil 3D for construction by an external contractor in the near future.

For the benefit of the school and its donors, a 3D model of the ravine has additionally been constructed to visualize the space for future project endeavors.

We believe our work enables the school to reach their goal of deepening relationships within the school’s increasingly diverse student body while simultaneously teaching students to practice stewardship of God’s intricate and inspiring creation.

Team 2: Creation Connections
Alex Newell, Hannah Smith, Bryce Bundens
Team 3, a group of four civil and environmental engineering students, collaborated with Chet and Katie Williams, who are active missionaries in Shell, Ecuador. The team came together with a goal of improving and designing a new drinking water system for the client property, which currently serves the community as a school, workshop, and dormitory.

The property’s current hydraulic system is connected to a municipality water supply which contains significant quantities of microorganisms. Furthermore, this water is inadequately treated by the municipality with inconsistent chlorination. As a result, the Williams’ and their guests are currently reliant on purchased bottled water jugs for consumption.

To tackle this challenge, Team 3 developed a plan for an installation of a new rainwater collection and treatment system in addition to the existing municipal system. After careful research and investigation of the property surveys, the team’s proposed design featured filtration and disinfection techniques, including gutter filters, POU water filters, and electrolysis. Constant communication between the clients and locals engineers was performed to ensure the development of a reliable design. The team’s work was also assisted by a visit to the property for additional survey measurements and water quality testing.

The ultimate objective of this team’s design was to ensure a provision of clean water to the Williams family and the people they serve. The team has created a solution that will assist the ministry of the Williams, as well as provide a model for successful rainwater catchment and treatment to other members of the Shell community.
Team 4 worked with Calvin’s Physical Plant and Athletic Department to help redesign the new baseball stadium as part of the future outdoor athletic renovations. The original goal was to determine if keeping the baseball field at its current location or moving it to the athletic complex at Gainey was more environmentally friendly. After consulting with the architect of the project GMB and the head athletic director Dr. James Timmer, they decided the baseball stadium will remain at its current location. The team then pivoted to creating a three stage plan that can be implemented over the course of the construction process. The three stage plan includes: improve dugouts and bleachers, adding synthetic turf, and creating a student seating and players’ lounge.

As Christian engineers, the team recognized construction currently degrades much of the environment. To uphold Calvin’s mission statement the team wanted to develop new techniques for the construction industry to design future projects with a carbon footprint in mind. Therefore, the team developed a framework that Calvin could use to track the carbon footprint of future construction projects. A “Carbon Calculator” was created to track the carbon emissions associated with the construction process of athletic fields.
According to a 2014 University of Michigan Study, 1 in 5 people above the age of 75 have a documented mobility issue. Considering the popularity of gardening among the elderly population, the team saw a need to design a solution for this inequity. After doing market research, the team found that there were no suitable options available to the public that made getting to ground level easy and repeatable for those with mobility issues. Most of the market consisted of either all-terrain rollators or padded devices to be laid on the ground and requiring the user’s strength to lower themselves to the ground, which is not a reasonable option for someone with limited mobility. This need in the market is what the Garden Helper plans to fulfill.

The team set out to design a rollator device outfitted with a motorized kneeling/seat platform with a control system allowing the user to kneel on the platform and be lowered to the ground and raised back up. The rollator is specifically designed for outdoor use, using larger, sturdier wheels compared to wheels of a normal walker, as well as a locking brake system to ensure the device is secured in place when raising or lowering. It is equipped with handles on the sides and ends of the kneeling platform for additional stability, and the kneeling pad will double as a lid to a compartment where the lifting mechanism, control system, and battery will reside. The lifting mechanism is a winch assembly stored inside the seat with cables exiting the side of the platform and attached at the tops of the side triangles.
Performing tests on model rockets is difficult and expensive because of varying atmospheric conditions and marginal costs per launch. So, CRITTERS (Calvin Rocket Investigation and Testing Tools for Engineering and Research Students), composed of three mechanical engineers and one electrical, designed an instrumentation setup for creating a meaningful simulation of a model rocket in flight in a more controlled context.

This was accomplished using two systems. First, the RATS (Rocket Analysis Test Section) interfaced with Calvin’s Wind Tunnel to measure air velocity and aerodynamic drag. Second, the FERIT (Fixed Engine Rocket Instrumentation Tester), a separate apparatus used outdoors for safety, measured thrust of model rocket engines over time. The air velocity measurements were taken with a pitot tube and accompanying differential pressure transducer, and the drag and thrust forces were measured with load cells. All these sensors connected to a Raspberry Pi utilizing a custom user-interface.

Apart from the requirements related to types, magnitudes, and precision of measurements, a particular focus of this project was to make the systems user-friendly. This goal informed design decisions such as making the RATS easy to install by not using caulk, making the FERIT lightweight for portability, designing mounting systems that can smoothly accommodate an assortment of rocket and engine sizes, and implementing various software features including live data graphing and changeable units.
The Bikers worked to design an electric-assisted bicycle rack to alleviate the need for upper body strength during the loading and unloading of bicycles from a platform hitch bicycle rack.

This project was inspired by their customer, John Stehouwer’s aunt and uncle, who represent a customer market of aging individuals that are buying into e-bikes (electric-assisted bicycles). These customers are looking for a way to transport their e-bikes. These e-bikes can weigh 75+ pounds and induce a transportation challenge. Traditional bicycle racks have not offered a sufficient solution for these e-bike customers.

Early in their design the team was faced with challenges. With two students returning from a gap year and the others seeking a welcoming group, the team had to find a relevant issue in the engineering field that they could design a solution harmoniously together. The Bikers united around the bicycle, making bicycle adventures accessible to their loved ones. Through their team formation adversity, cultural and talent diversity, and unification on two rolling wheels, the Bikers found their own way to play to each member’s strengths resulting in a successful product.

During the design of their product, the Bikers learned the practical experience of an engineering design project. Through meetings with their industrial consultant, the Bikers analyzed design dimensions, manufacturability, and feasibility tradeoffs. By the end of their senior year, the Bikers were able to transform a complex problem into a simple solution.

The Bikers’ solution offers a modular design for easy storage with a lift mechanism driven by a linear actuator and guided by a hardened steel rail. These design choices are certain to satisfy any potential customer.
While there are public wheelchair accommodation ramps, physically handicapped people in wheelchairs still struggle in environments that we take for granted. Leisure activities such as getting onto a boat from a dock or traversing a muddy terrain while taking a morning stroll, are actions that wheelchair users view with apprehension. To solve this problem, the team designed an attachable-portable wheelchair ramp that allows the user to travel over small inclines such as a curb.

This design relies on a gearbox which is mounted on a stand behind the wheelchair. The gearbox has an input shaft which controls the rotation of the two output shafts on either side. The output shaft’s rotations control steel tubes that hold the retractable arms, which then brings the arm from behind the wheelchair to the front, placing the two 3’ x 8” aluminum ramps in front of the user.

The ramps and arms will be set at an angle and will be locked in place by a “table-lock mechanism” which will create a fixed angle to clear the user’s head and align with the average height of a curb and stair at 6-7” high.

The team created a model as a proof of concept to showcase the design. Additionally, a digital model was created to analyze how the mechanism reacted to loads and torques.
Team Sedi Sensor worked with Plaster Creek Stewards to measure how cloudy the water of the stream is. The cloudiness (turbidity) of the stream provides a proxy to measure how much sediment is present in the water.

Measuring the sediment in rivers is an important metric for determining the health of the stream. Sediment pollution is caused by erosion from stormwater runoff and by agricultural and construction projects. This pollution damages the habitat of aquatic life and can worsen the effects of other pollutants.

The team designed a solution incorporating an optical sensing mechanism guided by research on the most effective techniques to measure water turbidity. In the design, infrared (IR) light bounces off particles in the water and is measured by a photodetector. As the turbidity increases, the amount of light detected increases. The mechanical housing constrains the IR Light Emitting Diode (LED) and the photodetector to the optimal detection angle while ensuring a water-tight seal. The electrical hardware amplifies the signal and powers the device. The software on the microcontroller computes the turbidity measurement, stores the data, and transmits the data over Wi-Fi to a researcher’s mobile device.

The team’s design integrates design elements from similar products that provide similar functionalities.
The goal of team Vision is to bridge the autonomous gap between industry and the public by creating a central autonomous nervous system fashioned onto a chassis. Public access to autonomous devices enables the modern user to accomplish more. The goal of this project is to create a vehicle that uses distance and camera sensors to follow a designated object.

The afferent nervous system is composed of three unique sensors: a camera, that analyzes the surrounding environment using OpenCV, ultrasonic sensors, used to determine the distance between the robot and the object being tracked, and limit switches, that instantly stops the robot if triggered by bumping into something. The camera tracks a previously distinguished color (neon yellow). OpenCV - a library of programming functions mainly aimed at real-time computer vision - is run on our main processor - a Raspberry Pi - that also interfaces with the rest of the efferent electrical components.

The motors and motor controllers are powered by a 12 volt car battery. The Raspberry Pi is powered from a 5 volt battery bank. Two batteries are used to avoid stepping down the voltage. A breaker with an emergency stop button is fashioned onto the top of the robot. The motor controllers are Talon SRXs and the motor are brushed DC motors that are controlled via the Raspberry Pi. The chassis was refashioned from a used mobility scooter and was painted gold for extra pizzaz.

The team is excited to introduce you to our project. Please stop by and see us!
The first six months of a baby’s life are a crucial time of growth when reliable monitoring and care is essential. Inspired by the needs of family and friends with babies, Team 11 designed and built “A Better Crib” (ABC). Built for babies between 0 and 6 months, ABC is an app-controlled smart-crib that is safe, affordable, accessible, and sustainable. It is built with a wooden base structure, supported by 4 steel, hairpin legs, enclosed by mesh walls supported by a plastic frame, and designed to fit a 1 in-thick mattress. All the electrical features are controlled by a mobile app through a Raspberry Pi and powered with a standard 110-volt plug.

To prioritize safety, ABC was designed to meet federal standards for regulation-size bassinets. It has strong, soft mesh walls and zero pinching hazards to ensure safety both inside and outside of the bassinet. It was also designed for monitoring with a live video and sound feed and live heart-rate monitor displayed on the app. ABC was also designed to ensure affordability. In the current market, smart-cribs average over $1000 to buy/rent; ABC was designed and built to be produced for less than $500.

Another major goal in the crib design was accessibility. ABC was designed so that the height of the crib is customizable, specifically for wheelchair users or those with limited mobility. An app-controlled rocking feature was also created for users who may not be able to rock a baby to sleep due to physical limitations. Additionally, the app was user-tested for ease of use and for those with impaired eyesight. The final goal of ABC was sustainability. To minimize indoor pollution and chemical emissions from the crib’s use and build, ABC was designed with intentionally sourced materials to meet Greenguard Gold Certification for cribs.
Team 12: Knight Light

Nathan Holwerda, Jacob Meulink,
Oghenekevwe Tejevbo, William Terpstra

With the presence of pandemic protocols throughout the world and health concerns on the minds of every student at Calvin, Team Knight Light created a device to alleviate some of the concern about cleaning high-contact surfaces on a university campus.

One of the most contacted surfaces in any building is the door handle. The team’s system aims to reduce the amount of time humans spend on cleaning door handles while providing a safe and effective method to aid in preventing the spread of the common cold, influenza, E. coli, staphylococcus aureus, and other harmful bacteria that cause illness and infection.

The team designed an ultraviolet (UV) light system to destroy harmful bacteria on door handles. UV light is used in surgical rooms to sterilize all surfaces for surgery and reduce the amount of bacteria a patient is exposed to. The UV lights were attached to an extendable carriage that is raised and lowered using a multispeed stepper motor. To prevent the Knight Light from interfering with regular usage of the door, our team implemented motion sensors that automatically signal the carriage to retract and allow the user to operate the door.

The device houses a green Light Emitting Diode (LED) to signify that the door handle has been appropriately sterilized. It also houses a red LED to signify that it has not completed its cleaning cycle.

This project highlights the importance of keeping people safe and helping our communities get back to the connection we had pre-pandemic. Team 12 hopes that this project will foster a sense of mindfulness and a global perspective on how to keep our neighbors safe.
Team RailCARD consists of four mechanical engineering students who came together with an interest in electromagnetic propulsion to drive forward motion.

As it stands, electromagnetic motion is limited to few transportation devices around the world: primarily electromagnetic aircraft launch systems aboard aircraft carriers and the six commercially operational maglev trains.

These systems create a magnetic field from electricity which provides linear propulsion for a vessel. While these systems are useful, they are used few and far in between compared to internal combustion engines and fossil fuels.

Team RailCARD aims to create a small scale linear motor to show the viability of larger linear motors to be used for linear transportation purposes. The team built a model roller coaster and cart, and pursued a design that uses pairs of coils to pull then push the cart down the track as it approaches and passes the coils. The scalability of this project intends to provide a versatile alternative that addresses the issue with current fossil fuel combustion engines. Ideally, these systems will draw power from the electricity grid and will require less fossil fuels as sustainable energy collection improves.
The Gravity Cruisers designed and constructed an electrically powered, all terrain longboard that serves as a recreational tool as well as a functional device for short term commutes in a variety of weather conditions. Current market solutions typically are either only electrical or only capable of off-roading, with little cross-over. What few current market solutions that do both are typically exorbitantly expensive.

The team’s design drew inspiration from existing electrically-powered longboards and scooters. The design consists of an aluminum chassis underneath a traditional skateboard deck with a modified A-arm suspension. A battery and two in-wheel motors, when paired with a Bluetooth speed controller, allow the remote powering and speed control of the longboard. The board is steered as a traditional longboard is by tilting the deck to either side, while the typical longboard trucks are replaced by the suspension system that allows for the wheels to move independently of each other.

A full CAD rendering was created in SolidWorks and FEA simulations were run to determine the necessary material properties. Dynamic motion simulations were run in MSC Adams allowing for the response of the system to external obstacles to be identified and determine the appropriate springs in the suspension. A working prototype was created using externally manufactured parts, while the suspension and chassis were entirely customized.

The prototype is capable of speeds over 10 mph and was tested on concrete, grass, dirt and sand to validate that it was capable of handling all terrains.
Team BicyClamp designed and constructed a hybrid electronic and mechanical bicycle locking system. They wanted to design a system that was an improvement to the current bicycle locking mechanism. To further prevent the possibility of bike theft on college campuses and large cities, the BicyClamp stall eliminates the need for a personal bike lock. Its steel arm stops bike thieves from using bolt cutters. In addition, all THREE major parts of the bike are locked: the main frame and both wheels. The team’s goal for this project was to develop a prototype of a single locking stall that would eventually be replicated in groups of 8-10. The stall was designed to minimize its footprint so that more bikes could be placed in a smaller amount of space. Careful consideration was put into the motion of the locking arm, ensuring that the arm effectively secures the bike in each stall while still being user friendly.

The team designed the user interface to be easy and simple to use. All someone needs to interact with the stall is a 4-digit PIN or their ID card to lock and unlock their bicycle. This process was designed to be less complex and take less time than the current locking mechanisms.

The overall mechanism consists of a keypad and display to walk the user through the entire process. Once the arm is placed around the bike, a motor and gear system automatically engages the lock, securing the bike in place. Upon returning to the station, a simple scan of the ID or entering of your PIN will release the lock. This prototype was designed to lock most adult sized bicycles using materials that were feasible and provided the proper functions for the project.
Team 16: Automated Maintenance Pool System (AMPS)
Josiah Balona, Meron Kebede, Rohan Mall, Samuel Ydenberg

Team AMPS is a multidisciplinary group of mechanical and electrical engineers. The project consisted of designing a device that can automatically maintain the chemical balance in swimming pools. Currently, pool owners are responsible for chemical maintenance, which is done by taking a sample of water and, using test strips, checking the concentration of important water health characteristics. Implementing this traditional method takes time and there is chemical waste due to human error. If too much of a pool chemical is added, the water can cause painful symptoms such as skin and eye irritation, rashes, nose and throat pain or asthma. If too few are added, it can lead to algae bloom and harmful bacteria growth. This is why proper pool care is essential to keep the swimming pool in a usable condition.

The key aspect of this autonomous device is its ability to measure the water health characteristics and dispense the appropriate amount of chemicals. This is done through a two-part device, a sensor that is in the skimmer box of the swimming pool and a dispensing system in the control room. These components communicate with each other wirelessly via a Bluetooth connection between two single board computers. This device is self-sustained and the only requirement on the pool owner is refilling the chemicals in the storage containers and replacing the test strip reel. Overall, this design will significantly reduce the responsibility of the pool owners when it comes to preserving the chemical balance and allow them to enjoy their pool without worry.
Team 17: Team Inertia
Sam Dare, Alex Johnson, Colton Smits, Michael Vis

Team 17 is comprised of three Electrical and one Mechanical (Colton Smits) engineering students. The Team worked to develop a revolutionary 3D printer from the ground up, with fully custom electronics, sheet metal design, and software. Controlling the hardware and software allowed the team to build a printer that was faster, simpler, and easier to use than any other 3D printer on the market. They also designed the mechanical parts to yield extremely accurate printed parts.

To begin, the team started by looking at existing 3D printers in the marketplace, ranging in cost from $200 through $25,000. The team found that on every single printer, compromises were made between ease of use, affordability, speed, and accuracy of parts. After much research, they set out to make a printer that did not set those requirements at odds. A huge part of that was using custom software and electrical hardware, as that allowed the team to cut costs to the level of a much cheaper 3D printer and include all the complex features the high-end printers come with. The team also designed a touch screen interface to be used by users interacting with the printer. They also set to design all mechanical components to be easy to machine, with the vast majority able to be cut on a CNC laser. This allowed the cost to come down significantly, but with careful design the team was able to maintain the accuracy of a high level printer. This required a deep understanding of the relationship between the mechanical, electrical, and software engineering, and the team learned the most about this blend of engineering fields.

A prototype was completed and tested, and the team is planning to continue development of this printer to see if it ends up worthy of a commercial product. Team 17 sees the possibilities of widespread 3D printing as endless; it hopes their project will help companies produce parts with less waste and help students see their designs come to life both in and out of the traditional classroom.
Three chemical engineers set out to design a lanthanum iron oxide (LaFeO$_3$) production plant in order to help expedite worldwide hydrogen production. LaFeO$_3$ is a semiconductor material that is capable of producing hydrogen and oxygen via water splitting using only sunlight and no electricity.

The process flow diagram seen below illustrates the proposed plant design. The top section will react lanthanum salts with ethanol to produce lanthanum ethoxide, and the bottom section will react iron nitrate with water and ammonium to produce iron hydroxide. The two streams will converge and be sent to a spray pyrolysis reactor, where they will be heated and crystallized into the product, LaFeO$_3$. LaFeO$_3$ could be the next new material in hydrogen energy production!
Team JAGS Soap, composed of four senior chemical engineering students, designed and optimized a production facility that will create solid bar soap. The COVID-19 virus has negatively affected all our lives in some way, and sanitation has never been more important. With this in mind, the team hopes to help promote a healthier and more sanitary lifestyle.

Traditional soap making methods utilize a hydrolysis chemical reaction called saponification. This reaction takes a fatty acid from a triglyceride, and reacts it with a strong base in the presence of water, to produce glycerin and carboxylic salt (soap). Rather than using a single fatty acid, the team decided to use a combination of three different acids (60% oleic, 15% lauric, and 25% palmitic) for it produces a higher quality soap in terms of cleansing rating, bubbly lather, creamy lather, hardness, and conditioning.

The team decided to pursue a continuous process rather than a batch process for it produced a more consistent final product, as well as an efficient process that reduces waste. With a plan to produce 1000 kg/hr of soap, our production facility will be able to produce approximately 8,818 total bars of soap per hour using this continuous process.

The design process was optimized to maximize economic profit while minimizing initial investment costs.

\[
\text{NaOH + Triglyceride} \rightarrow \text{Glycerin + Carboxylic Salt (Soap)}
\]
Have you ever thought about what it takes to produce the food we eat? Ammonia is a key component utilized in most fertilizers within the agricultural sector. The conventional method of producing ammonia, however, produces a significant 12% of global carbon emissions. Team Go Green (Ammonia) presents an innovative solution to tackle the issue of climate change. The team approached the design with a focus on sustainability and developing a more energy efficient process for producing ammonia.

This project focused on the design of a green ammonia processing plant with the use of the biochemical enzyme nitrogenase as a catalyst for nitrogen fixation. The process features a cryogenic air separation unit, a bioreactor, and a separation vessel. Since this is a first-of-a-kind process, it is anticipated that a pilot study will be completed in order to inform the design of a full-scale plant that would produce 300 tons of NH$_3$ per day.

Design decisions were made based on considerations of the engineering code of ethics and Christian principles and design norms. The green ammonia production plant will be developed in Rhode Island, compliant with local and national regulations and guidelines. Energy will be provided through a purchase agreement with a wind developer. The impact of this project is the development of a more feasible and environmentally friendly approach to producing ammonia.
Motivation: Access to clean drinking water is a worldwide problem in which various areas require different water treatment methods due to economic, social, and accessibility issues. This project is focused on the people in Rwanda, where clean drinking water is very difficult to find. The main purpose of this project is to provide clean drinking water to a “cell” in Rudashya, Rwanda, which consists of six different villages and serves almost five thousand people.

Meet the Team: Our team consists of four chemical engineers which each have unique backgrounds. Carly is an engineer by day and playlist curator by night, collaborating with numerous artists and record labels. If you don’t see Joshua in SB120, he is probably practicing his moves on the chess board and in the dance studio for Dance Guild. Glory is a huge foodie always trying out different recipe for all kinds of food, which is one of the reasons why she chose Chem E. Abbey is an amazing volleyball player and a coach for teenage girls, leading her team to win the Regional Championship.

Design: Our process involves a dual-system approach that will produce minimum of 40,000L/day of water utilizing slow sand filtration and electrochlorination. This is because we wanted to have a very simple and relatively low cost system. Groundwater is the main water source that will be used in this process. In the process, slow sand filtration is first used to decontaminate water of solids, minerals, and all of the other components that need to be extracted in order for the water to become potable. Next, electrochlorination involves the usage of rock salt and electricity to chemically disinfect the water by producing a hypochlorite solution that will be dosed into the filtered water.
Engineering Faculty

Chemical Concentration
Jennifer Jewett Van Antwerp
Jeremy Van Antwerp
Andrew Wilson

Civil & Environmental Concentration
Leonard De Rooy
Julie Wildschut
David Wunder

Electrical & Computer Concentration
Randall Brouwer
Monica Groenenboom
Mark Michmerhuizen

Mechanical Concentration
Gayle Ermer
Fred Haan
Chris Hartemink
Matthew Heun
Ren Tubergen

Adjunct Faculty
David Allen
Andrew DeJong
Michael DeVries
Andrew Jo
Melissa Okenka
Ron Plaisier
Aaron VanderHill
Eric Walstra
Wayne Wentzheimer

Staff
Chuck Holwerda
Jessica Noble
Michelle Krul
Chris Sorensen