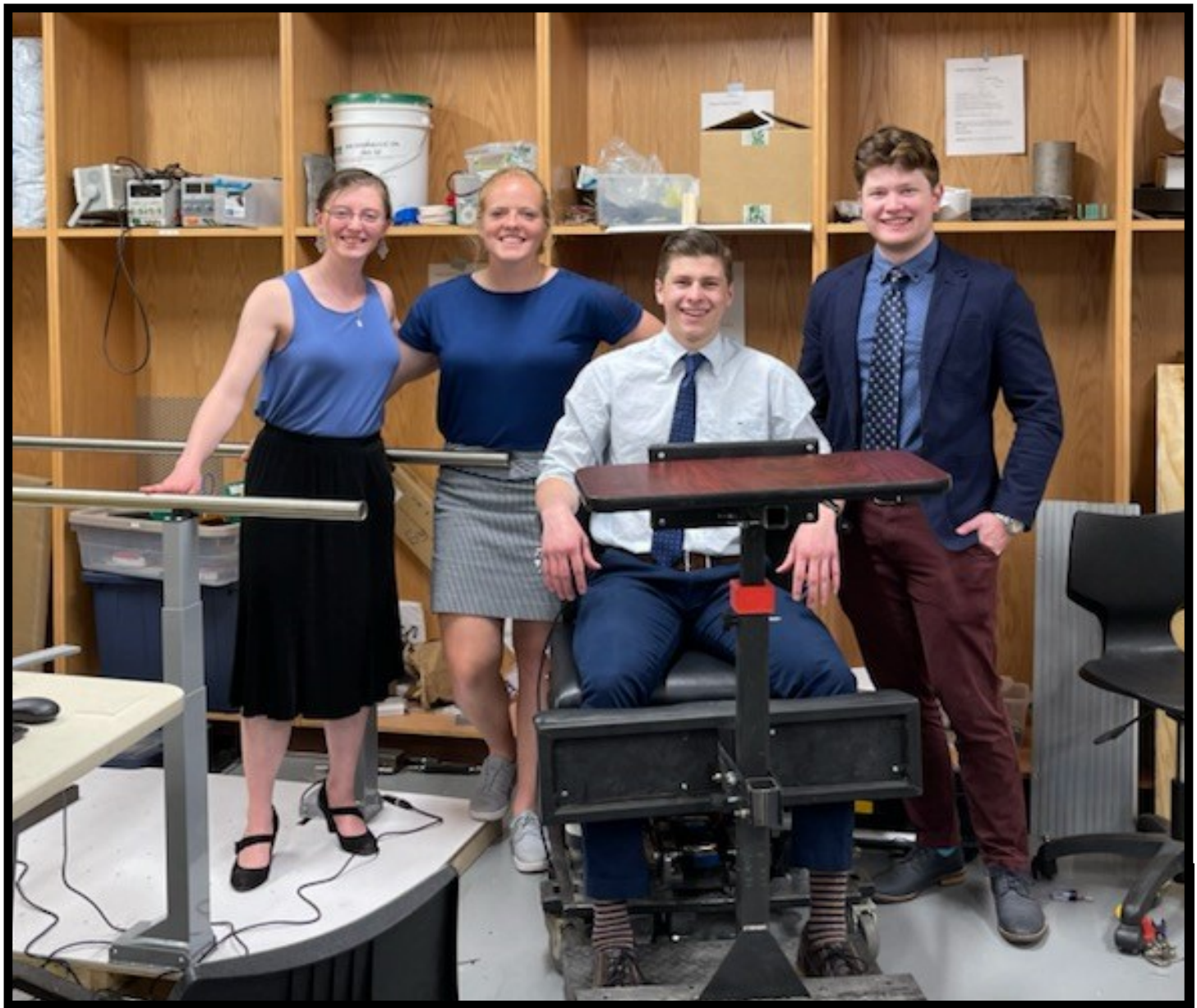
INGENIUM

noun: from Latin, meaning natural talent or disposition

Benedictine College - School of Engineering Newsletter

Vol 5 Issue 1— Summer 2021

Chemical Engineering • Civil Engineering • Electrical Engineering • Mechanical Engineering



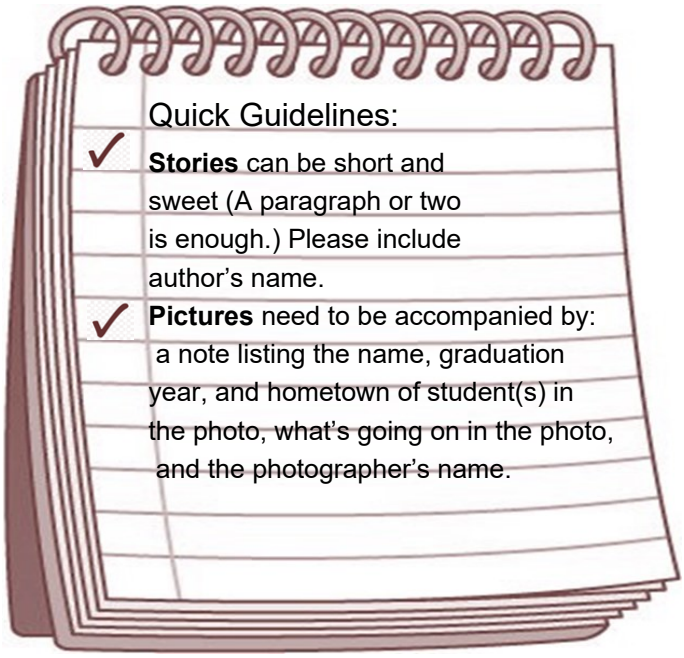
A Look Inside

Alums, we'd love to hear from you!

Hearing from our engineering alumni simply makes our day. Please consider checking in with us and sharing your success story or important events in your life.

Engineering Students, Have a Great Story? A Fun Picture?

Please submit it for consideration in the next issue!
Send submissions to:
Jann McGregor at
JMcGregor@Benedictine.edu
or John Modlin at
JModlin@Benedictine.edu



Ingenium Editors

Faculty: *John Modlin* **Student:** *Max Davy*

On the Cover: *(Left to right) Grace Rembold, Jane Pennefather, Alexander Newton, and Rory Opp pose with their completed Senior Design project.*

Faculty Contact Information

Department Chair
Darrin Muggli
DMuggli@Benedictine.edu

Civil Engineering
Mike Berry
MBerry@Benedictine.edu

Peter Merkle
PMerkle@Benedictine.edu

Scott Newbolds
SNewbolds@Benedictine.edu

Chemical Engineering
Scott Blonigen
SBlonigen@Benedictine.edu

Darrin Muggli
DMuggli@Benedictine.edu

Electrical Engineering
Megan Paciaroni
MPaciaroni@Benedictine.edu

Andrew Downs
ADowns@Benedictine.edu

Mechanical Engineering
Patrick O'Malley
POMalley@Benedictine.edu

John Modlin
JModlin@Benedictine.edu

Charles Sprouse
CSprouse@Benedictine.edu

Administrative Guru
Jann McGregor
JMcGregor@Benedictine.edu

Lab Manager
Sean Bauer
SBauer@Benedictine.edu

A Message from the Chair

Dr. Darrin Muggli

Greetings from the School of Engineering!

I was certainly happy to see all of the students back on campus this past year, although it also was strange to teach class in front of a bunch of masked marauders. When we were allowed to remove the masks, I had difficulty recognizing the students that had been in my class the previous semester. The lack of on-campus students in spring 2020 made me forget that peculiar smell of the student lounge near the end of the spring semester…a bouquet of lack of sleep, poor eating choices, and fear. It was nice, sort of, to have it back in spring 2021. Anyway, here's hoping that we have just a regular old school year in 2021-2022.

Record Freshman Enrollment – I am very excited to announce that this year's freshman engineering enrollment of 101 students has set a new record. Accordingly, for the first time ever, we have four sections of Intro to Engineering. Overall, we should have about 250 students in the program

Faculty Updates - Dr. Juan Carlos Araque left Benedictine in Spring 2021 to accept a research position with NASA. While he continued to teach during the spring semester as an adjunct, he is now moving to Johnson & Johnson in New Jersey to work full time. We will miss him, but wish him all the best in his new career.

Professor Steve Spencer retired at the end of Spring 2021. He joined the engineering faculty as an adjunct in spring of 2010 and has taught and mentored many students both in and out of the mechanical engineering program. He always had a huge heart for his students and was willing to go the extra mile for them. We are so grateful for everything Professor Spencer has done for engineering, and will miss him greatly! We wish him a happy retirement full of canoeing!

We are happy to welcome Steve's replacement in John Modlin. John has also been associated with our program for many years, as he has served as a member and even president of our advisory board for many years. John is excited to make the move from a successful career in industry to teaching so please drop by his office and introduce yourself to him.

Our Electrical Engineering program is growing binarily, since we have gone from 20 faculty to 21. Dr. Andrew Downs accepted the position in Spring 2021 and will begin teaching classes this Fall. We are excited to have him onboard! We are looking to add EE faculty number 0011 this year.

God bless,
Dr. Darrin Muggli

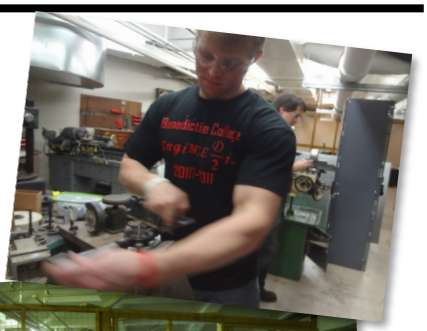
Farewell to Professor Spencer

Ten+ years of great times! First class Spring 2010, Dynamics. Last class Spring, 2021 Senior Design. It has been a “Dynamic” ride, and the people I have had the opportunity to work with have kept things from becoming “Static.”

With my “Intro” into the program, we had five students and one full-time faculty (Dr. Muggli). I have had the great pleasure of watching a host of very capable people join the department and getting to know some of the hundreds of students that have passed through it. While it was fun to develop new classes and labs, it was also humbling to see how much the bar was raised when others took over those classes.

2012: first senior design project, on the roof of Westerman.

Some of the classrooms were kind of primitive in the beginning and the machine shop was described as a WWII submarine engine room, but smaller. That isn’t to say the school has not been supportive. The facilities have been somewhat Fluid, with renovations and upgrades occurring most years. One space on the north side was a wire storage space when I started, became the student study area, was renovated into a classroom (no HVAC, but 30 chairs), and eventually became part of W134-5.



2011: one of the first classrooms, and the machine shop.

Of course, the best part has been working with the students. I have been continuously impressed with the quality of the students attending Benedictine. They have been some of the best people I have encountered. Period. The Energy they have shown in class projects has been fun. The freshman sumo bot competitions have always been loud. The seniors have never approached a design the way I would have (they have been better). To see the teams take an idea and discover that they could be successful has been a joy.

Some of the senior design projects were hot, big, took several years to complete, or were a real grind.

Freshman Sumo Bots

2014 student study (and sleeping) area. Now part of W134-5.

Farewell to Professor Spencer

Some Discovery Day Projects

Then of course there has been the Discovery Day projects. Over the last decade and several dozen projects, I think only one was my idea. The items that students have done have been incredible and fun. It has been wild to see what they came up with — from hover boards, guitars, and concrete canoes, to planes.

On the "just fun" side, there have been the groups that have gotten together for Spooky Science and, of course, pranks. The pranks the students have played on me or the other faculty have been unbelievable in their imaginativeness. From hanging my office from the ceiling, Christmas wrapping the double wide faculty trailer, to creating a "cut out" rendition of a faculty meeting — they have been great fun.

Spooky Science

Of course, one of the big benefits of teaching at Benedictine has been the opportunity to wear my tie collection.

Some of the student pranks

By far the biggest joy I have had over the last decade is watching everyone grow and become some of the best people I know. Not just good engineers, but good people. In my retirement, I am looking forward to watching how the school of engineering continues to improve, and how our students and alumni go forward — ever forward.

Professor Spencer sporting one of his many ties.

Best tie ever

New Faculty Members

Andrew Downs

Dr. Andrew Downs is a new fall addition to the school of engineering and will be teaching electrical engineering with Dr. Paciaroni. Before taking the position at Benedictine, he held a variety of positions ranging from F-16 mechanic to nuclear engineer. After many years of feeling the call to teach, Dr. Downs is excited to share some experience, teach some engineering, and have a little fun! As of July, he, his wife Kajda, and their three children: Mary Ann, 9, Augustine, 6, and Blaise, 3, live here in Atchison. Prior to Atchison, his family has lived in Ames, Iowa among other rainier place

When Dr. Downs' is away from campus, he and his wife are avid cat herders. In the spare time he does have, he likes to read a bit of science fiction and shop for an ever more obnoxious Hawaiian shirt. He also enjoys CrossFit…but don't get him started… This semester Dr. Downs is teaching Electric Drives and Computer Apps. He promises that both courses will be both entertaining and informative! He currently resides in the office adjacent to Dr. Muggli and encourages students to stop by anytime they wish to discuss electrodynamics, share a Seinfeld quote, or just say, "Hello."

John Modlin

John Modlin has been hired to fill the mechanical engineering faculty opening created by Steve Spencer's retirement. Although new to the faculty, John is not new to Benedictine School of Engineering. He first connected with Dr. Muggli over 10 years ago, while his daughter Veronica was attending BC. John got involved with the program by making a presentation at an Engineering Colloquium in 2011 and serving several years on the Board of Industry and Academic Advisors. He recalls a conversation after a BIAA meeting a few years ago, in which Steve suggested that there might be a teaching opportunity following his retirement. That opportunity presented itself last fall and the timing worked out perfectly!

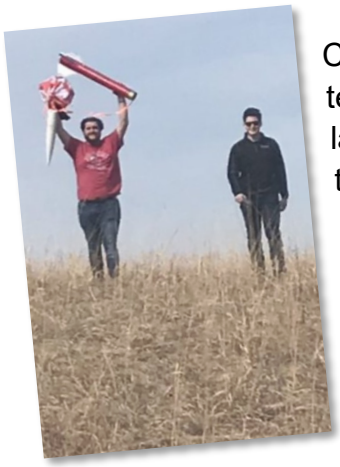
John has a BSME from the University of Missouri-Rolla (now Missouri S&T) and a MSME from Purdue University. He worked in the electric power industry for 33 years, holding multiple positions in engineering and management, before retiring in April. John and his wife Jeanne co-own Blessings of St. Joseph, a Catholic gift and bookstore in St. Joseph, Missouri, where the reside. They have six children, including two Ravens, Veronica '12 and Paul '18, and 10 grandchildren.

Reflecting on his transition to Benedictine, John said, "I really appreciate the warm welcome and assistance that I've received from the faculty and Jann McGregor this summer. Steve has spent hours helping me prepare for Senior Design. Charles Sprouse, Pat O'Malley, and Scott Blonigen have been very helpful, too. They have provided valuable guidance as I prepare for courses, providing input on course content, sharing resources, and helping me get familiar with programs such as Blackboard. Jann has been super in answering my questions and helping me settle in! I'm excited to be starting my second career as an assistant professor of engineering at Benedictine College!"

Discovery Day Projects

High Power Rocket

Connor Muehler, *John Morran, Max Davy, Michael Roche, Prof. Steve Spencer, Prof. Patrick O'Malley*



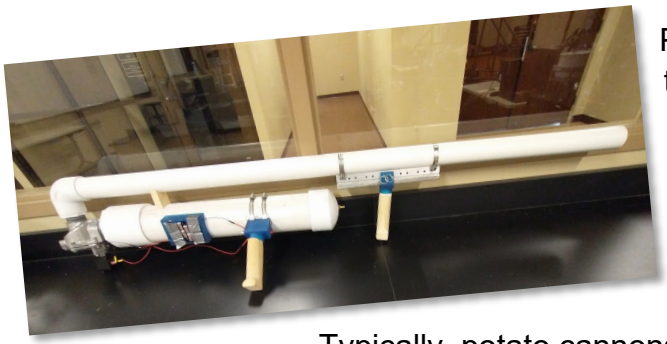
Continuing the work of the 2020 High Power Rocket team, this year's team sought to construct, prepare, and launch two high power rockets, also seeking to certify two members of the team at High Power Level 1.

High power rocket certifications take place at three levels, allowing the user to purchase higher power motors after each successful certification. High power rockets are rockets using motors above the 'G' power class, having combined total impulse greater than 320 Newton-seconds or a liftoff mass above 1500 grams. The rockets constructed and launched were the Apogee Zephyr and the LOC Vulcanite H76, powered by class H and class I motors, respectively. Certification at each level requires the rocket is constructed by the one being certified, per Tripoli and NAR—the two amateur high power rocketry associations.

The launches took place outside Brainard, Nebraska. Due to the efforts of the High Power Rocket team, Benedictine College now has a High Power Level 1 Certified student.

Potato Cannon

Joseph Crouch, *Silas Whitehead, Max Palmer, Prof. Steve Spencer*



Potato cannon designs consist of three main sections: the pressure chamber, the valve, and the barrel. To achieve any significant velocity from a compressed air powered potato cannon, the barrel length must be quite long, making the cannon cumbersome to use.

Typically, potato cannons of this model are at a set size, limiting the number of people who can enjoy it. We sought to build a potato cannon that most anyone could adjust to their personal size.

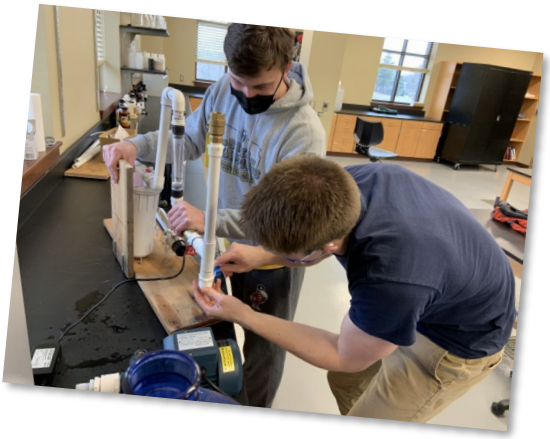
Most of the adjustability comes from a 12" rail attached to the bottom of the barrel with an adjustable handle so that people in a range of sizes can enjoy this incredibly fun cannon. Students visiting the college for the BCYC Engineering track had the opportunity to use the cannon to launch potatoes, some over 300 yards.

Discovery Day Projects

Ultraviolet Water Purification

Rebekah Nelson, *Anthony Bridges, Grace Nelson, Patrick Lange, Shannon Rajkowski, Prof. Scott Blonigen*

Surface water treatment is a process that is vital for the health and success of humans. Urbanization has allowed surface water treatment plants to supply clean drinking water to millions of people. This process has room for improvement, such as reducing overall costs and creating a more widespread and environmentally sustainable system. The use of ultraviolet light to disinfect water has been a tool for surface water systems since 2006.



Ultraviolet light is an effective purification method because it quickly inactivates microorganisms in the water from reproducing and infecting. This water purification method has many benefits: it is used in place of harsh chemicals that can contaminate the water and be harmful for the environment. It is also a more cost-efficient purification method.

For our project, we designed and built a small-scale water filter that uses UV-LED water purification. This two-step process consists of a sediment filter to filter out the larger particles and a UV light for disinfection. The goal of our project this year was to gain a better understanding of how to design and build a fluid system using piping, fittings, valves, and pumps. In the future, we plan to test the system for effectiveness by using contaminated water. We also plan to investigate ways that UV-LED can be added or maximized within current large-scale surface water treatment processes with the hopes of eventually lowering overall costs and having greater environmental sustainability.

Glass Fusing Kiln and Telescope

Gregory Bourget, *Prof. Patrick O'Malley*

This multiphase project involved the design and construction of an electric kiln and a six-inch reflector telescope. The reflector telescope, invented by Sir Isaac Newton in 1668, consists of two mirrors: a parabolic primary (to gather and focus light) and a flat secondary (to reflect the light to the telescope's eyepiece). The substrate for the telescope mirrors is typically a glass blank that has been ground to the proper shape.

Despite glass being a cheap commodity today, blanks suitable for grinding into parabolic mirrors are expensive, with eight-inch blanks often commanding prices greater than $125. This inspired the decision to combine the

Discovery Day Projects

Glass Fusing Kiln and Telescope (Cont'd)

project with another project, the design and fabrication of a cheap electric glasswork kiln; coupled with a PID control system, electric kilns offer excellent control of the heating and annealing process.

The kiln refractory bricks were produced by mixing several ingredients, including fireclay, burnout materials (to decrease the thermal conductivity), and water. After many hours of research, a custom electrical circuit consisting of dozens of electrical components was selected over commercial options due to safety and cost concerns. Although the development path for this project changed greatly since the grant application was filed, the core objectives—the production of an electric kiln, a glass blank, a parabolic primary mirror, and the telescope structure—remained the same. To accelerate project development, the primary was cut and ground from a thick scrap sheet of glass obtained from a broken window, and the kiln was only used for blank production trials.

CNC Laser Cutter Design

Maximilian Davy, *Prof. Charles Sprouse*

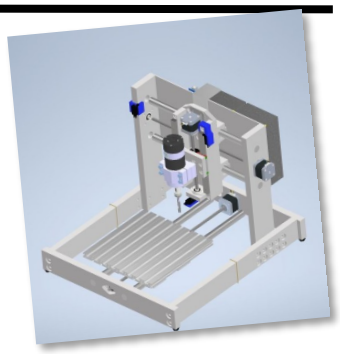
Laser machining uses high-intensity pulses of laser light to vaporize the material in a very small area. As a result, it can cut details that are impossible with traditional machining as well as operate at a significantly higher speed.

While laser cutting technology is not new and the technology is being constantly improved, there is a need for inexpensive, quality machines with larger working areas. Most laser cutters with large working areas are either designed for use by people with little fabrication experience, or for use in harsh industrial environments. In an application such as Benedictine's engineering machine shop, both of these feature sets are unnecessary and add considerable expense.

This project involved the design of a CNC laser cutter for use in the Engineering Shop. The laser cutter will enable automated cutting of engineered parts, such as gears or brackets, from sheets of plastic, wood, paper, or fabric. It will also enable the engraving of images, text, or other designs into the aforementioned materials, as well as ceramics, glass, and metals.

Discovery Day Projects

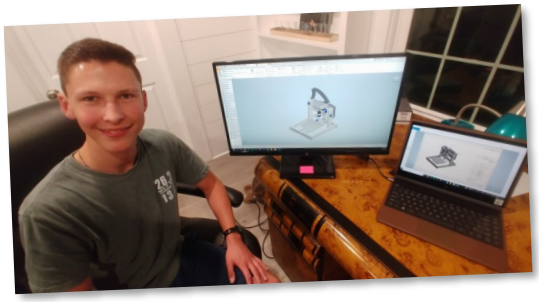
CNC Machine Re-Design



Marco Kouatly, *Prof. Steve Spencer*

A CNC machine, or Computer Numerical Control machine, is a programmable device used to carve or drill pre-programmed designs into materials, such as foam, wood, or metal. A CNC typically operates by moving a drill bit and a material build plate in the X, Y, and Z axes, allowing the cutter to remove material in any direction at any point.

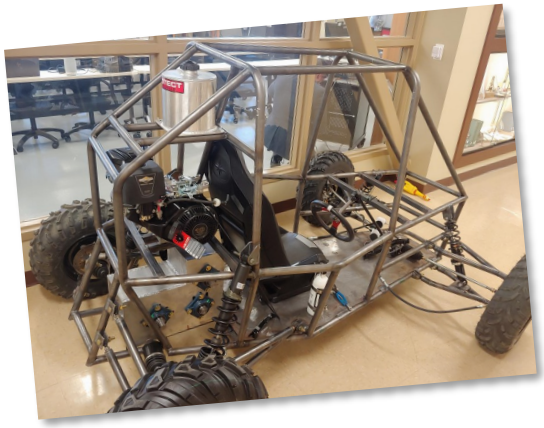
The basis for my project was an existing draft of a desktop CNC designed by professional engineer and BC alumnus Aiden Shaughnessy ’17. The Z axis of the physical prototype CNC was wobbling on the Z axis, so Mr. Shaughnessy reached out to me to re-design the Z-axis assembly on the Autodesk Inventor CAD software.



Mr. Shaughnessy also offered me the opportunity to re-design the entire CNC under his supervision. Since the beginning of the semester, I have developed my design of the original CNC into the model. I plan to finish the CAD in preparation for building a physical assembly. My takeaways from this project are an in-depth experience of the Autodesk Inventor software, an experience of crafting a bill of materials, shopping for industrial parts online, and a working CNC with which to build prototype models and other engineering creations further in my career.

Junior Design

Baja Vehicle



Three teams designed and built a Baja vehicle similar in style to those used in the Society of Automotive Engineers (SAE) competition, while also accounting for what consumers want in such a vehicle.

To perform well in the competition, Baja vehicles need to traverse obstacles – such as rocks and logs – climb hill inclines of 40°, accelerate quickly over 60 feet, and be reliable throughout endurance races.

To be attractive to consumers, the vehicle needs to be safe, visually appealing, fun, and affordable.

Junior Design

Baja Vehicle (Cont'd)

Baja Frame and Human Interface

Brett Shepardson

Cole Lehman

Ian Daly

Maria Piché

Baja Drivetrain

Harsh Anchan

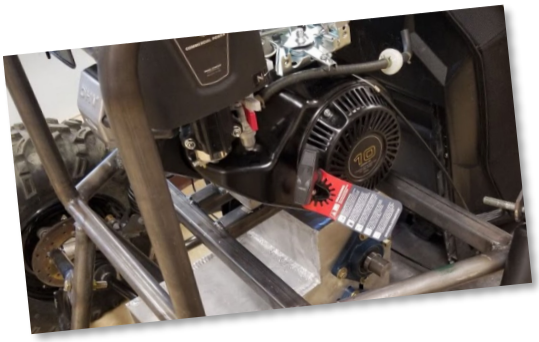
Jack Burke

Frank Feuerborn

John Paul Jochum

Chris Logan

Elizabeth Zoch



Baja Suspension, Steering, and Brakes

Zach Biermann

Jacob Deschler

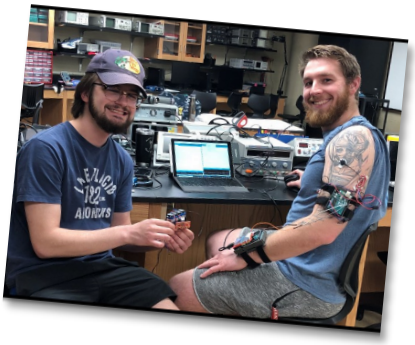
Brett Dickason

Jackson Doherty

Sam Fabozzi

Grip Training Exoskeleton

Anna Arensberg, Anna Doyle, Justin Nichols, Wildes Rempe

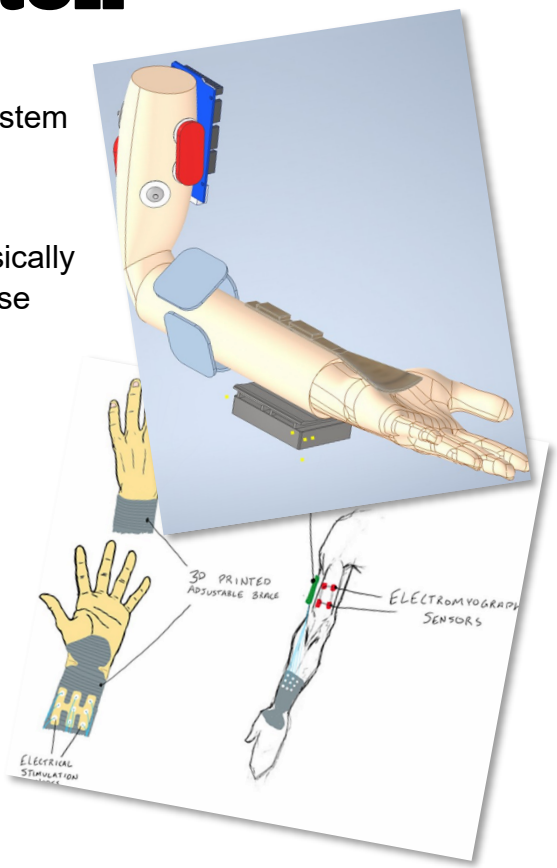


This team designed and built a system to enhance grip strength.

Their project aimed to provide increased capabilities for the physically impaired and rehabilitation for those with physical injuries.

The device uses Electromyography (EMG) sensors near the elbow and Electrical Stimulation (E-Stim) pads on the wrist to dynamically activate muscles in the hand based on the user's nerve signals to the forearm. The device uses an Arduino CPU and a touch screen to adjust the level of assistance for the individual user.

The device shows the potential to help those suffering from Cerebral Palsy, Multiple Sclerosis, Stroke, Arthritis, or other conditions regain or improve motor control in the hand.

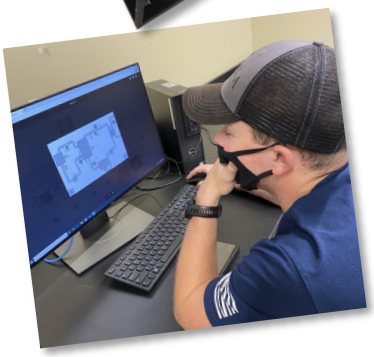


Capstone Projects

Process Trainer/Stirred Reactor

Client: Benedictine College School of Engineering

Mechanical: Luke Brungardt, Maximilian Davy, Aaron Ptak



The Process Trainer/Stirred Reactor is a piece of lab equipment that has the capabilities to mimic many industrial processes. It can control temperature, flowrate, and flow level using valves, pumps, thermocouples, flow sensors, and load cells.

The Process Trainer/Stirred Reactor will be used by the Mechanical and Chemical Engineering students at Benedictine College. It will be used to teach mechanical engineering students how to program and implement PID (proportional, integral, and derivative) controllers. The chemical engineering students will use it to run endothermic and exothermic chemical reactions inside the stirred reactor.

Pedestrian Access

Client: City of Atchison Kansas

Civil: Ian Daly, Cole Lehman, Maria Piché, Karina Scheller

This group designed a safe, direct pedestrian pathway to connect Atchison's new lighted sidewalk along Second Street to the waterfront along River Road.

The team collected and processed topographic survey data using global GPS and the AutoCAD Civil3D software package. Grading, drainage, and paving components were developed using the software, which was then used to develop construction drawings. The team also collected soil samples to evaluate soil characteristics as relating to pavement subgrade and retaining wall design. The total project was developed to fit within the context of its surroundings and improve pedestrian safety and accessibility in an environmentally responsible and economically viable manner.

The group received an Outstanding Senior Project

Capstone Projects

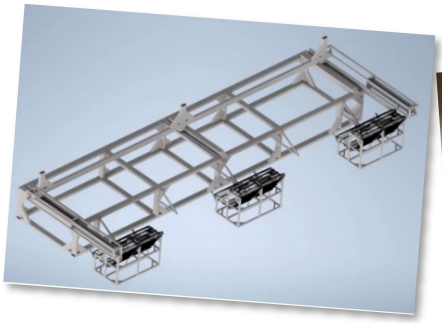
Automated Bar Unloading & Sorting

Client: Progress Rail Services Corp, Atchison Kansas

Mechanical: Heather Smith, James Vogel, Joseph Wiechelman

The Rail Crew designed a device for Progress Rail Services Corporation that will make the first production step at their manufacturing plants more efficient. This automated device replaces the company's existing manual bar unloading and sorting system and will make the production process more efficient and safer for workers.

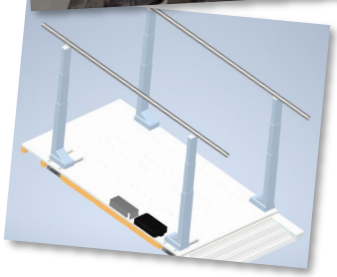
Their small-scale proof-of-concept device features a controlled piston-powered ram that unloads several bars at a time into a holding trough, and a gearmotor-driven chain ladder system that picks up one bar at a time and reorients it before depositing it into a magazine feeder. Every function will be remotely controlled through a PLC user interface.



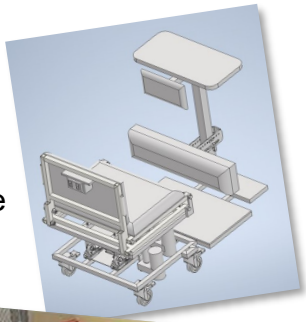
Stand Assist Chair & Parallel Bars

Client: Amberwell Health, Physical Therapy Group, Atchison Kansas

Mechanical: Zander Newton, Rory Opp, Jane Pennefather, Grace Rembold



Stand Assist Chair: This chair is designed to assist patients who have difficulty moving from sitting to the standing positions. Patients may have experienced a stroke or paralysis and need to re-train their muscles. The chair's seat fully extends upward, pushing the patient into the standing position. A table, knee stabilizer, and chest stabilizer add extra support for the patient.



Parallel Bars: The parallel bars are for physical therapy patients who need to either practice walking or need to learn how to walk again by using these bars as upper-body support. The bars can move vertically and horizontally to fit the ergonomics of the patient.

Capstone Projects

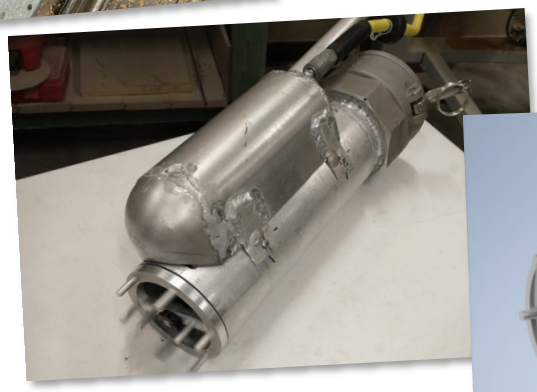
Grain Obtainer

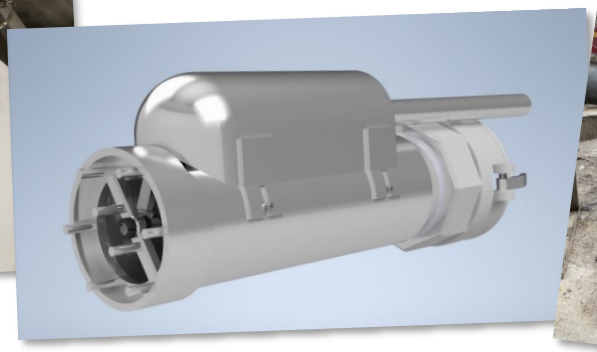
Client: MGP Ingredients, Atchison Kansas

Mechanical: Keenan Graef, Dimitri Maricich, Liam Morel

The team worked with MGP Ingredients to design a system that will remove grain from their storage bins. The environment inside the grain bin is extremely dangerous and, worldwide, leads to about 30 deaths each year.

The purpose of this device is to reduce the safety risks involved with pneumatic conveying and make the process more efficient by reducing the amount of time an operator must attend to the system. It uses suction from a vacuum to move grain into the system. The claw at the front of the attachment breaks up clumps of grain and maintains steady flow. A pneumatic motor powers the claw through the use of a crank rocker.





E-Stroller

Electrical: Julia Betzig, Leo Santucci, Melody Scott (non-BC student)

This team designed and built an E-stroller for Senior Design.

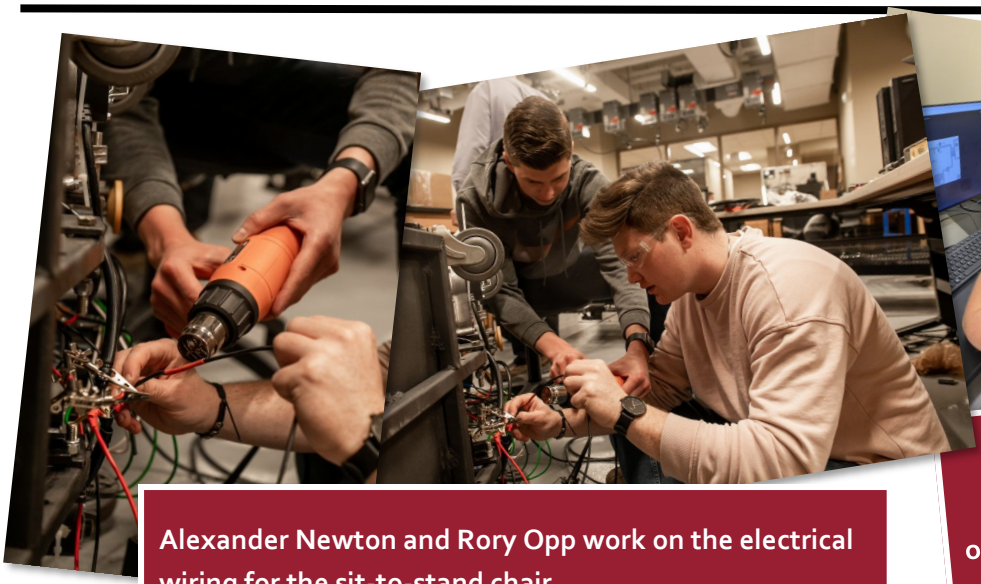
This motorized baby stroller's features include:

- Handlebar pressure sensors to detect user input, adjusting speed accordingly using a full PID control loop.
- Automatic self-deceleration when the user lets go of the handlebars.

The team selected parameters for speed and acceleration with safety in mind.

Other features include a USB phone charger, headlights, and rechargeable batteries.

Capstone Projects

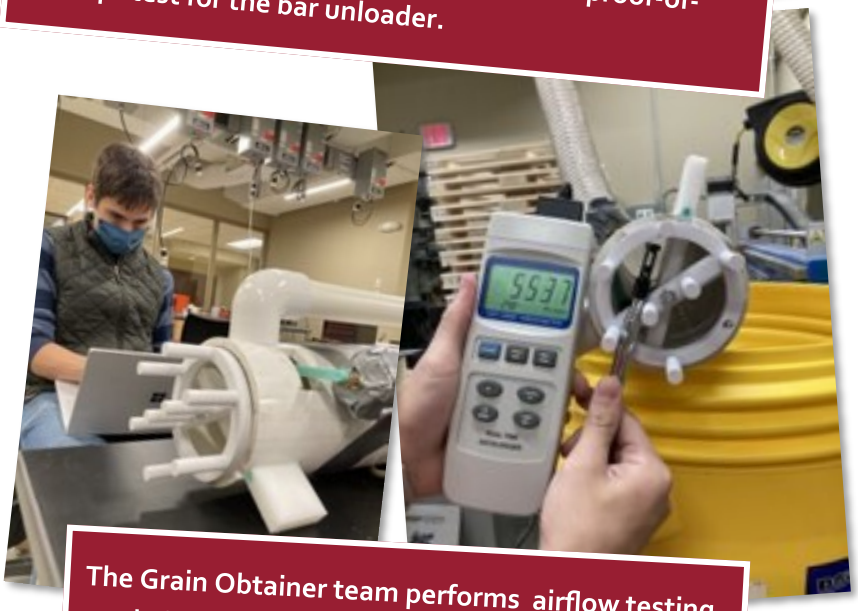


Alexander Newton and Rory Opp work on the electrical wiring for the sit-to-stand chair.

Aaron Ptak, Luke Brungardt, and Max Davy put the finishing touches on the process trainer.

Joe Wiechelman and James Vogel conduct a proof-of-concept test for the bar unloader.

Dimitri Maricich tests the grain obtainer on site at MGP's grain elevator.



The Grain Obtainer team performs airflow testing on their prototype .

Congratulations!

May 2021

Civil Engineering

Brett Shepardson

Cole Lehman

Ian Daly

Maria Piché

Mechanical Engineering

Aaron Ptak

Alexander Newton

Alexandreu Hammeke

Grace Rembold

James Vogel

Jane Pennefather

Keenan Graef

Chemical Engineering

Alissa Muggli

Electrical Engineering

Julia Betzig

Matthew Krishnan Myjak

August 2021

Civil Engineering

Filipe Nunes

Mechanical Engineering

Dimitri Maricich

Liam Morel

December 2021

Civil Engineering

Karina Scheller

Mechanical Engineering

Heather Smith

Luke Brungardt

Maximilian Davy

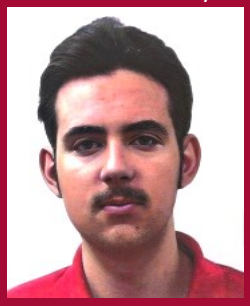
2021 Graduates

Julia Betzig

Luke Brungardt

Ian Daly

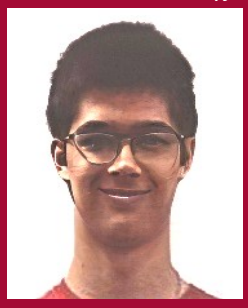
Maximilian Davy



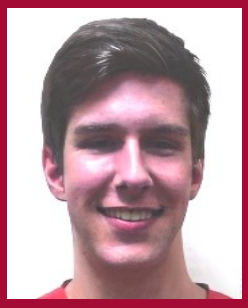
Keenan Graef

Alexandreu Hammeke

Matthew Krishnan Myjak



Cole Lehman



Dimitri Maricich

Liam Morel

Alissa Muggli

Alexander Newton

Filipe Nunes

Jane Pennefather

Maria Piché

Aaron Ptak

Grace Rembold

Karina Scheller

Brett Shepardson

Heather Smith

James Vogel

Around the Department

Students place rubber ducks outside of Professor Spencer's office.

2020 and 2021 Graduates gather with friends, family, and faculty before graduation.

Summer Student Workers

This summer, five student workers assisted the faculty with various tasks around the department. They organized labs, classrooms, and storage space, helped professors gather information for ABET re-accreditation, worked with high school students attending the Engineering track of BCYC, and more. This was Alex Hammeke's fourth and Joe Cline's third summer working for the School of Engineering.

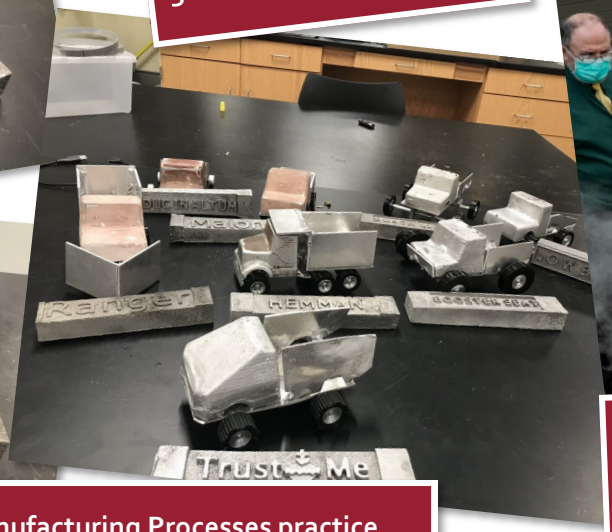
From left to right: Joe Cline, Alex Hammeke, Filipe Nunes, Natalee Rose Brake, and Max Davy.

Around the Department

BC Alumnus Leads Prospective Student Visit

Benedictine College graduate Jonathan Shoulta ’18 is now a high school teacher at Ozark Catholic Academy in Tontitown Arkansas. Jonathan recently led a trip with a group of prospective students from his school to Benedictine, where faculty member Dr. Scott Blonigen spoke with them about Benedictine College’s engineering program.

Dr. Muggli addresses graduating students.



Students in Manufacturing Processes practice by fabricating model trucks and nameplates.

Students in Manufacturing Processes Lab use the CNC Mill (top) to create molds for casting (bottom).

Parting Shots

INGENIUM

Benedictine College - School of Engineering Newsletter

Ingenium signifies intelligence, character, genius — all of which describe Benedictine College engineers. The use of the Latin language shows solidarity with the Church, whose official language is Latin, and with the scientific community, which for many years communicated primarily through Latin. *Ingenium* is a proud testament to our history and character as engineers and as members of the Benedictine College community.

Benedictine College School of Engineering
1020 North Second St., Atchison, KS 66002
www.benedictine.edu/engineering